

ZERO BRINE Final Forum

De Oude Bibliotheek, Delft,
The Netherlands

4 November 2021 (10:00-16:30 CET)



The ZERO BRINE project (www.zerobrine.eu) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730390.



KEY ZERO BRINE RESULTS

MORNING SESSION



Roelof Moll
Executive Project Manager
ZERO BRINE

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Roelof Moll is Executive Project Coordinator for ZERO BRINE and manager of the section Hydraulic Structures and Flood Risk at Delft University of Technology . During his career of 40 years in the water sector, he has worked at Wageningen University, Delft Hydraulics and Royal Haskoning DHV, directing large international water projects in Europe, Asia, Africa and Latin-America.

PROGRAMME

Key ZERO BRINE Results – Morning Session

- 10:00** Opening and welcome *Ir. Roelof Moll, Executive Project Coordinator, ZERO BRINE*
- 10:10** Presentation of ZERO BRINE *Prof.Dr.Ir. Luuk Rietveld, Chair of Department of Water Management, Technical University of Delft*
- 10:30** ZERO BRINE Pilot Plants: Spain, Poland, The Netherlands and Turkey *Dr. Xavier Martinez, Director of Water, Air and Soil Unit, Eurecat | Dr. Krzysztof Mitko, Assistant Professor, Silesian University of Technology | Dr.Ir. Henri Spanjers, Associate Professor and Industry Water Group Lead, Technical University of Delft | Dr. Ahmet Baban, Associate Professor and Senior Research Scientist, TÜBITAK*
- 11:00** Demonstration of Brine Excellence Centres: Technologies and Simulation suites *Dr.Ir. Henri Spanjers, Associate Professor and Industry Water Group Lead, Technical University of Delft*
- 11:15** Demonstration of the Online Brine Platform *Maria Kyriazi, Senior Researcher, National Technical University of Athens | Kees Roest, Programme Director, Institute for Sustainable Process Technology*
- 11:30** Coffee Break

ZERO BRINE Research – Afternoon Session

- 11:45** ZERO BRINE Special Issue – Part I
- Mechanisms controlling ion rejection in membrane filtration in presence of saline multi-ionic mixtures *Dionysia Diamantidou, Process and R&D Engineer, Lenntech*
- Valorization of Coal Mine Effluents – Challenges and Economic Opportunities *Nikhil Pawar, PhD candidate, DLR*
- Using life cycle assessment at an early stage of design and development of zero discharge brine treatment and recovery *Nilay Elginöz, Senior researcher, Swedish Environmental Institute (IVL)*

12:45 Lunch Break

13:45 ZERO BRINE Special Issue – Part II

- High silica concentration in RO concentrate *Amir Haidari Manager of Process Technology and Innovation, Hatlenboer-Water*
- Benthic biodiversity and environmental gradients of the Port of Rotterdam: A unique estuarine system with strong human impact *Frithjof Kuepper, Professor, University of Aberdeen*
- Physicochemical model for simulating the chemical processes during the crystallization of minerals from spent Ion Exchange Regenerant *Dr. Marc Arpad Boncz, Associate Professor UFMS (Brazil)*
- Pilot studies on circular economy solution for the coal mining sector *Dr. Krzysztof Mitko, Assistant Professor, SUT*

14:45 Coffee Break

Impact of ZERO BRINE – Closing Session

- 15:00** Business cases and Circular Economy - Interactive Session *Dr. Dimitris Xevgenos, Innovation Manager and Managing Director, ZERO BRINE*
- 15:30** ZERO BRINE and EU Policy Panel Discussion: ‘How can ZERO BRINE results support the development of circular economy within Europe through EU Policies?’ *Maria Kyriazi (Chair) | Loïc Charpentier, Water Innovation Policy Officer, Water Europe | Corinne van Voorden, Dutch Ministry of Economic Affairs, Netherlands Enterprise Agency and Member of Advisory Board, ZERO BRINE | Dr. Gijsbert Korevaar, Assistant Professor Policy Management Studies, TU Delft*
- 16:00** Stakeholder Perspectives and Follow-up projects
- Perspectives for desalination as regards Polish saline coal mine waters *PhD Eng. Grzegorz Gzyl Assistant Professor at Główny Instytut Górnictwa (GIG)*
- Words from the Advisory Board *Michiel van Haersma Buma, Chairman of the Advisory Board, ZERO BRINE*
- 16:30** Closure

Conference Dinner + Cocktails



Luuk Rietveld
Scientific Coordinator
ZERO BRINE

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Luuk Rietveld is Professor of Drinking Water & Urban Water Cycle Technology. He is Chairman of the Department of Water Management, Delft University of Technology, and focuses his research activities on treatment processes. His special interests include water quality and treatment, wastewater reclamation, water supply for the poor.



ZERO BRINE

A circular economy approach

Industrial waste water - Resources recovery – Waste reduction

Luuk Rietveld, Scientific director, TU Delft

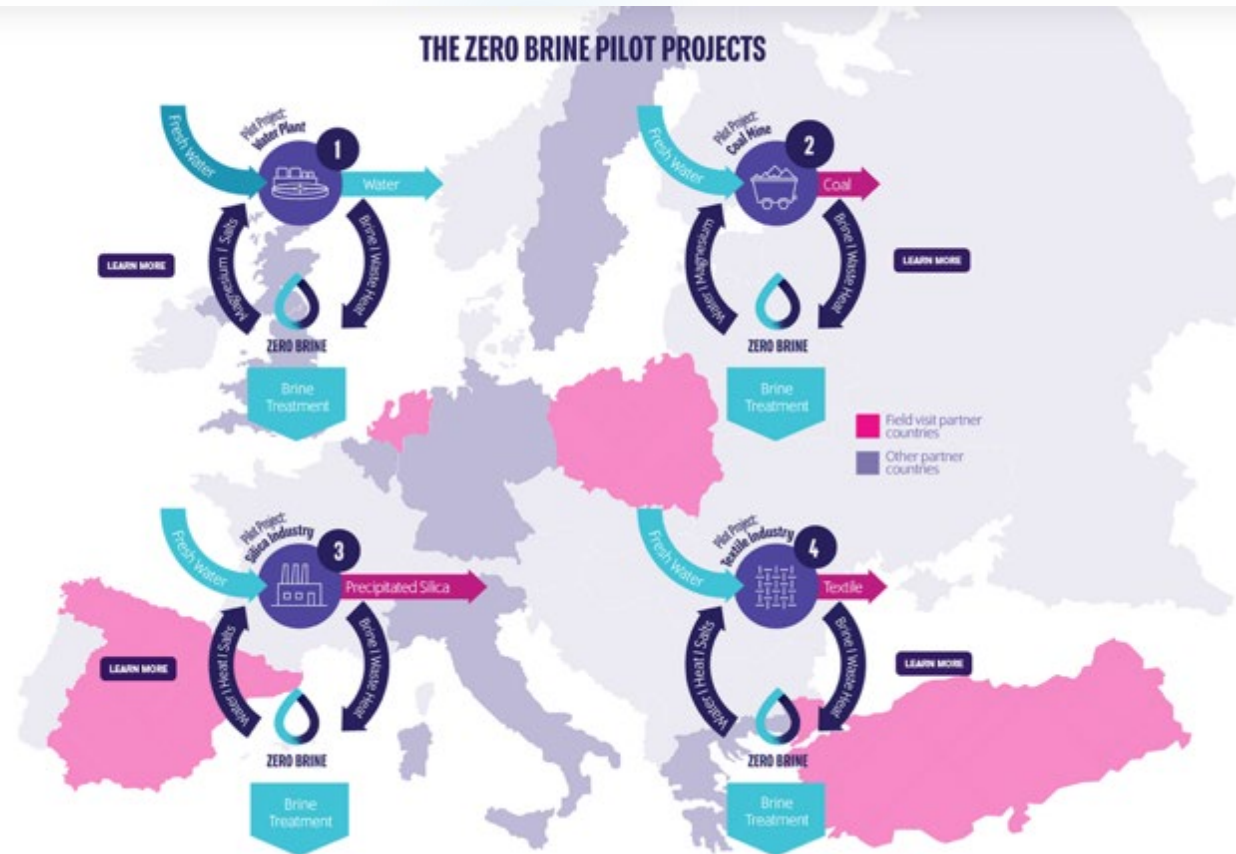


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4 industrial sectors

From SPIRE Roadmap to Processes4Planet





ZERO BRINE project



Project Goal: The ZERO BRINE project aims to facilitate the implementation of the Circular Economy package and the SPIRE roadmap in various process industries by developing necessary concepts, technological solutions and business models to redesign the value and supply chains of water and minerals.

- **Recovery of resources** from saline impaired effluents (brines) generated by the process industry.
- **Eliminating wastewater discharges** and minimizing the environmental impacts .
- Integrating several existing and innovative technologies to **recover products of high quality** and sufficient purity to represent good market value.

Industrial Wastewater ◆ Resource Recovery ◆ Circular Economy



1. Demin water plant EVIDES in NL

Resources recovered:

94.7% Calcium recovery ($\text{Ca}(\text{OH})_2$) for external valorisation (>95.6% purity)

87.8% Magnesium recovery ($\text{Mg}(\text{OH})_2$) for external valorisation (>88.9% purity)

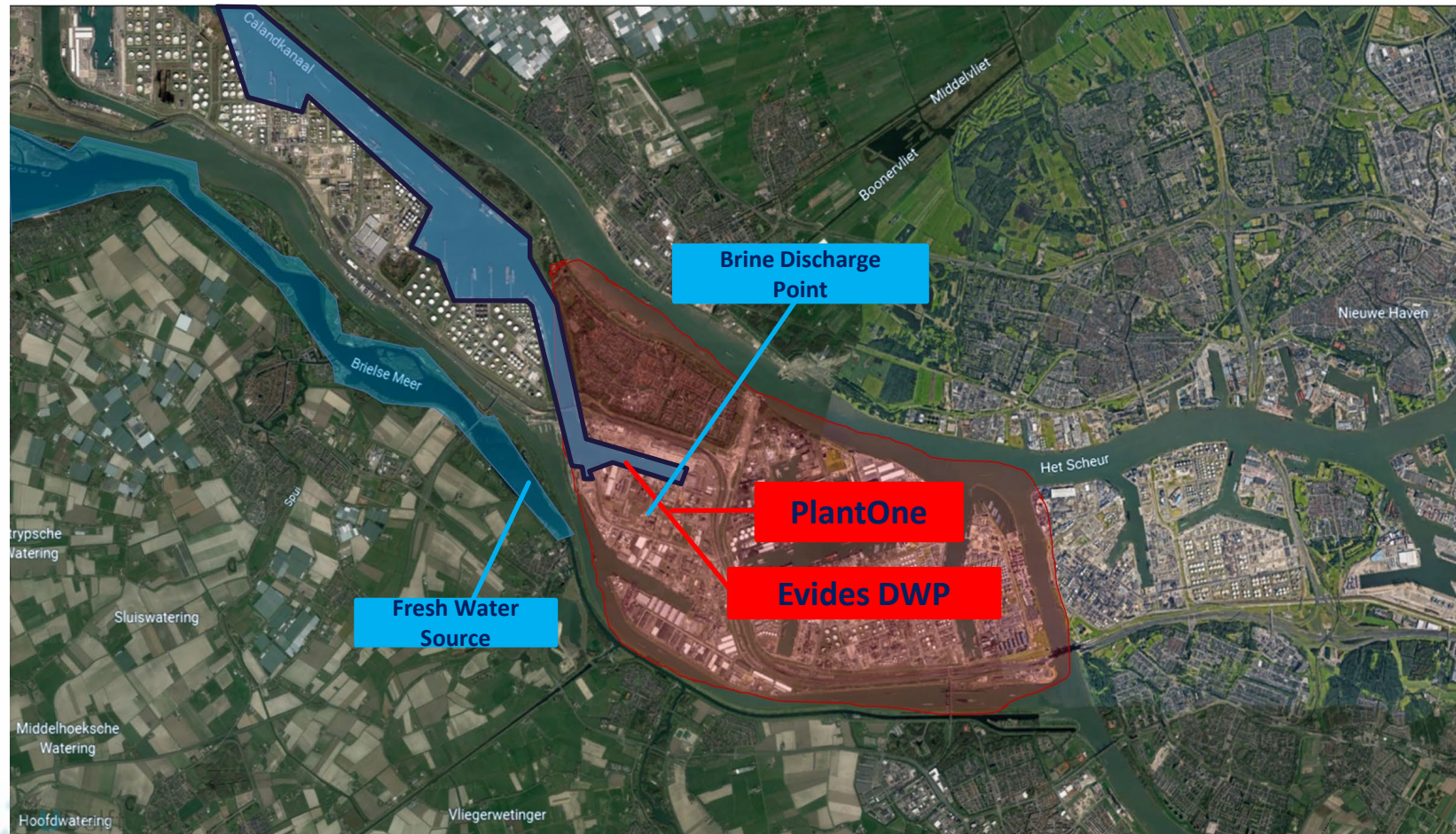
93% Sulphate recovery (Na_2SO_4) for external valorisation (unwashed: 94.6% purity)



Industrial Wastewater ◆ Resource Recovery ◆ Circular Economy



1. Demin water plant EVIDES in NL



Industrial Wastewater ◆ Resource Recovery ◆ Circular Economy

2. Coal mine Bolesław Śmiały in Poland

Emissions: 32.5% CO₂ reduction;

Energy: 33% reduction;

Resources recovery:

90.6% water recovery (demi water)

92.8% salt recovery (99% purity)

94.9% magnesium hydroxide recovery for external valorisation (97% purity)

0.84 kg/m³ gypsum for external valorisation





3. Silica mine IQE in Spain

Emissions:

100% reduction of brine discharged to the environment;

60% reduction of sodium sulphate (Na_2SO_4) releases into the Ebro River;

6000 tons/year CO_2 reduction;

Recovered resources:

90% recovery of sodium sulphate (Na_2SO_4) for valorisation (>99% purity);

Sodium hydroxide (NaOH) (94% purity) and sulphuric acid (H_2SO_4) (72% purity).





4. Textile Industry at Zorlu in Turkey

Emissions:

90-95% reduction of brine discharged to the environment;

150-200 tons/year CO₂ reduction;

Resources recovery:

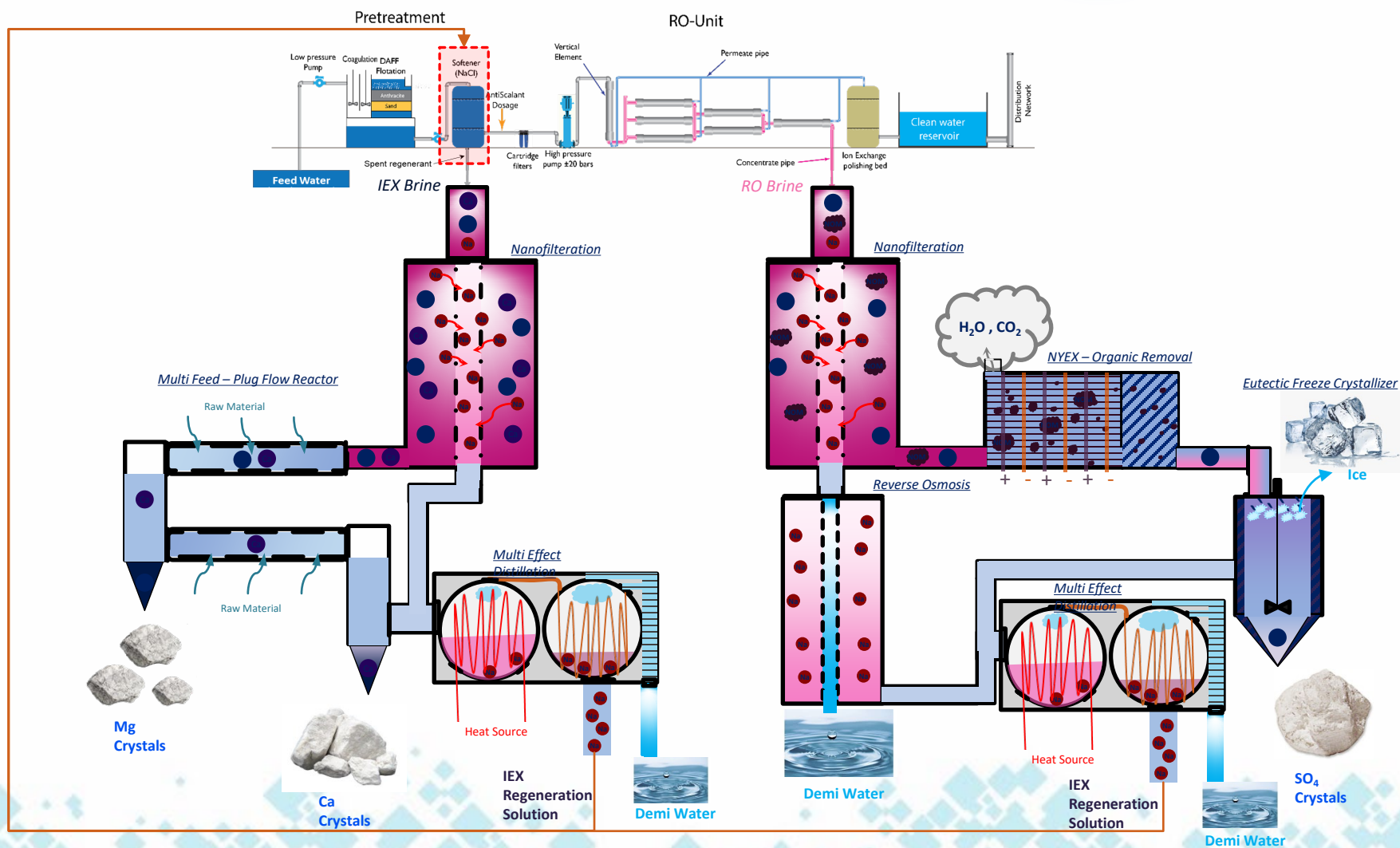
70-80% water recovery from brine treatment system for onsite use;

600-700 tons salt/year for onsite dyeing of textiles.



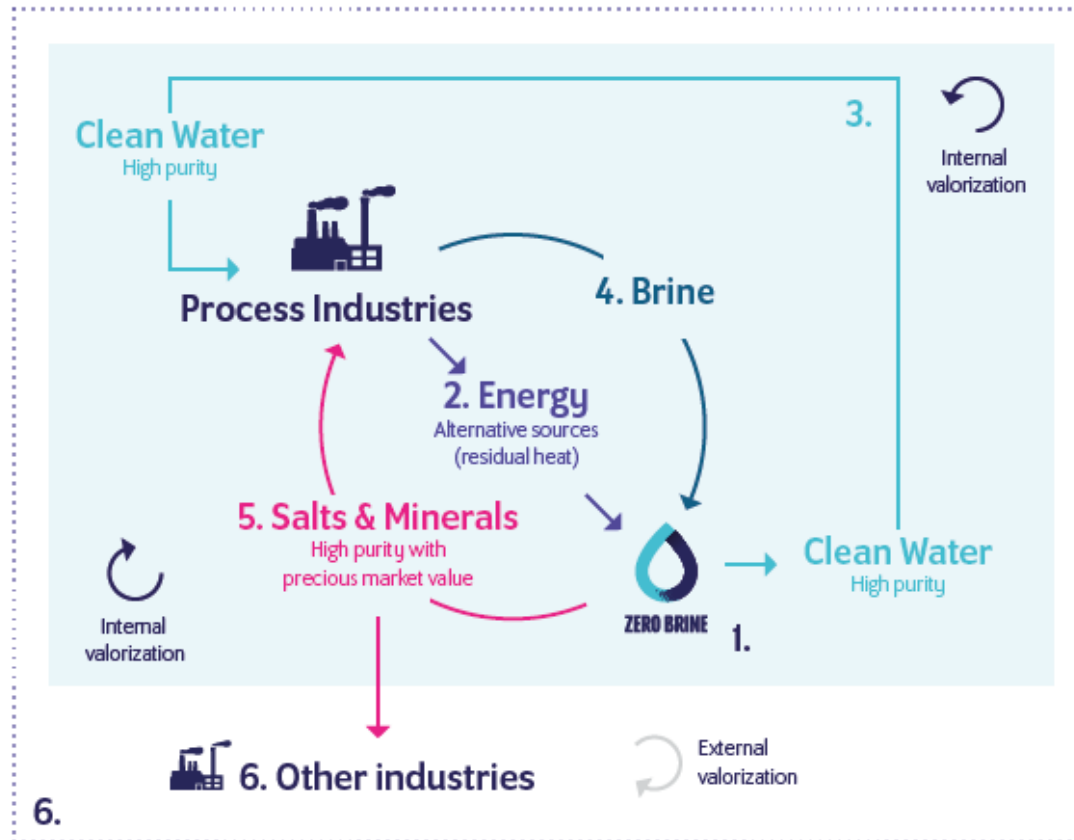


ZERO BRINE project



Industrial Wastewater ◆ Resource Recovery ◆ Circular Economy

Techno-economical analysis



1. ZERO BRINE technology

- High CAPEX / Low OPEX
- Required lower energy compared to current treatment practices

2. Energy

- Alternative and cheaper energy source to reduce CAPEX

3. Clean Water

- Lower water consumption by reusing the recovered water

4. Brine

- No water required for dilution
- No brine discharge
- No environmental levies

5. Salts & Minerals

- Internal use of salts and minerals
- Trading salts and minerals as a new source of revenues

6. Other Industries

- New supply chain of water and minerals lead to lower water pollution and potentially would lead to lower carbon emission on global scale

Knowledge development & sharing

BRINE Excellence Centres:

The Netherlands, Spain, Italy, Greece and Poland

RCE Simulation software package

📖 Effectivity of technologies

📖 Energy

📖 Cost



Online Brine Platform

Matchmaking between brine suppliers and salt users

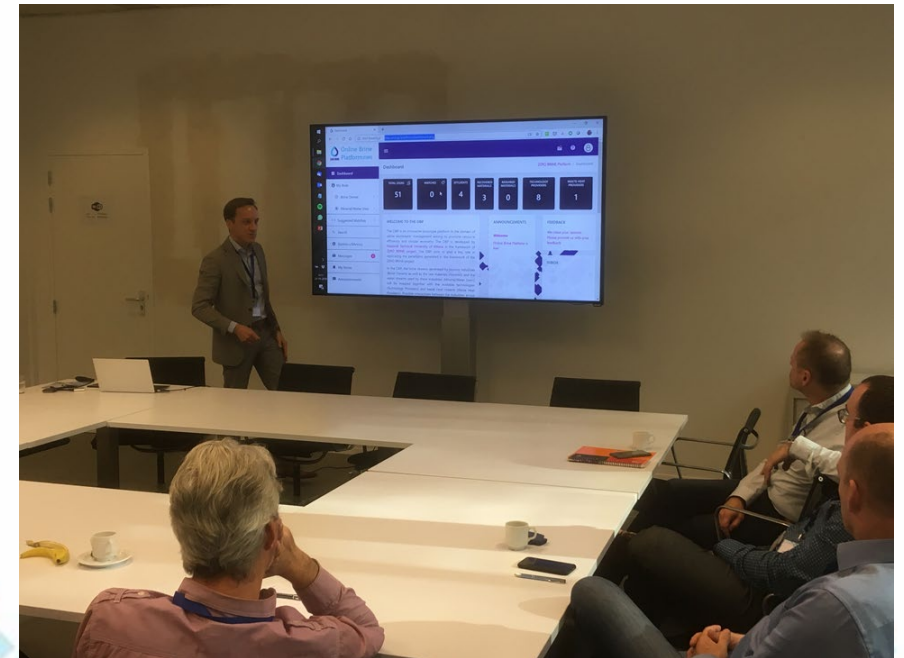
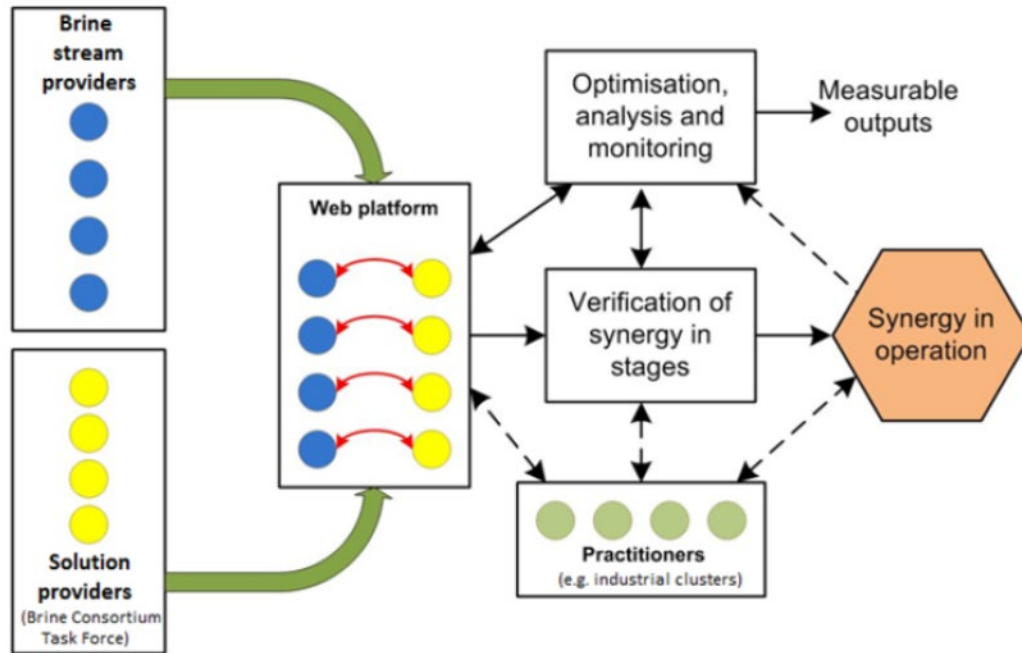


Figure 4: Application of the Online Brine Platform, correlation between brine stream providers, solution providers and practitioners



Overall conclusions

From waste into products:

- Upscaling of the technologies should be further studied
- Entrepreneurs reluctant to accept responsibilities in the circular setting.
- Government policies on waste and product are not tuned to circular use of resources yet.



Overall conclusions

Business cases:

- Very site-specific character.
- Permits, subsidies and taxes determine the attractiveness of ZERO BRINE technologies.
- Practical considerations limit the applicability of technically sound technologies.



Overall conclusions

Sectoral development within Europe:

- Scarce minerals can be recovered from brines and re-used to reduce dependency from other continents or China.
- A global strategy for self-sustainability within Europe is not in place yet.
- Resources, energy and basic industries would ask for additional policy instruments to encourage implementation of circular economy solutions.



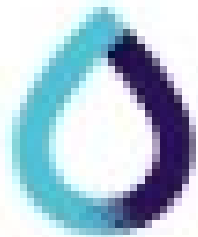
Xavier Martinez

Director of Water, Air and Soil Unit

Eurecat

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Xavier Martinez is a chemical engineer and environmental researcher with professional activities focusing on the design, execution and coordination of R+D+I projects in the field of chemistry, environmental chemistry and water treatment technologies. Currently, he leads the Water, Air and Soil Unit at Eurecat.



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PILOT PLANT

Silica production
plant

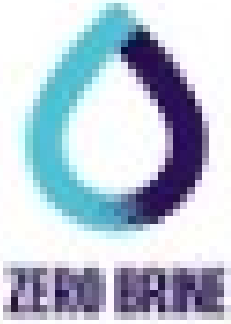




Krzysztof Mitko
Assistant Professor
SUT

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Dr. Mitko is an assistant professor at the Silesian University of Technology, Faculty of Chemistry. His research interests include electromembrane processes (electrodialysis, electrodeionization, membrane capacitive deionization); removal of metal ions from the waste waters; seawater, coal mine water and industrial wastewater desalination.



PILOT PLANT
Boleslaw Śmiaty
coal mine



Henri Spanjers

Associate Professor, Industry Water Lead
TU Delft

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Henri Spanjers graduated as an Environmental Engineer. He worked with a number of research institutes in various EU countries and was project director with a consultancy firm. He is currently professor at Delft University of Technology, faculty of Civil Engineering and Geosciences, where he leads the Industry Water group. He is Editor-in-Chief of the Water Resources and Industry journal.





Ahmet Baban

Associate Professor, Senior Researcher

TÜBİTAK

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Senior Research Scientist working at TÜBİTAK Marmara Research Center, Environment and Cleaner Production Institute– Turkey. Research topics include water and wastewater management, water reuse, advanced treatment technologies, textile industry, food industry water management, circular economy, and sustainable water management.





Henri Spanjers

Associate Professor, Industry Water Lead
TU Delft

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Henri Spanjers graduated as an Environmental Engineer. He worked with a number of research institutes in various EU countries and was project director with a consultancy firm. He is currently professor at Delft University of Technology, faculty of Civil Engineering and Geosciences, where he leads the Industry Water group. He is Editor-in-Chief of the Water Resources and Industry journal.



RCE simulation platform

Modeling of Circular Economy-based WW Treatment Chains

ZERO BRINE Final Forum, 4th November 2021

M.Sc. Nikhil Pawar, Dr. Thomas Pregger, Dr. Benjamin Fuchs

German Aerospace Center (DLR), Institute of Networked Energy Systems, Curiestrasse 4, 70563 Stuttgart, Germany





Agenda



- What is RCE?
- Technology Tools published via RCE
- Illustration of a modeled Treatment Chain



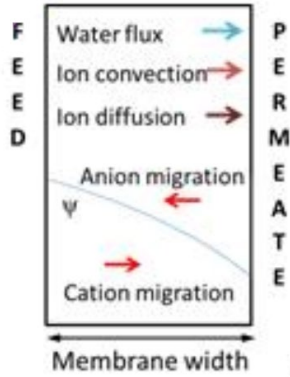
What is RCE?

- **Remote Component Environment (RCE)**¹ is an open-source, distributed integration environment which can be used to simulate complex treatment chains by combining Tools developed and shared by different teams within a project
- **Tools:** These could be techno-economic modeling of a treatment technology like nanofiltration (NF)
- **Application:** To determine economic feasibility of a proposed treatment chain by performing its techno-economic simulation

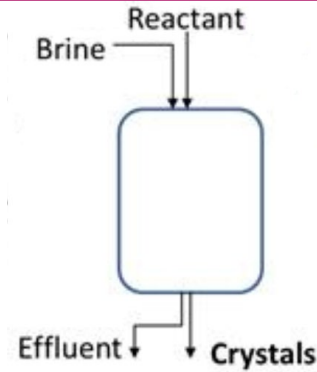


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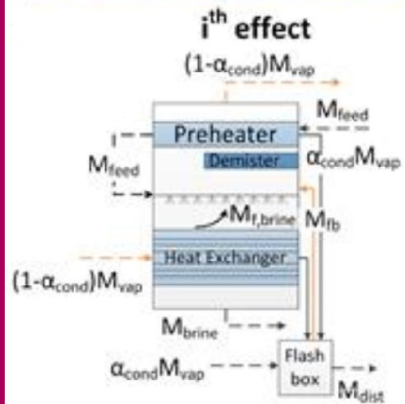
Technology Tools published via RCE



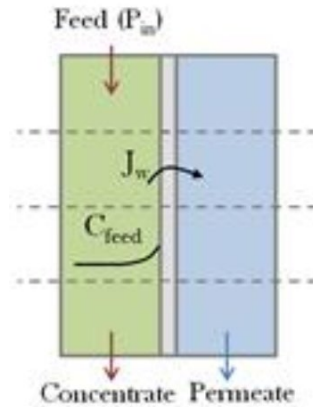
Nanofiltration (NF)



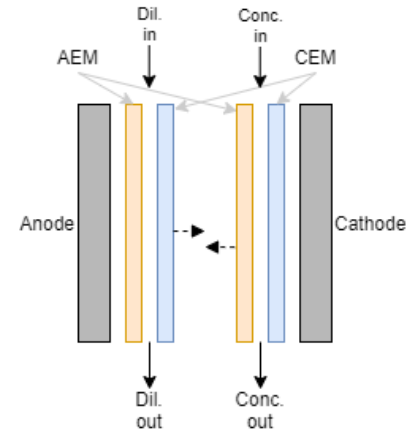
Crystallizers for several minerals & salts (Mg, Ca, NaCl)



Multi-effect distillation (MED)



Reverse osmosis (RO)



Electrodialysis (ED)

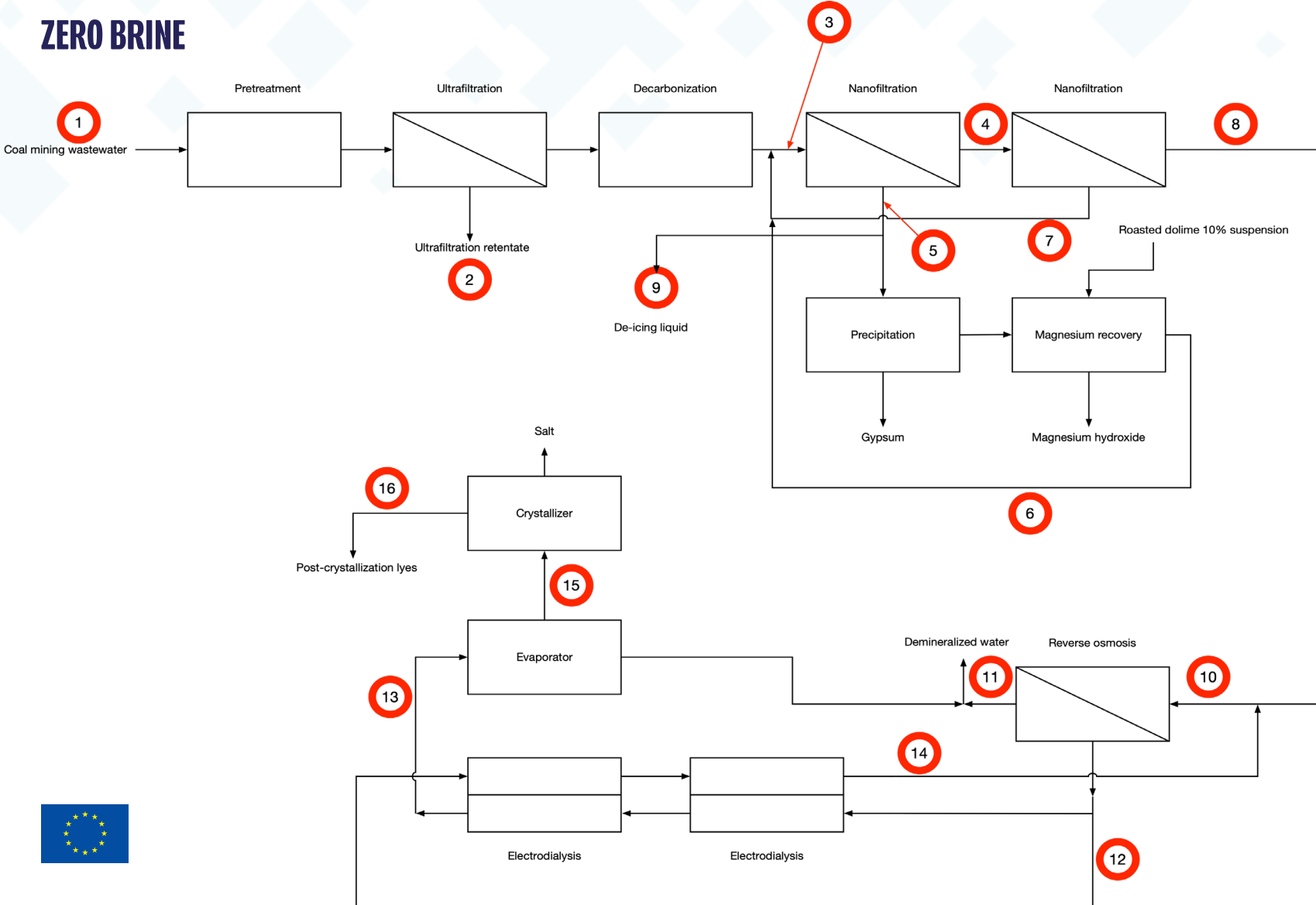




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Illustration of a modeled Treatment Chain



- **Example:** Coalmine effluent treatment chain (Polish case study)
- **Technologies:** NF, CaSO_4 & $\text{Mg}(\text{OH})_2$ precipitators, RO, ED, MED and NaCl Evaporator
- **Goal:** Estimate economic feasibility of the chain

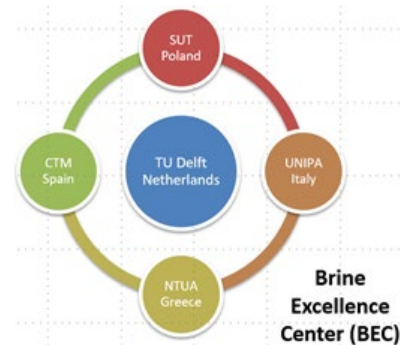


Further Information

- To explain and encourage the implementation of wastewater treatment chain simulations on RCE, exemplary workflows and RCE Cookbook are available
- For more information on this and getting access to the Technology Tools:
 - Dr. Benjamin Fuchs (Benjamin.Fuchs@dlr.de)
 - Nikhil Pawar (Nikhil.Pawar@dlr.de)



Demonstration of Brine Excellence Centers: Technologies and Simulation Suites





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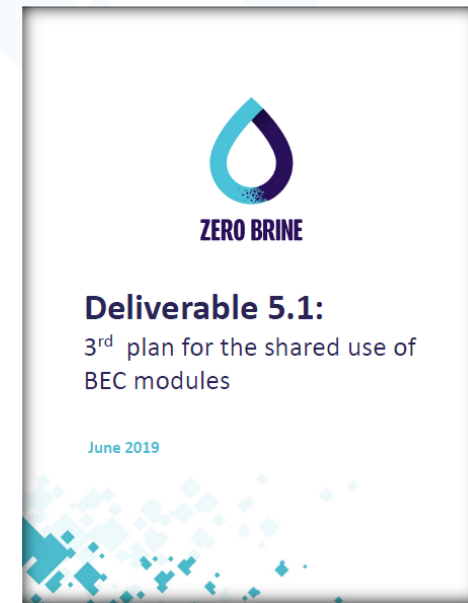
WP5: Optimization of innovative technologies - Integration of bench-scale and optimized pilot systems into fully-equipped Brine Excellence Centers (BECs) – Development of technology libraries (software tool) and integration into a common platform

- Task 5.1: Upgrade of pilot brine treatment systems
- Task 5.2: Development of BECs (equipment, plan)
- Task 5.3: Development of software tool and integration



Deliverables

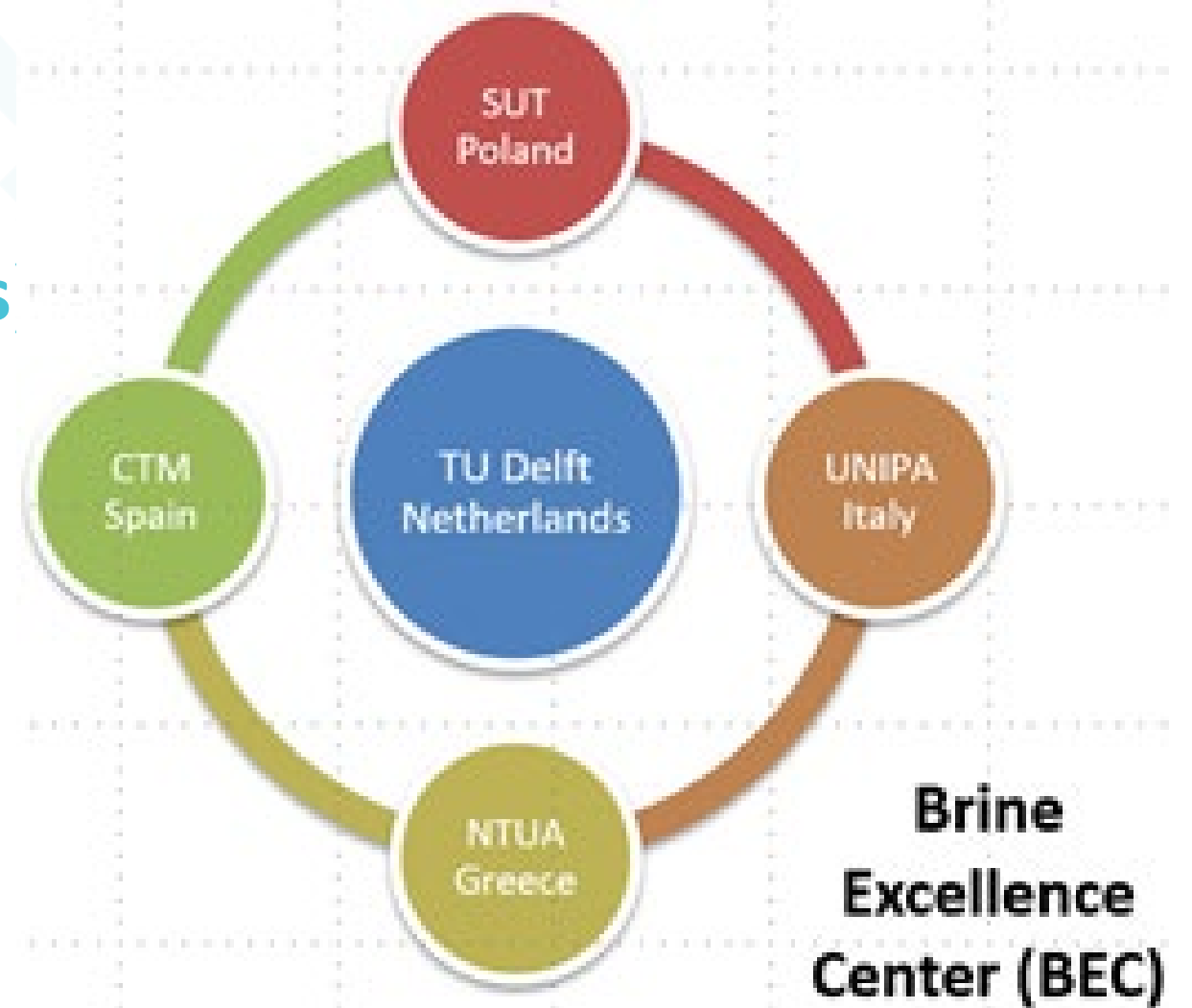
- D5.1: Plan for the shared use of BEC modules
- D5.2: Software tools for the simulation of brine treatment technologies (technology libraries and integrated platform)





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Brine Excellence Centres (BECs)



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15 November 2021

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Leaflet BEC



IS YOUR COMPANY OR ORGANISATION INTERESTED IN TESTING ITS BRINES? CONTACT FOR MORE INFORMATION:

Henri Spanjers
Associate Professor & Group Leader Industry Water,
TU Delft

+31 15 2789128

H.L.F.M.Spanjers@tudelft.nl

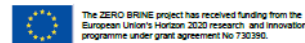
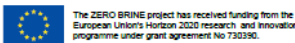
Faculty of Civil Engineering and Geosciences
Building 23 – Room 4.63
Stevinweg 1
2628 CN Delft



NETHERLANDS BRINE EXCELLENCE CENTRE



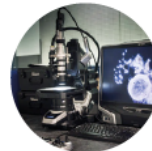
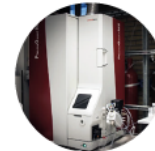
ZeroBrine www.zerobrine.eu @zero_brine



The core research activities at the NL BEC focus on developing a process for the separation and recovery of salts, minerals, and clean water from brines. The BEC is equipped with bench-scale and industrial pilot scale technologies that operate as part of a process train or independently, more specifically, Eutectic Freeze Crystallisation, Nanofiltration, Ion exchange, and Reverse Osmosis Filtration. In addition to technologies, NL BEC is equipped with analytical and measuring instruments to assess the physical, chemical, and microbial characteristics of brine solutions.

ANALYTICAL AND MEASURING INSTRUMENTS

- ◆ Ion Chromatography (IC)
- ◆ Inductively coupled plasma - mass spectrometry (ICP-MS)
- ◆ TOC analyser
- ◆ High-performance liquid chromatography (HPLC)
- ◆ Liquid chromatography–mass spectrometry (LC-MS)
- ◆ Gas chromatography for VFA and Biogas
- ◆ Digital Microscopes
- ◆ Isotope Analyser
- ◆ Particle Counter
- ◆ Particle Size Distribution Analyser (PSD)
- ◆ Rheometer



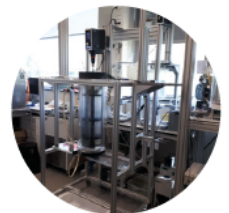
INDUSTRIAL PILOT SCALE TECHNOLOGIES

- ◆ Nanofiltration (NF)
- ◆ Reverse Osmosis (RO)
- ◆ Ion Exchange Column (IX)
- ◆ Eutectic Freeze Crystalliser (EFC)



BENCH-SCALE TECHNOLOGIES

- ◆ Nanofiltration (NF)
- ◆ Reverse Osmosis (RO)
- ◆ Closed Circuit Reverse Osmosis (CCRO)
- ◆ Ion Exchange columns (IX)
- ◆ Electrodialysis (ED)
- ◆ Bipolar Membrane Electrodialysis (EDBM)
- ◆ Eutectic Freeze Crystalliser (EFC)
- ◆ Anaerobic Membrane Bioreactor (AnMBR)
- ◆ Up-flow Anaerobic Sludge Blanket (UASB)

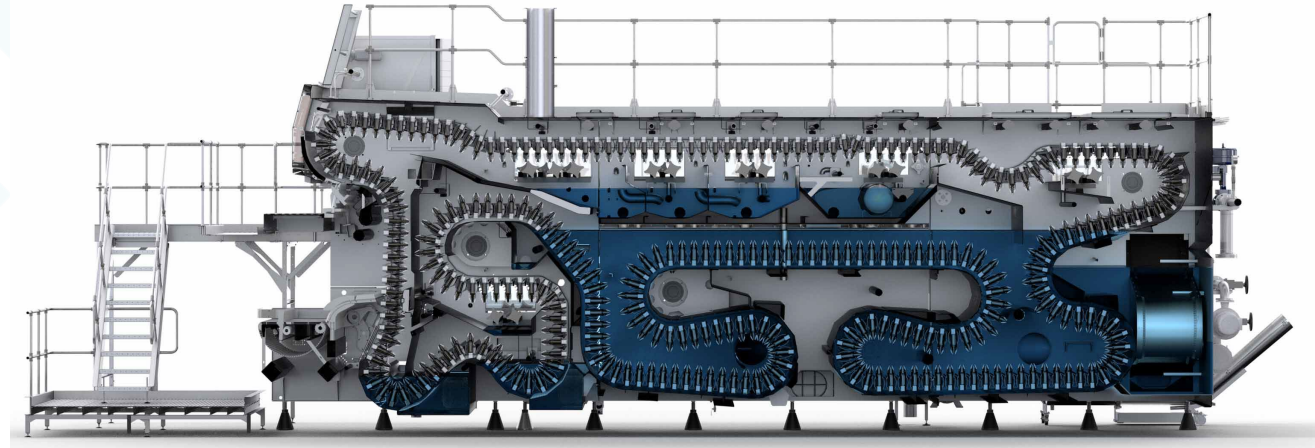


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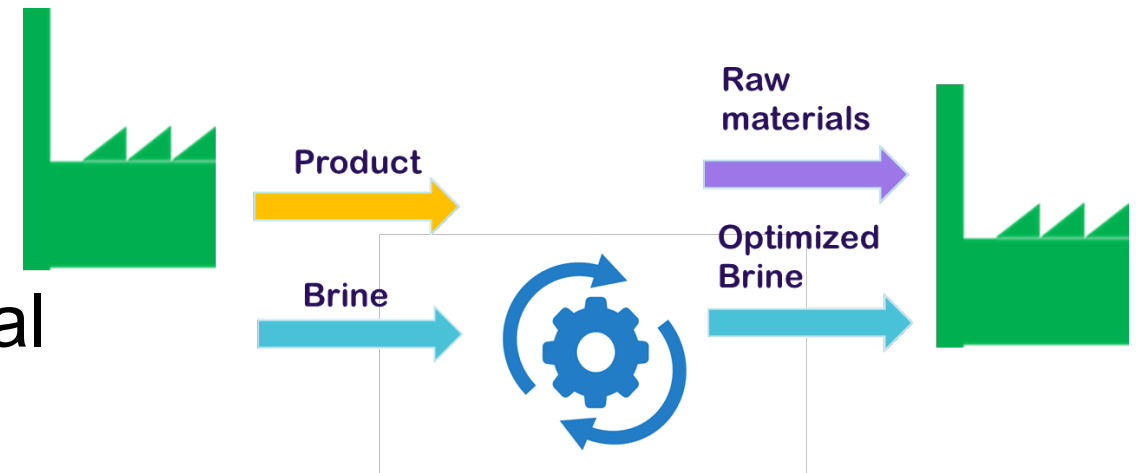


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BEC follow-up examples



- Sustainable Bottle Washer (Heineken): Recovery of caustic from bottle washer effluent
- Brine2Beton (NEOM): use residual brine in production new materials





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Thank you for your attention

www.zerobrine.eu

#ZeroBrine

@zero_brine_



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Maria Kyriazi
Senior Researcher
NTUA



Kees Roest
Programme Director
ISPT

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Online Brine Platform Towards Circularity and Industrial Symbiosis

Dr Maria Kyriazi

National Technical University of Athens

kyriazimaria@mail.ntua.gr

Dr Kees Roest

Institute for Sustainable Process Technology

kees.roest@ispt.eu



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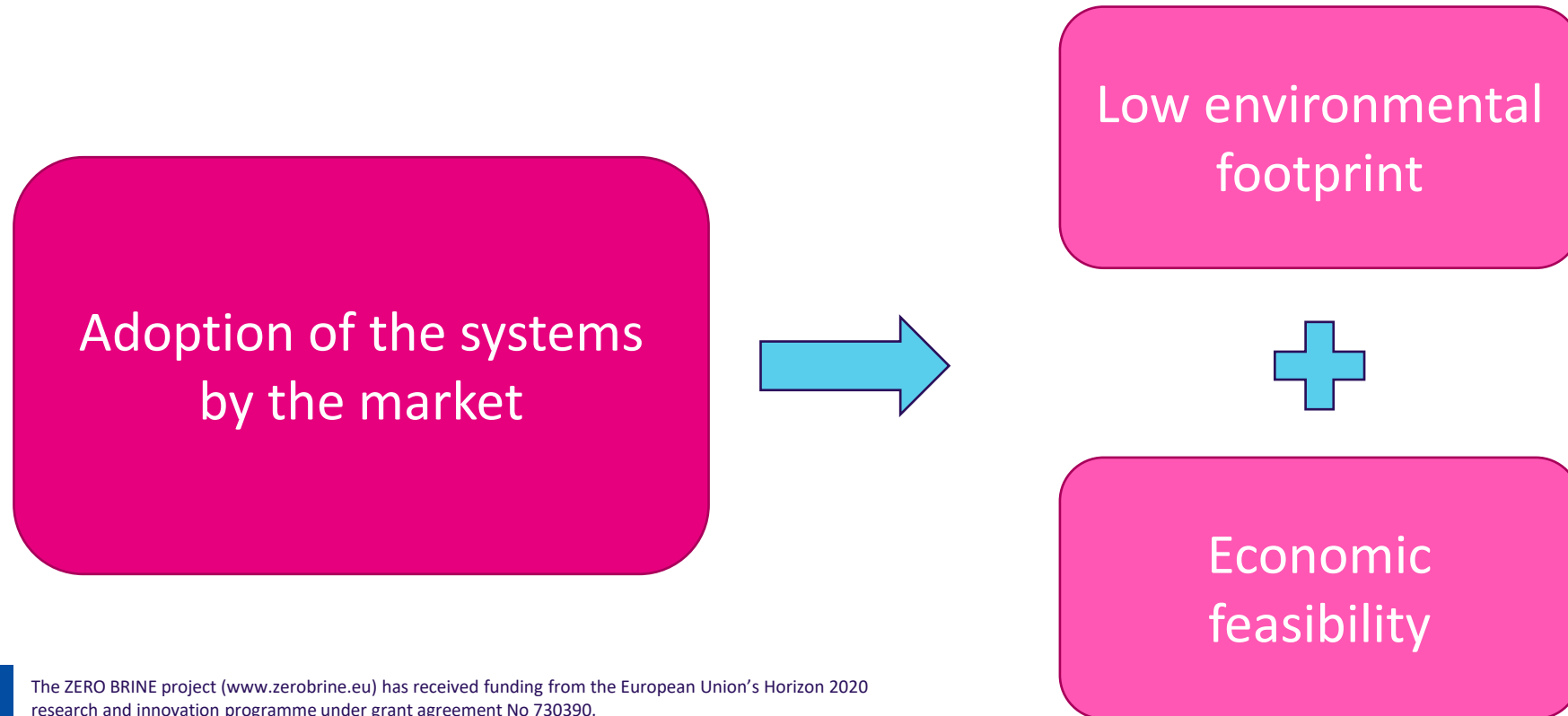
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The idea of an industrial symbiosis platform

Zero Brine aims to the implementation of smart systems which can contribute to the elimination of the negative impacts from brine discharge



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The idea of an industrial symbiosis platform

- The economic feasibility is based on the value of the products that water treatment systems can produce.
- These products must be raw materials that the market needs and
- The income from their exploitation must be higher than the capital and operational cost of the system used for their production.
- Even in case that valuable raw materials are produced many problems about their exploitation have been noticed.
- ZB project tried to solve this problem bringing in contact all the actors of this market with an easy and immediate way.





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Aim of the Online Brine Platform

The OBP enables the creation of a network among different stakeholders, active in the domain of brines.

OBP addresses to industries or SMEs :

interested in wastewater management

technology providers

raw material market suppliers

wastewater aggregators

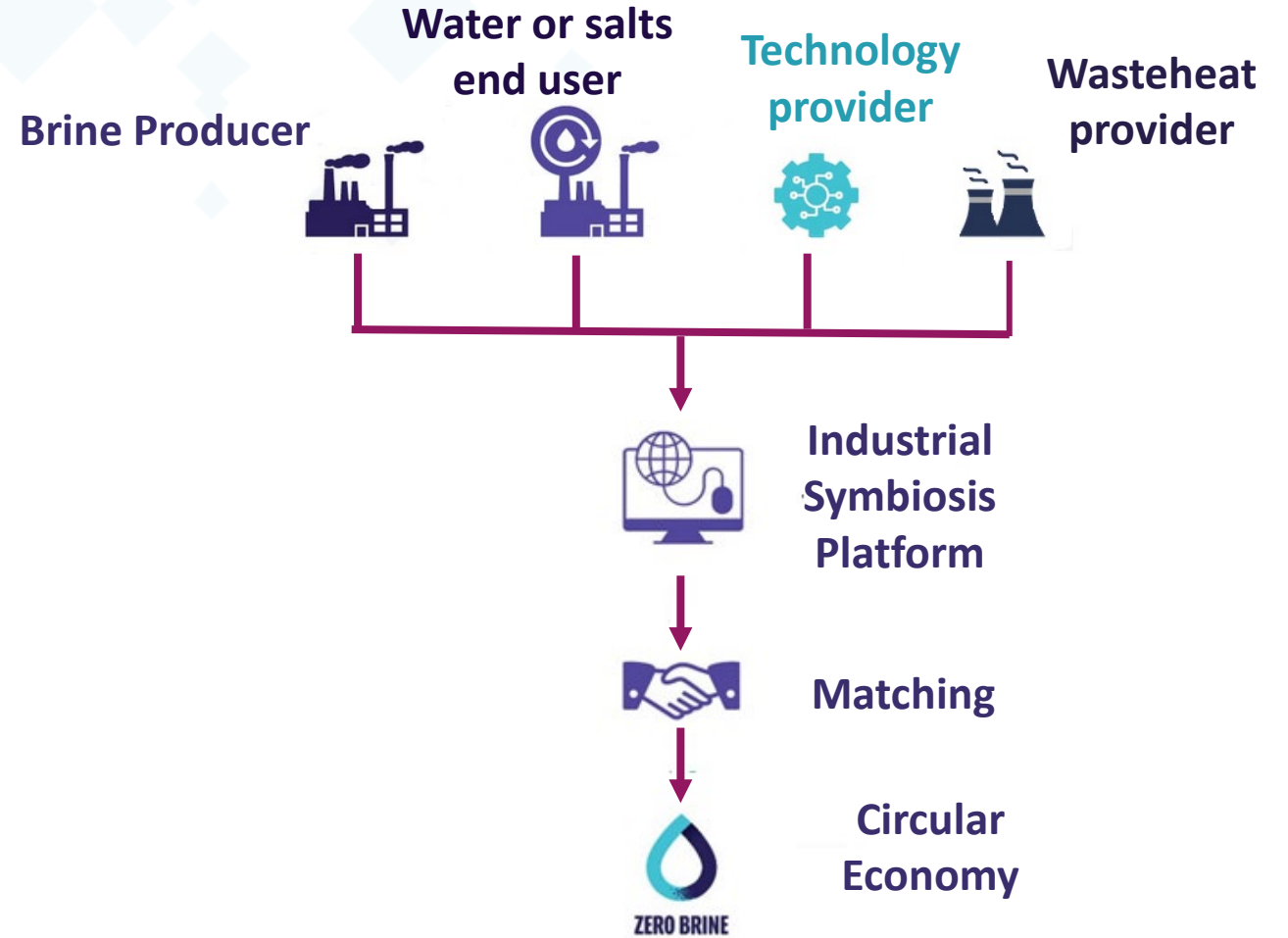
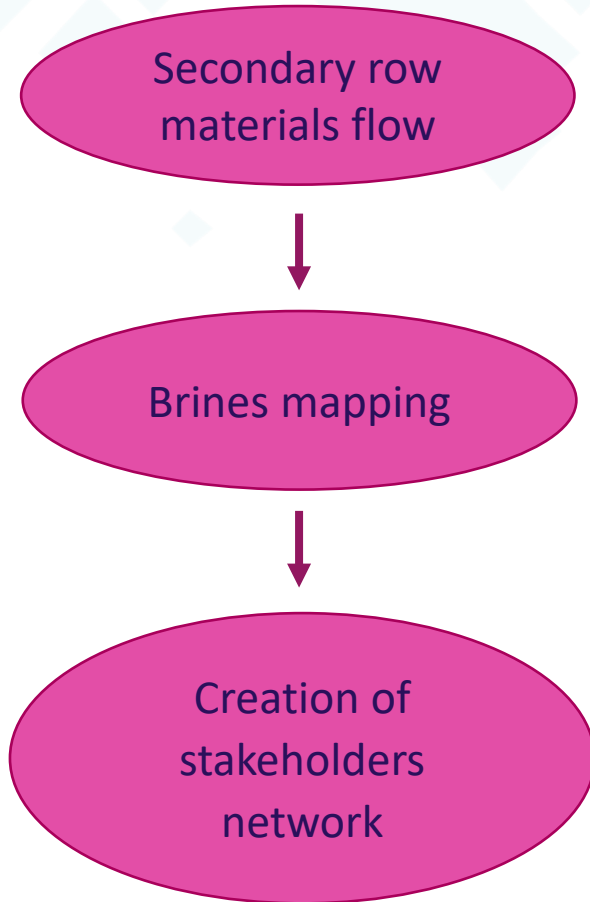
wasteheat providers





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How OBP works



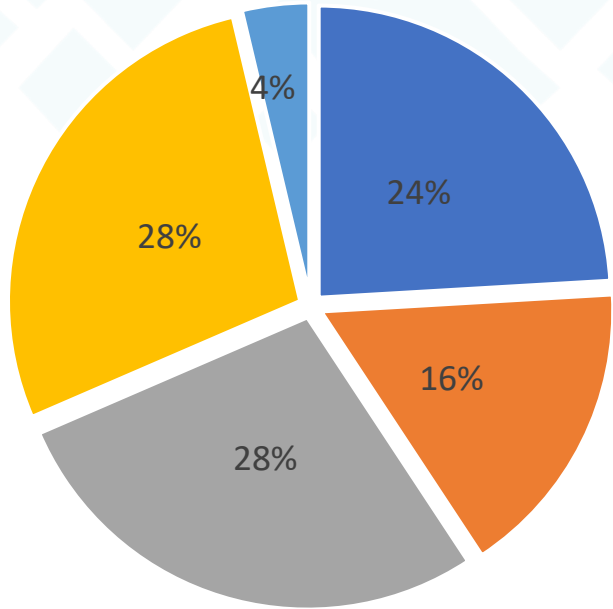




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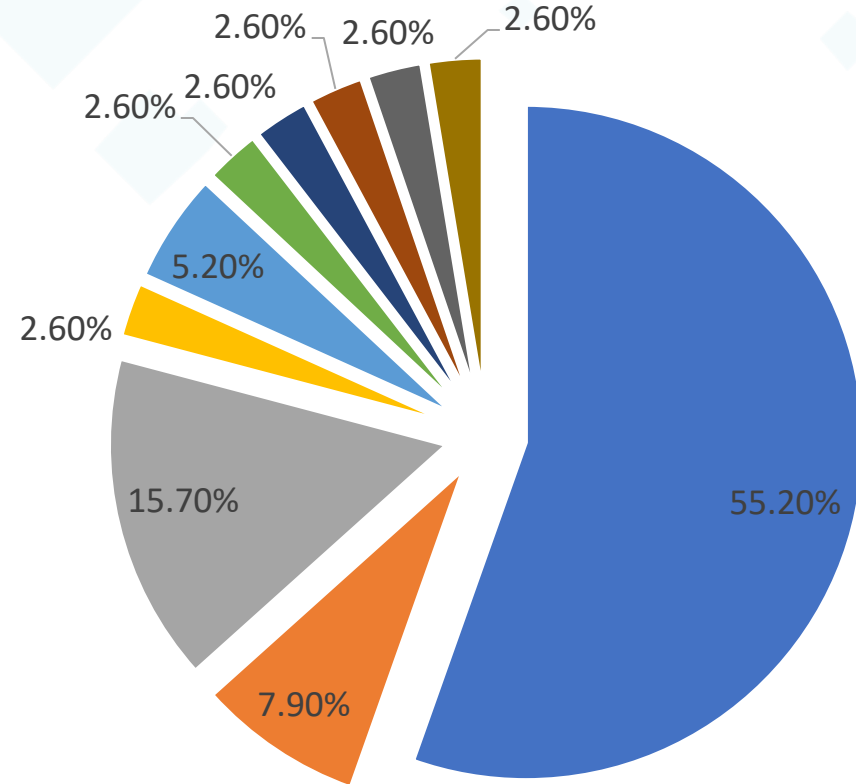
OBP users

> 400 active users



- Brine Owners
- Mineral Water Users
- Technology Providers
- Industry aggregator choice
- Waste heat provider

Distribution of platform users according to the role they select during their registration



- Netherlands
- Germany
- Spain
- Turkey
- USA
- Belgium
- UK
- Greece
- Denmark

Distribution of platform users according to the country their enterprise or organization is based

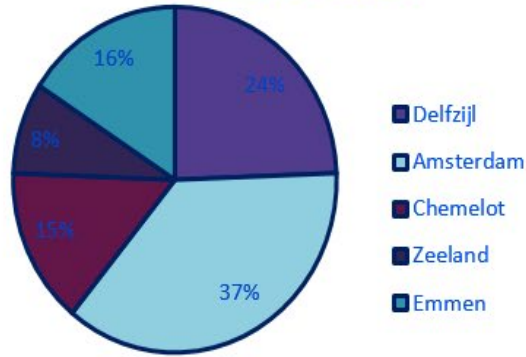




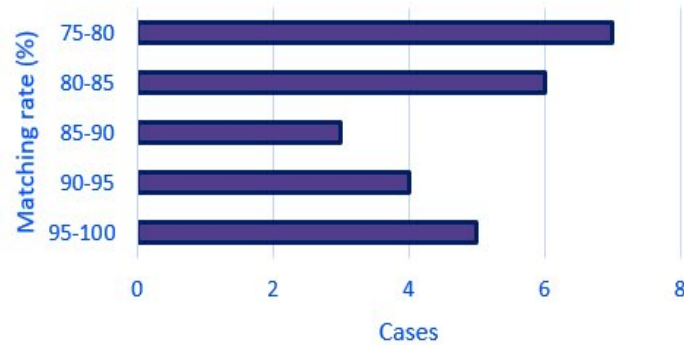
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OBP metrics

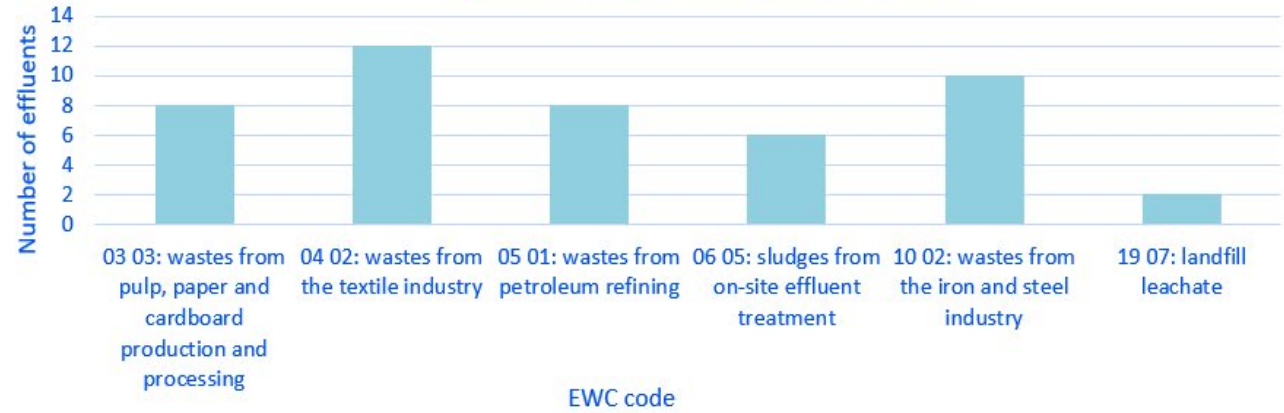
Users per cluster



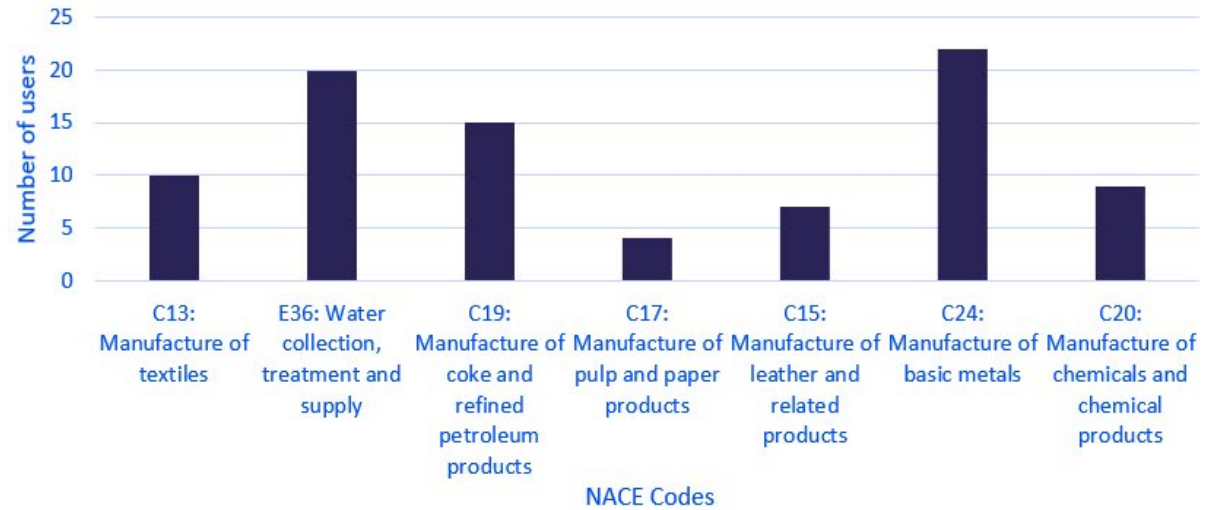
Matching rate



Registered effluents per EWC code



Registered users per NACE code



Thank you for your attention!



**Industrial
Wastewater**



**Resource
Recovery**



**Circular
Economy**



ZERO BRINE

Kees Roest

- Institute for Sustainable Process Technology
 - Program director - Industrial Fluids Processing

- KWR Water Research Institute
 - Senior scientific researcher - Energy & Circular Systems
 - Project manager
 - Programme Manager TKI Water Technology projects KWR





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Institute for Sustainable Process Technology (ISPT)

- Independent open innovation platform, founded by and for the process industry.
- Facilitates research and development of sustainable process technologies through joint projects in which process industries, knowledge institutes and technology providers collaborate.
- Collaboration, sharing and dissemination is crucially needed to accelerate innovation.



"...Creating an environment of trust among companies, knowledge institutes and technology providers that share a common goal..."



The ZERO BRINE project (www.zerobrines.eu) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730390.

15 November 2021

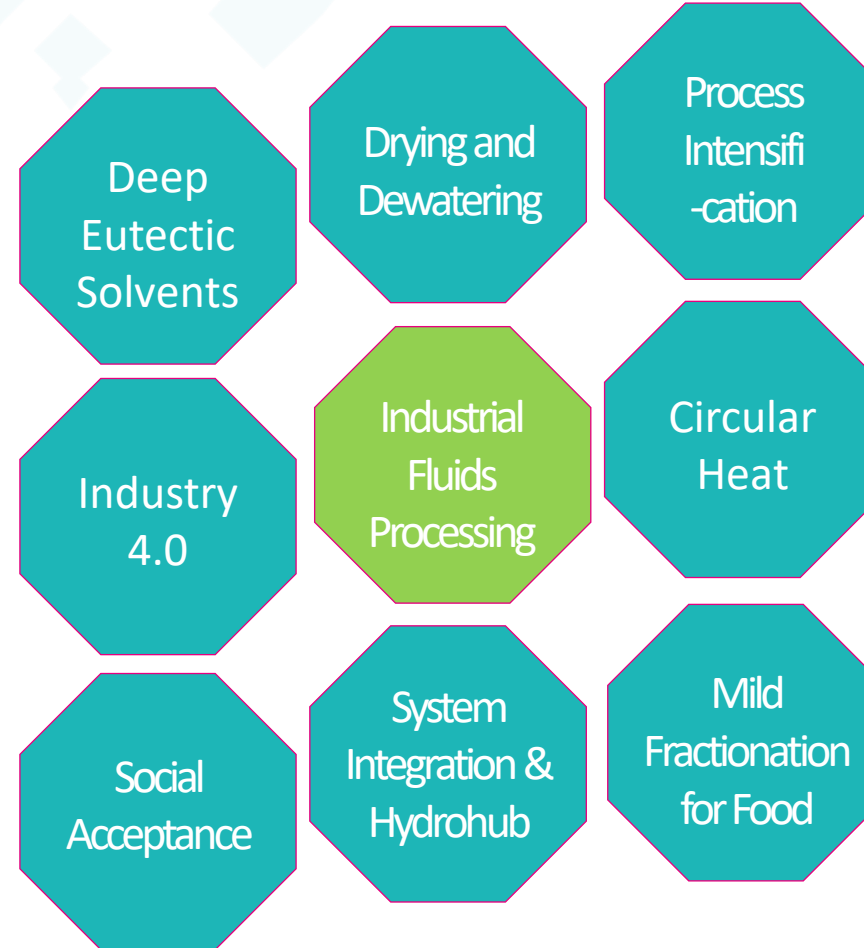
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ZERO BRINE

The way ISPT works: clusters

A cluster is a set of multiple innovation activities with a common theme, all results are shared.



WHAT RESOURCES CAN THE ZERO BRINE PROCESS RECOVER?



Minerals
(magnesium)



Salts
(sodium chloride,
potassium salts,
carbonates, other salts)



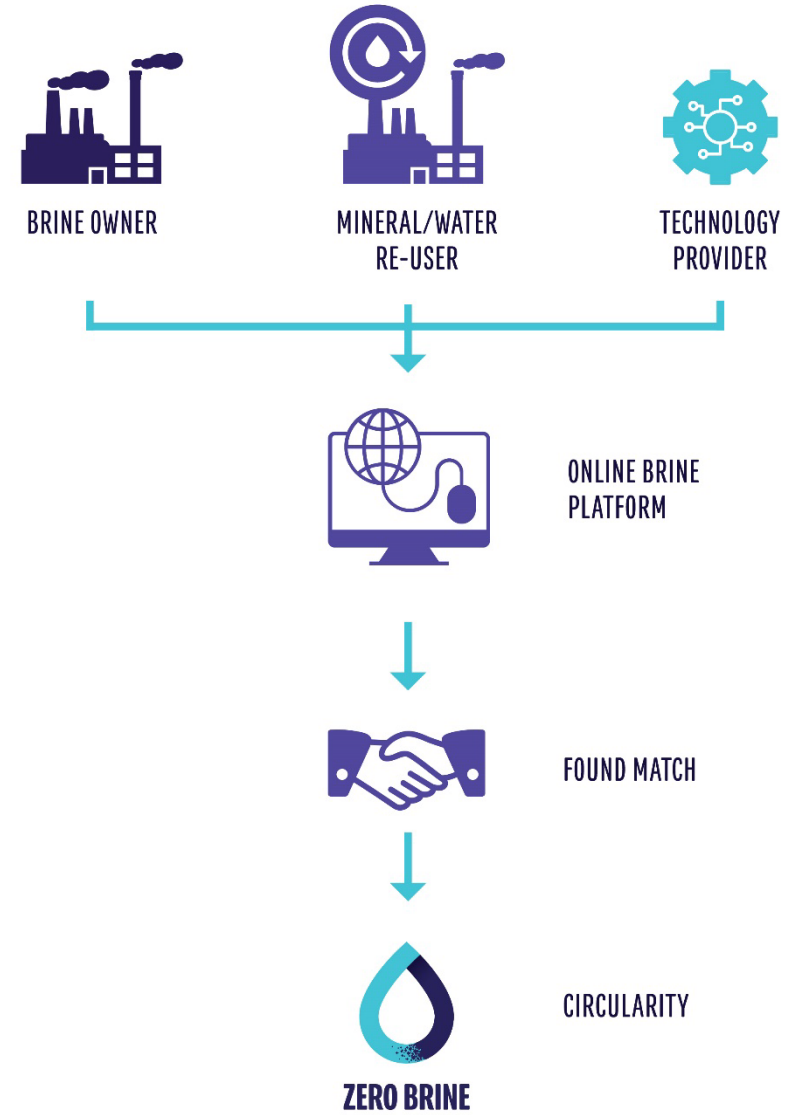
Clean water



Waste heat

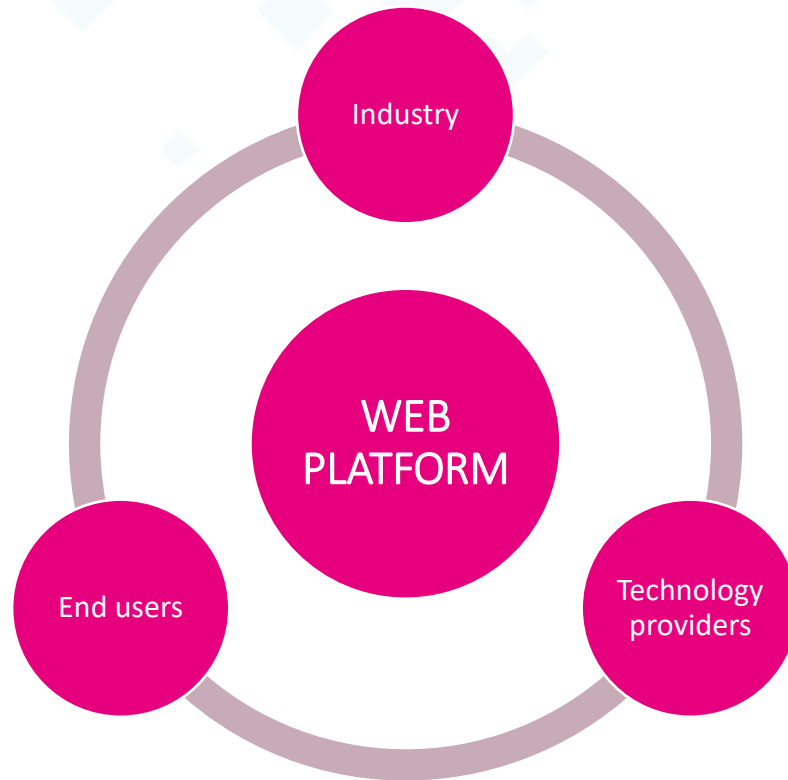


Online Brine Platform (zerobrine.eu)



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ONLINE BRINE PLATFORM



- Match brine producers with end-users
- Match brine recovery/treatment needs with technology providers
- Online market place for brines



ZERO BRINE

ONLINE BRINE PLATFORM

The screenshot displays the 'Online Brine Platform (OBP)' interface. On the left is a navigation sidebar with the following items: Dashboard, My Role (highlighted), Search, Statistics, Messages (with a notification badge), My Notes, Announcements, FAQ, OBP Portal, and ZERO BRINE Project. The main content area is titled 'OBP Role' and includes a breadcrumb 'ZERO BRINE Platform / OBP Role'. Below the title is a section for 'USER ROLE' with the instruction: 'Please select how you intend to use the OBP. You can have a single or a multiple OBP role.' There are four role options, each with a radio button and an icon: 'Brine Owner' (factory icon), 'Mineral/Water User' (factory with water drop icon), 'Technology Provider' (gears icon), and 'Waste Heat Provider' (factory with smoke icon). An 'Update User' button is located at the bottom left of the role selection area.



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Accelerating the transition to a Dutch circular economy

- Since 2016, the goal is for the Netherlands to have a **completely circular economy** by 2050!



Government of the Netherlands

- Circular Economy Accelerator portal (Versnellingshuis)
- Responsibility for waste generated – potential further expansion of producer responsibility, Circular design, Targeted price incentives (high prices for not sustainable products and financial benefits for sustainable companies), Circular procurement



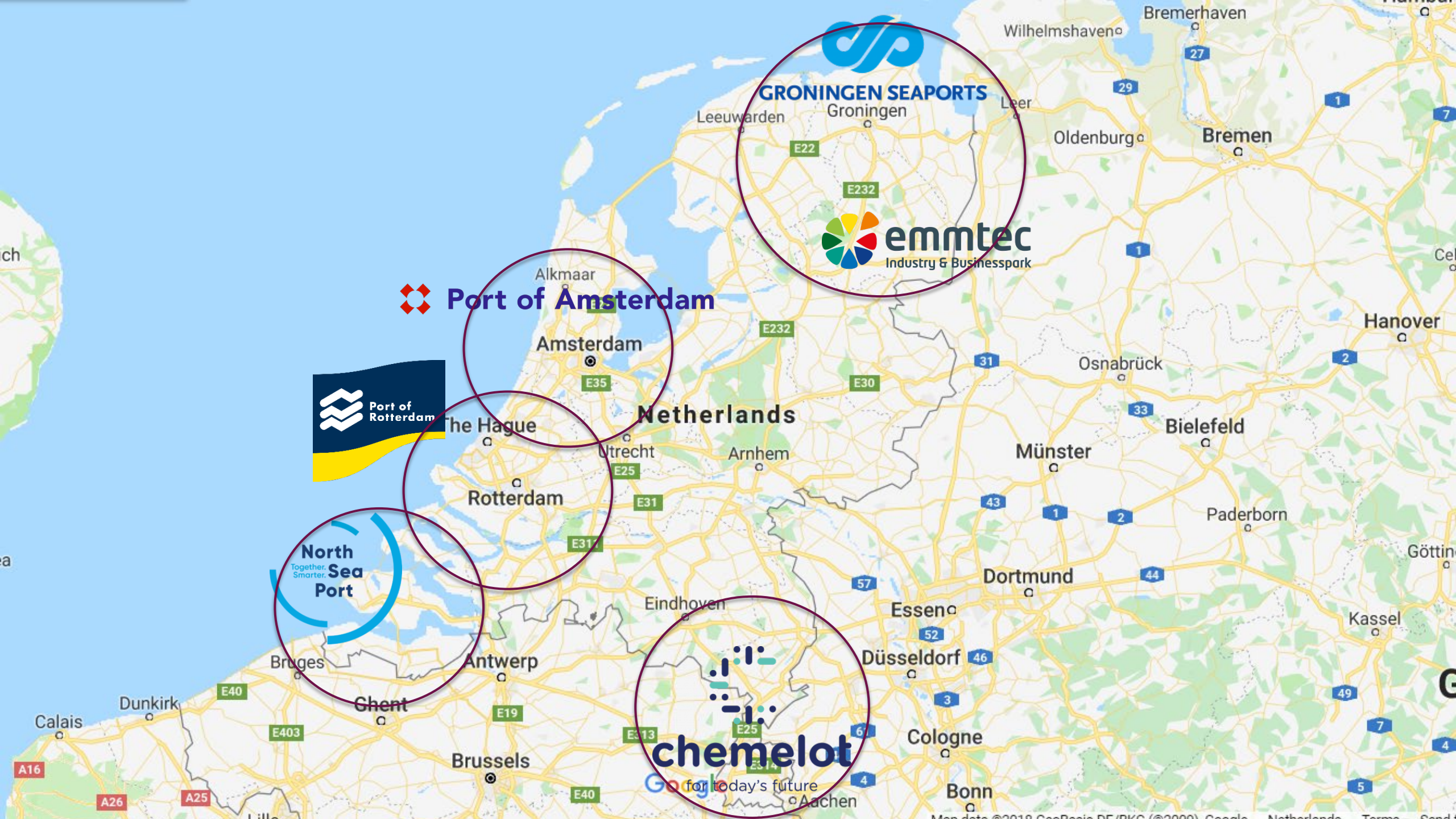


ZERO BRINE

ZERO BRINE Work Package 6 (Online Brine Platform – Application of the software for the case of the Netherlands)

- Online training sessions
 - Online Training for Industrial Cluster Authorities Towards Circularity and Industrial Symbiosis
 - Online Training for Companies: Towards Circularity and Industrial Symbiosis
- Capacity building (Circular Economy, Industrial Ecology, Industrial Symbiosis)
- Demonstration events
- Online Brine Platform (video, tutorial and questionnaire)





GRONINGEN SEAPORTS
Groningen



emmtec
Industry & Businesspark



Port of Amsterdam



Port of Rotterdam



North Sea Port
Together. Smarter.



chemelot
for today's future



ZERO BRINE

Demonstration events

- Five (5) workshops promote the OBP, increase capacity building and raise awareness about industrial symbiosis via a serious game:
 - Delfzijl/Emmen,
 - Amsterdam,
 - Chemelot,
 - Zeeland and
 - Rotterdam





ZERO BRINE

Online Brine Platform



Navigation bar with a hamburger menu icon on the left and notification, help, and user profile icons on the right.

- Dashboard
- My Role:
 - Waste Heat Provider
- Search
- Statistics/Metrics
- Messages (0)
- My Notes
- Announcements
- FAQ
- OBP Portal
- ZERO BRINE Project

Dashboard ZERO BRINE Platform / Dashboard

TOTAL USERS	MATCHES	EFFLUENTS	RECOVERED MATERIALS	REQUIRED MATERIALS	TECHNOLOGY PROVIDERS	WASTE HEAT PROVIDERS
2382	13	8	5	11	17	5

WELCOME TO THE OBP

The OBP is an innovative prototype platform in the domain of saline wastewater management aiming to promote resource efficiency and circular economy. The OBP is developed by [National Technical University of Athens](#) in the framework of **ZERO BRINE project**. The OBP aims to play a key role in replicating the paradigms generated in the framework of the ZERO BRINE project.

In the OBP, the brine streams generated by process industries (Brine Owners) as well as the raw materials (minerals) and the water streams used by these industries (Mineral/Water Users) will be mapped together with the available technologies (Technology Providers) and waste heat streams (Waste Heat Providers). Possible interactions between the industries across the value chain will be identified. Brine Owners and Mineral/Water Users could be automatically matched, by the OBP algorithm.

In addition to the OBP, a **web portal** is created to access specific information in the domain of saline waste water management. A collaboration tool (forum) is embedded to the portal in order to facilitate communication between key stakeholders.

ANNOUNCEMENTS

Welcome
Online Brine Platform is live!

INBOX



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Database with brine producers & minerals end-users

- Contains:
- Brine producers
 - Qualitative information: Cluster, sector, etc.
 - Quantitative information: chloride release, sulphates release, etc
- Minerals end-users:
 - Quality
 - Quantity

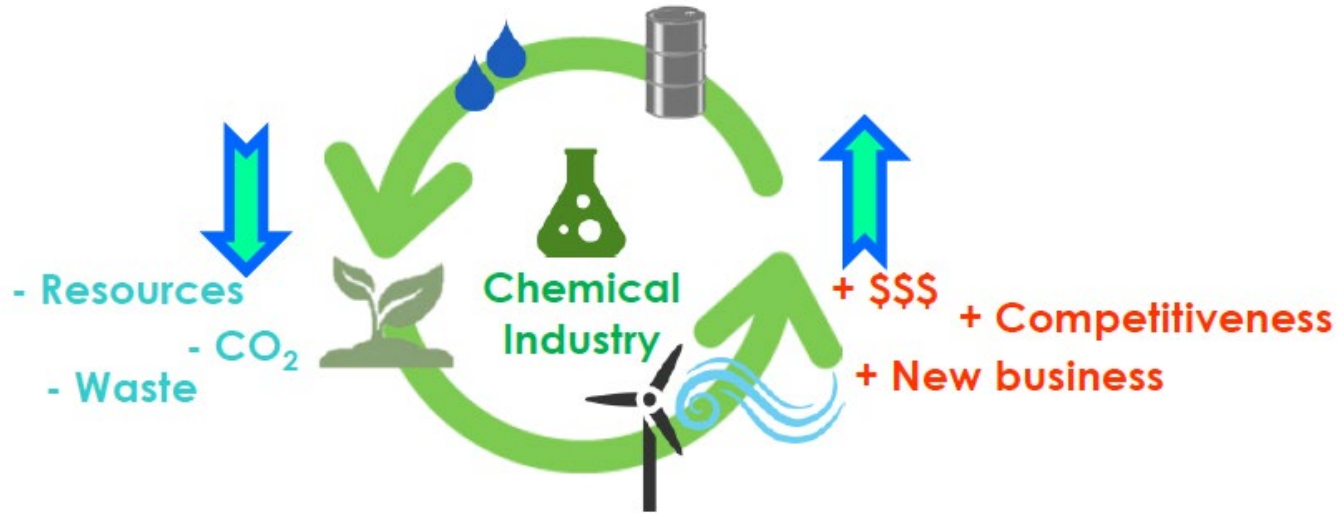
	A	B	C	D	E	F	G	H	I
	Company name	Cluster	Production	Sector	Amount of chloride (kta/year)	Amount of Sulphates (kta/year)	Total Organic Carbon (kg/year)	Total Nitrogen (kg/year)	Emitted to
1	Utilities & Other stakeholders important for the Cluster								
2	Utilities & Other stakeholders important for the Cluster								
3	Waternet: RWZI West	Amsterdam	Wastewater treatment plant	Water treatment	15.71	0.6264	817300	565000	Surface waters
4	Waternet: RWZI Westpoort	Amsterdam	Wastewater treatment plant	Water treatment	10.21	0.2486	394600	183300	Surface waters
5	A1	Amsterdam	The cluster operator	-	-	-	-	-	-
6	A2	Amsterdam	Online platform	-	-	-	-	-	-
7	Companies								
8	Afval Energie Bedrijf (AEB Amsterdam)	Amsterdam	Separation/Incineration of waste	Waste Processing	3.414	-	4227	1782	Surface waters
9	Albemarle Catalysts Company	Amsterdam	bromine, refining catalysts (for	Chemical	negligible	negligible	negligible	32880	Sewers
10	A3	Amsterdam	Road construction products	Construction	na	na	na	na	na
11	A4	Amsterdam	Bio-based chemicals + Catalysts	Chemical/R&D	na	na	na	na	na
12	A5	Amsterdam	Soy products, emulsifiers and other foodstuff	Food	na	na	na	na	na
13	A6	Amsterdam	Production of biodiesel from waste fats and oils	Chemical	na	na	na	na	na
14	Sonneborn Refined Products B.V.	Amsterdam	from base and petroleum oils	Chemical	0.03489	0.7567	10100	negligible	Surface waters
15	Cargill (Multiseed)	Amsterdam	Oilseed crushing facility	Food	0.07201	negligible	28970	1754	Load to sewers
16	Cargill (Soja)	Amsterdam	Soya processing	Food	0.02978	0.5105	na	7349	Load to sewers
17	Chemtura Netherlands BV (now Lanxess)	Amsterdam	Flame retardant and lubricant additives	-	0.09058	negligible	negligible	negligible	Load to sewers
18	ICL Fertilizers	Amsterdam	Fertilizer production	Chemical	0.02575	na	na	na	Load to sewers





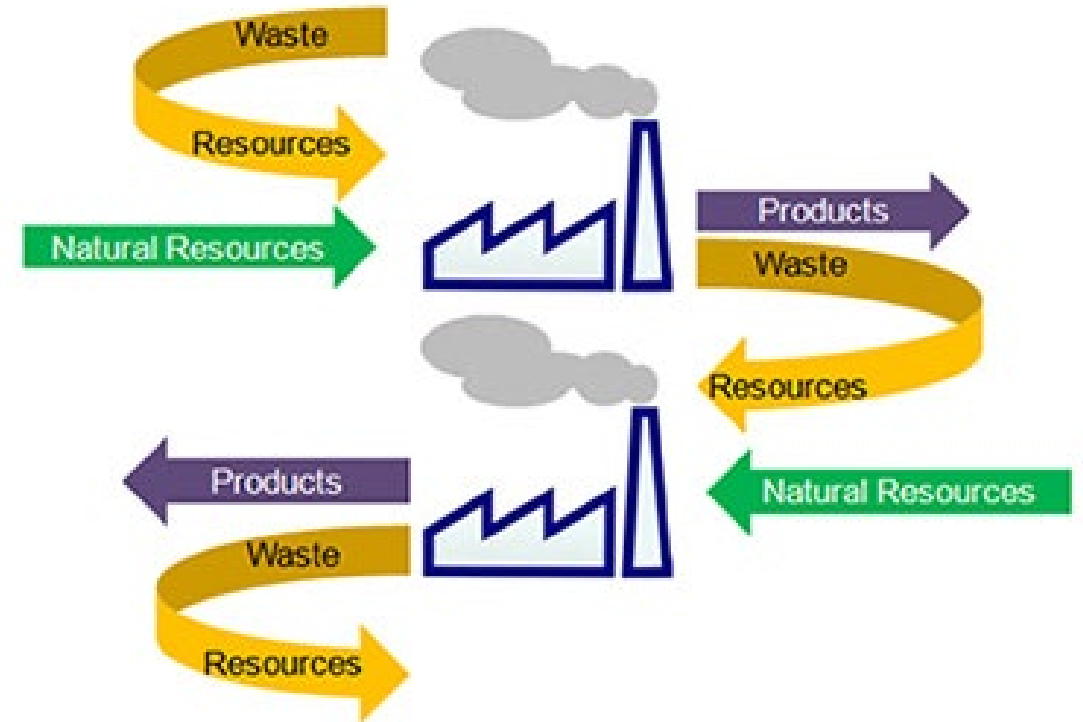
ZERO BRINE

Circular economy among companies = Industrial symbiosis



- + Economic benefits
- + Environmental benefits
- + Social benefits

- Lack of cooperation among industries
- Lack of trust among industries
- Lack of information sharing





ZERO BRINE

Questions?



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Process Technology**

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www.zerobrine.eu



[#ZeroBrine](https://twitter.com/ZeroBrine)

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Thank you



ZERO BRINE



@ZERO_BRINE_



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COFFEE BREAK

11:30-11:45