ZERO BRINE

Creating Acceptance for Circularity

22 & 29 September 2021

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 893924.

Agenda

15:00 – **Welcome** – Kees Roest

15:10 – **Introduction** to the structure of the ZERO BRINE project – Gijsbert Korevaar

15:20 – **Videos** of the ZERO BRINE pilot plants in Poland and Spain

15:30 – **Social acceptance discussion** between participants and researchers from the Consortium – led by Patricia Osseweijer

- A business model perspective – Giulia Calabretta
- Inputs from integrated sustainability assessment – Gijsbert Korevaar

16:25 – **Wrap up**, closing words – Kees Roest

PLEASE NOTE – This webinar will be recorded.

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Speakers

Kees Roest (Moderator)

Programme Director - ISPT

Dr. Gijsbert Korevaar

Assistant Professor of Industrial Symbiosis – TU Delft

Dr. Giulia Calabretta

Associate Professor of Strategic Value of Design – TU Delft

Patricia Osseweijer

Biotechnology and Society Section Lead – TU Delft

Polish Pilot

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Spanish Pilot

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Quality Standards

Dr. Gijsbert Korevaar

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My background

- Chemical Engineering design research
- Industrial Ecology education development
- Industrial Symbiosis projects and research
- Circular Economy education and research

- Faculty of Technology, Policy and Management
- Department of Engineering Services and Systems
- Energy and Industry section

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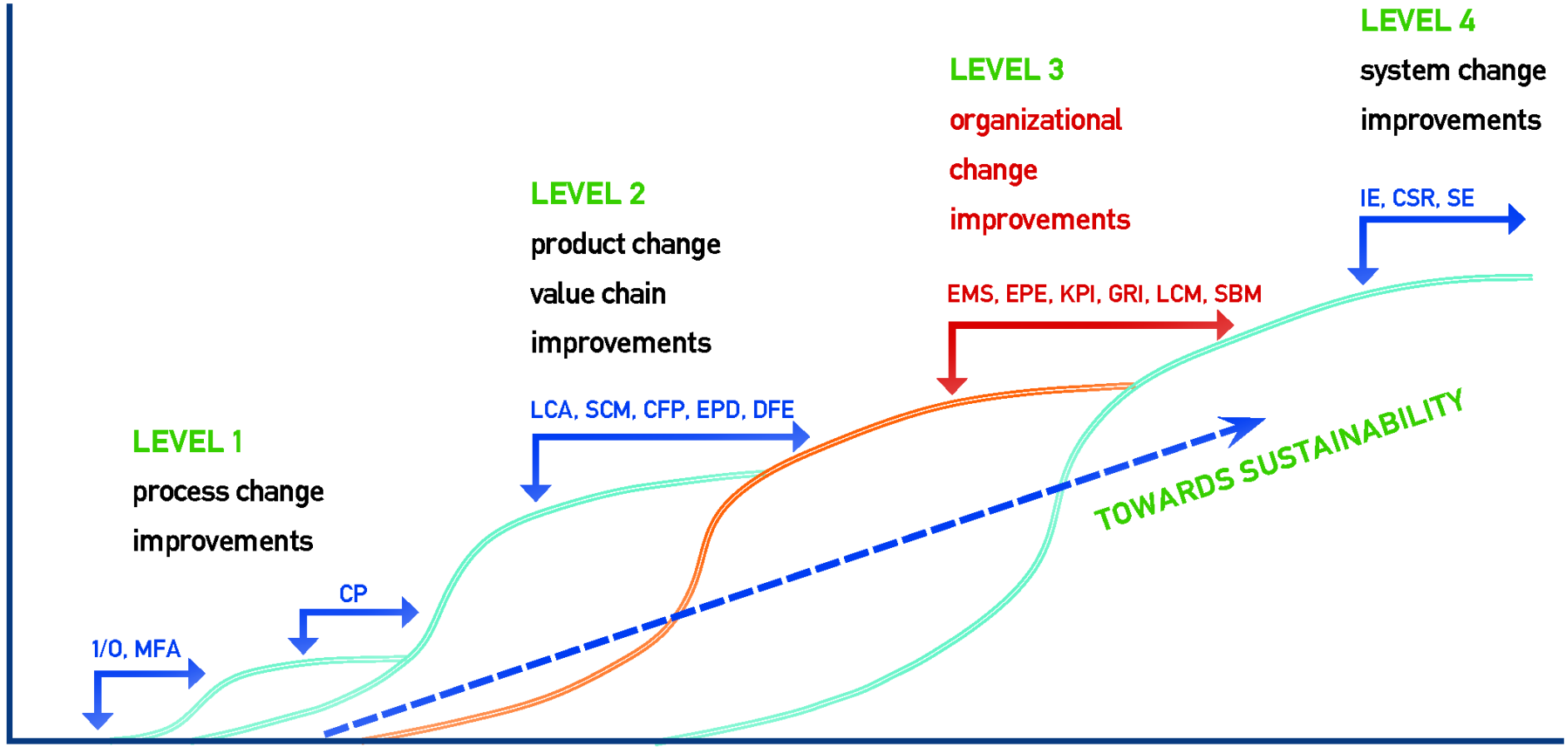
Level 4: system change improvements



Industrial Symbiosis – main topics

Industrial - resources, production, transport, waste treatment

- Symbiosis … linked together with a mutual benefit

- What is needed:
- Process Intensification
- Innovative (Bio)-Chemical Routes
- Design Value Chains and Supply Chains as Closed Loops
- Smart Infrastructures
- Sufficient Diversity
- Organisational Embedding
- Evaluation and Management of Sustainability Performance

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INDUSTRIAL ECOLOGY

Discipline that uses ecological principles in order to analyze and design industrial systems and to reduce their impact on the environment.

Eco-industrial park

Community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials.

Industrial symbiosis

Dynamic process based on the interaction of separate businesses entities that create a cooperative network to achieve competitive advantage by physical exchange of materials, energy, water, and/or by-products as well as services and infrastructures.

Industrial symbiosis dynamics

Ways in which an industrial symbiosis is generated and structured from a technical and organizational point of view.

Technical dynamics

- Process oriented
- Residue oriented
- Place oriented

Organizational dynamics

- Anchor manufacturer
- Eco-cluster development
- Government planning
- Business incubator

CIRCULAR ECONOMY

Industrial system that is restorative or regenerative by intention and design.

Circular economy principles

1. Design out waste/Design for reuse
2. Build resilience through diversity
3. Rely on energy from renewable sources
4. Waste is food/Think in cascades/Share values
5. Think in systems

Circular economy strategic framework

1. Narrowing resource loops
2. Slowing resource loops
3. Closing resource loops

\+

A. Technical innovation
B. Business model innovation
C. Collaboration

Circular business models

Disruptive business models aiming to drive the sustainability of a business network through the circular strategies, linking up material flows, using resources most efficiently and ideally eliminating waste.

Dematerialization (1. Avoid)	**Produce on demand** (1. Avoid)	**Remanufacturing** (2. Replace)	**Refurbishing** (2. Replace)
Upgrading (2. Replace)	**Hybrid model** (3. Reduce)	**Industrial symbiosis** (3. Reduce)	**Collection service** (4. Reuse)
Collaborative consumption (4. Reuse)		**Performance model** (4. Reuse)	**Closed loop recycling** (5. Recycle)
Downcycling (5. Recycle)	**Upcycling** (5. Recycle)	**Energy recovery** (6. Recover)	

Key concepts for Quality indicators

1. Environmental and economic assessments
2. Life Cycle Sustainability Assessment
3. Ecological impacts from brine discharge
4. Policy review and assessment

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Table 2. Recovered materials by the four locations of ZERO BRINE

Recovered material	CAS no.	Source of waste water	Location	Potential end-markets (professional use)
$Ca(OH)_2$	1305-62-0	Chemical industry, Silica industry	The Netherlands and Spain	This substance is used in the following areas: building & construction work, municipal supply (e.g. electricity, steam, gas, water) and sewage treatment, agriculture, forestry and fishing, formulation of mixtures and/or re-packaging, health services, printing and recorded media reproduction and scientific research and development. This substance is used for the manufacture of: mineral products (e.g. plasters, cement), wood and wood products, textile, leather or fur, rubber products, plastic products, machinery and vehicles, electrical, electronic and optical equipment, pulp, paper and paper products and furniture.
$Mg(OH)_2$	1309-42-8	Chemical industry, Coal mine industry, Textile industry, Silica industry	The Netherlands, Poland, Turkey, Spain	This substance is used in the following products: lubricants and greases, anti-freeze products, coating products, polishes and waxes, adhesives and sealants, polymers and fillers, putties, plasters, modelling clay. This substance is used in the following areas: building & construction work, agriculture, forestry and fishing, mining and formulation of mixtures and/or re-packaging. This substance is used for the manufacture of: chemicals, plastic products, textile, leather or fur, pulp, paper and paper products and machinery and vehicles.
Na_2SO_4	7757-82-6	Chemical industry, Silica industry	The Netherlands and Spain	This substance is used in the following products: plant protection products, textile treatment products and dyes, washing & cleaning products, cosmetics and personal care products and fertilisers. This substance is used in the following areas: agriculture, forestry and fishing, printing and recorded media reproduction and mining. This substance is used for the manufacture of: chemicals, textile, leather or fur, pulp, paper and paper products and food products.

Recovered material	CAS no.	Source of waste water	Location	Potential end-markets (professional use)
$CaSO_4$	7778-18-9	Coal mine industry and Textile industry	Poland and Turkey	This substance is used in the following products: fertilisers. This substance is used in the following areas: agriculture, forestry and fishing, mining, building & construction work and formulation of mixtures and/or re-packaging. This substance is used for the manufacture of: chemicals, mineral products (e.g. plasters, cement), pulp, paper and paper products and wood and wood products.
NaCl (both solution and salt)	7647-14-5	Chemical industry, Coal mine industry, Textile industry	The Netherlands, Poland, Turkey	This substance is used in the following products: pH regulators and water treatment products, fertilisers, water treatment chemicals, anti-freeze products, textile treatment products and dyes, laboratory chemicals, cosmetics and personal care products, inks and toners and paper chemicals and dyes. This substance is used in the following areas: agriculture, forestry and fishing, building & construction work, scientific research and development, printing and recorded media reproduction and health services. This substance is used for the manufacture of: textile, leather or fur, wood and wood products and food products.
Demineralised water		Chemical industry	The Netherlands	Can be used in the neighbouring chemical production as ultra-pure water.

Quality standard development

Deliverable Number	Deliverable Title	WP number	Type	Dissemination level
D7.1	Report on the unified approach of the environmental and economic assessments	WP7	Report	Public
D7.6	Report on the LCSAresults	WP7	Report	Public
D9.1	Report on environmental impactsfrom brine discharge	WP9	Report	Public
D9.2	Report on policy review and assessment / suggestions for BREF update	WP9	Report	Public

Keep in touch

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Social Acceptance Discussion

Led by Patricia Osseweijer

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Designing a circular business model for ZERO BRINE in Botlek

Dr. Giulia Calabretta

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The team: TU Delft Industrial Design Engineering

Dr. Giulia Calabretta

Prof. Nancy Bocken

Prof. Erik Jan Hultink

Dr. Brian Baldassarre

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Our approach: Experimentation

Circular business model experimentation entails defining an initial circular business model idea, and then iteratively refining it over time in collaboration with key stakeholders, to find an overlap between their different goals, economic and environmental benefits

- Co-design tool
- Co-design activities

(Baldassarre et al., 2020; Bocken et al., 2018; Konietzko et al., 2020)

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A circular business model for the Botlek area

business model a conceptual construct	=	**value proposition** what does the consortium make and sell to whom	+	**value creation** how does the consortium make it and with whom	+	**value delivery** how does the consortium reach the clients and deal with them	+	**value capture** where are the costs and how does the consortium make money

Business Models, Business Strategy and Innovation
David Teece, 2010

CIRCULAR BUSINESS MODEL for the Zero Brine demonstration in Botlek

Created by Brian Baldassarre
TUDelft

ZERO BRINE

WHAT IS THE IDEA?

What do you offer?
Who will use it/buy it?
Why will they use it/buy it?

WHAT IS THE IMPACT?

Why is it circular?
How do you measure it?

HOW DO WE PROFIT?

What are the costs?
What are the revenues?

HOW DOES IT WORK?

How does the business operate?

Time

HOW DO WE MAKE IT HAPPEN?

Which stakeholder is involved?
What does it do?
What does it get out of it?
What can go wrong?

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What do you offer?
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A modular solution for treating industrial wastewater (brines) while recovering valuable resources from it.

For companies discharging brines in the port of Rotterdam

Benefits:
- Reducing taxes and/or underlying costs for treating brines.
- Recovering clean water.
- Recovering resources to resell our reuse.

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Brine Center to run small-scale experiments for the client

If experiment is successful, full scale implementation

Collaboration in the assembling and installation

2 options:
- Build, Own, Operate and Transfer
- Service based/leasing

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ZB partners provide the technological modules

One ZB partner should lead the operational and managerial part

ZB partners provide the waste heat

ZB partners provide locations for Brine Excellence Centers

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WHAT IS THE IMPACT?

- Closing the loop of resources
- Cleaning and reusing wastewater
- Reducing the discharged brines
- Energy efficiency

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HOW DO WE PROFIT?

Costs:
- Financing the feasibility study
- Financing the installation

Revenues:
- Feasibility study (?)
- Full implementation

	IMPLEMENTATION BARRIERS			
	Cultural barriers	**Regulatory barriers**	**Economic barriers**	**Technical barriers**
Circular value proposition	Reactive approach to innovation	Unfavorable waste disposal regulations	Lack of a solid business case	Rebound effects
Circular value creation	Limited willingness to collaborate Explorative vs. exploitative mindsets	Issues with intellectual property rights	-	Low technology readiness level
Circular value delivery	-	-	-	Limited availability of necessary infrastructure Risk of damaging current infrastructure Energy efficiency issues
Circular value capture	-	-	Low price of virgin resources Unwarranted quality of recovered resources Limited volumes of recovered resources Increase of operational costs due to the new technology use Inability or unwillingness to cover initial investment	Reusing equipment within the service-based revenue model

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Lessons learned for achieving acceptance

- New circular business model opportunities:
  - Magnesium recovery
  - Brine Excellence Centers
- A granular and detailed understanding of stakeholders and barriers
- Unbalanced focus on technological discussion
- A need for deeper embedment of the business model discussion
- Taking responsibility for leading the business model discussion

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Led by Patricia Osseweijer

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Thank you for your attention

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