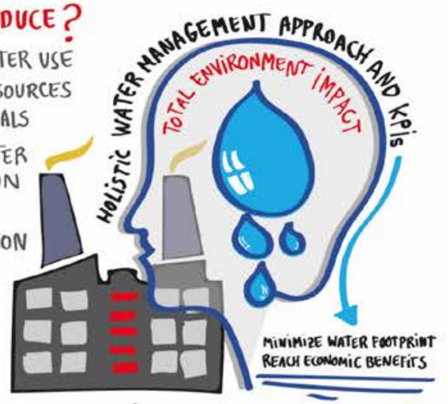
JOIN US TO LEARN MORE ABOUT:

INNOVATIONS & SUSTAINABLE SOLUTIONS

for FUTURE FRESH WATER saving

HOW TO REDUCE?

- → FRESH WATER USE
- → USE OF RESOURCES & CHEMICALS
- → WASTEWATER PRODUCTION
- → ENERGY CONSUMPTION



INSPIRE WATER

Spot View

www.inspirewater.eu

www.spotview.eu

Cross cutting issue conference

Holistic approaches for water and resource efficiency in process industry

25 – 26 March 2020

PLEASE REGISTER FOR FREE AT:

https://online.cme24.de/index.php?id=1191

Horizon 2020 European Union Funding for Research & Innovation

SPIRE Sustainable Process Industry through Resource and Energy Efficiency

WEDNESDAY 25.03.2020

10:30 AM → 3:30 PM CET

09:30	Web conference room is open
10:30	Start of the conference program
	Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)
10:30	Welcome *DECHEMA and CTP*
10:40	Welcome and introduction from SPIRE *Angels Orduna (SPIRE)*
10:45	Introduction of INSPIREWATER and SPOTVIEW *Staffan Filipsson (IVL), Eric Fourest (CTP)*
11:00	KEYNOTE: Challenges for the chemical industry – creating the next level of sustainable water usage *Niels Groot (Dow Benelux B.V.)*
11:10	KEYNOTE: Water and Resource efficiency in the Steel Industry: current challenges and new solutions under an ecosystem perspective *Sophie Carler (Jernkontoret)*
11:20	KEYNOTE: Water and Resource efficiency in the Pulp and Paper Industry: situation and new challenges with digitalisation *Jori Ringman (Confederation of European Paper Industries)*
11:30	KEYNOTE: Recent development in EU Water Policy *Bettina Doeser, Head of Clean Water Unit, European Commission*
11:40	PANEL DISCUSSION: Challenges for Water Management in Industry *Moderator: Brian Maguire (EBX MEDIA)* *Participants: Niels Groot (Dow Benelux B.V.), Sophie Carler (Jernkontoret), Jori Ringman (CEPI), Bettina Doeser (EC), Angels Orduna (SPIRE)*
12:15	Lunch break
13:15	Innovative and sustainable solutions in the steel industry – new developments in water management (INSPIREWATER/SPOTVIEW) *Martin Hubrich, VDEh-Betriebsforschungsinstitut (BFI), Elena Piedra Fernández, Beatriz Padilla Vivas (ArcelorMittal)*
13:30	Innovative and sustainable solutions in the steel industry – recovery of acids (INSPIREWATER) *Andreas Rosberg (Sandvik), Fredrik Hedman (IVL)*
13:45	New strategies and technologies for process water recycling in tissue paper industry (SPOTVIEW) *Antti Grönroos (VTT), Jenni Vaino (Essity), Pasi Nurminen (Valmet), Lotta Sorsamäki (VTT)*
14:00	New strategies for effluent reuse in packaging paper industry (SPOTVIEW) *Stéphanie Prasse (Centre Technique du Papier), Serge Andres (Saica EL)*
14:15	Coffee break
14:45	Improved technology solutions in the chemical industry (INSPIREWATER) *Jozef Kochan, Friedhelm Zorn (Clariant)*
15:00	Innovative and sustainable solutions in the dairy industry (SPOTVIEW) *Anastasios Karabelas, Dimitris Sioutopoulos (CERTH), Konstantinos Georgakidis (MEVGAL)*
15:15	Resource recovery from industrial waste water by cutting edge membrane technologies – Outcomes of the ReWaCEM project *Daniel Winter (Fraunhofer Institute for Solar Energy Systems ISE)*
15:30	End of the first day

THURSDAY 26.03.2020

09:00 AM → 12:30 PM CET

08:30	Web conference room is open
09:00	Wrap-up Day 1 *Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)*
09:10	KEYNOTE: The Energy Footprint of Water Treatment *Joachim Koschikowski (Fraunhofer Institute for Solar Energy Systems ISE)*
09:20	KEYNOTE: Water Footprint, financing industrial water through Blue Bonds *Jaap Feil (iWater – Water Footprint Implementation)*
09:30	KEYNOTE: The Value of Water *Gonzalo Delacamara (IMDEA Agua)*
09:40	PANEL DISCUSSION: How to save costs with water in industry? *Moderator: Brian Maguire (EBX MEDIA)* *Participants: Joachim Koschikowski (Fraunhofer ISE), Jaap Feil (iWater), Gonzalo Delacamara (IMDEA Agua)*
10:15	Coffee break
10:45	Holistic water management (INSPIREWATER) *Agata Andersson, Henrik Kloo (IVL)*
11:00	Environmental impacts of water optimization strategies developed within SPOTVIEW *Eiorri Igos (LIST)*
11:15	Environmental and economic assessment of INSPIREWATER solutions for resource recovery in process industries *Fredy Dinkel (FHNW)*
11:30	Next steps towards creating sustainable impact through business exploitation (INSPIREWATER/SPOTVIEW) *Presentation of the exploitation opportunities of both projects by PDC and IMCG*
11:45	Opportunities and challenges to implement new innovative technologies into existing industrial environments (INSPIREWATER/SPOTVIEW) *Panel discussion moderated by PDC/IMCG. Interactive session with technology providers and end users from both projects*
12:15	Wrap-up and some closing words
12:30	End of the conference

@dibuzpia DIBUZPIA

INSPIRE WATER SpotView

PROGRAMME — WEDNESDAY, 25 MARCH 2020

09:30 Web conference room is open

10:30 Start of the conference program
Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)

10:30 Welcome
DECHEMA and CTP

10:40 Welcome and introduction from SPIRE
Angels Orduna (SPIRE)

10:45 Introduction of INSPIREWATER and SPOTVIEW
Staffan Filipsson (IVL), Eric Fourest (CTP)

11:00 KEYNOTE: Challenges for the chemical industry – creating the next level of sustainable water usage
Niels Groot (Dow Benelux B.V.)

11:10 KEYNOTE: Water and Resource efficiency in the Steel Industry: current challenges and new solutions under an ecosystem perspective
Sophie Carler (Jerncontoret)

11:20 KEYNOTE: Water and Resource efficiency in the Pulp and Paper Industry: situation and new challenges with digitalisation
Jori Ringman (Confederation of European Paper Industries)

11:30 KEYNOTE: Recent development in EU Water Policy
Bettina Doeser, Head of Clean Water Unit, European Commission

11:40 PANEL DISCUSSION: Challenges for Water Management in Industry
Moderator: Brian Maguire (EBX MEDIA)
Participants: Niels Groot (Dow Benelux B.V.), Sophie Carler (Jerncontoret), Jori Ringman (CEPI), Bettina Doeser (EC), Angels Orduna (SPIRE)

12:15 Lunch break

13:15 Innovative and sustainable solutions in the steel industry – new developments in water management (INSPIREWATER/SPOTVIEW)
Martin Hubrich, VDEh-Betriebsforschungsinstitut (BFI), Elena Piedra Fernández, Beatriz Padilla Vivas (ArcelorMittal)

13:30 Innovative and sustainable solutions in the steel industry – recovery of acids (INSPIREWATER)
Andreas Rosberg (Sandvik), Fredrik Hedman (IVL)

13:45 New strategies and technologies for process water recycling in tissue paper industry (SPOTVIEW)
Antti Grönroos (VTT), Jenni Vaino (Essity), Pasi Nurminen (Valmet), Lotta Sorsamäki (VTT)

14:00 New strategies for effluent reuse in packaging paper industry (SPOTVIEW)
Stéphanie Prasse (Centre Technique du Papier), Serge Andres (Saica EL)

14:15 Coffee break

14:45 Improved technology solutions in the chemical industry (INSPIREWATER)
Jozef Kochan, Friedhelm Zorn (Clariant)

15:00 Innovative and sustainable solutions in the dairy industry (SPOTVIEW)
Anastasios Karabelas, Dimitris Sioutopoulos (CERTH), Konstantinos Georgakidis (MEVGAL)

15:15 Resource recovery from industrial waste water by cutting edge membrane technologies – Outcomes of the ReWaCEM project
Daniel Winter (Fraunhofer Institute for Solar Energy Systems ISE)

15:30 End of the first day

THURSDAY, 26 MARCH 2020 — PROGRAMME

08:30 Web conference room is open

09:00 Wrap-up Day 1
Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)

09:10 KEYNOTE: The Energy Footprint of Water Treatment
Joachim Koschikowski (Fraunhofer Institute for Solar Energy Systems ISE)

09:20 KEYNOTE: Water Footprint, financing industrial water through Blue Bonds
Jaap Feil (iWater – Water Footprint Implementation)

09:30 KEYNOTE: The Value of Water
Thomas Track (DECHEMA e.V.)

09:40 PANEL DISCUSSION: How to save costs with water in industry?
Moderator: Brian Maguire (EBX MEDIA)
Participants: Joachim Koschikowski (Fraunhofer ISE), Jaap Feil (iWater), Thomas Track (DECHEMA e.V.)

10:15 Coffee break

10:45 Holistic water management (INSPIREWATER)
Agata Andersson, Henrik Kloo (IVL)

11:00 Environmental impacts of water optimization strategies developed within SPOTVIEW
Elorri Igos (LIST)

11:15 Environmental and economic assessment of INSPIREWATER solutions for resource recovery in process industries
Fredy Dinkel (FHNW)

11:30 Next steps towards creating sustainable impact through business exploitation (INSPIREWATER/SPOTVIEW)
Presentation of the exploitation opportunities of both projects by PDC and IMCG

11:45 Opportunities and challenges to implement new innovative technologies into existing industrial environments (INSPIREWATER/SPOTVIEW)
Panel discussion moderated by PDC/IMCG. Interactive session with technology providers and end users from both projects

12:15 Wrap-up and some closing words

12:30 End of the conference

www.inspirewater.eu / www.spotview.eu

SPIRE 2050
Climate Neutral and Circular EU Process Industry
(P4Planet)

Àngels Orduña Cao
Executive Director
A.SPIRE

Cross-cutting issue conference (INSPIREWATER + SPOTVIEW):

Holistic approaches for water and resource efficiency in process industry

On line, 25 March 2020

SPIRE 2050 Ambitions: our share to the EU Green Deal

SPIRE
Sustainable Process Industry through Resource and Energy Efficiency

Closing the climate technological gap

Development of the required solutions to fully contribute to the EU Climate Neutrality scenarios

2015
-37% in $CO_{2éq}$ emissions versus 1990

2030
key technologies of SPIRE Vision 2050 ready for deployment (TRL9)

2050
Net-zero CO2 emissions

Scale-up Circular Resources for zero-landfilling

Spread the Hubs for Circularity across Europe to develop the required solutions to **move towards zero-waste-to-landfill and near zero-water discharge**.

2030
key technologies of SPIRE Vision 2050 ready for deployment (TRL9)

2050
ZERO landfilling of recyclable / recoverable waste in the EU

Global competitiveness

Development of technologies which create new investment opportunities for globally competitive EU Process Industries

Average growth in Gross Value Added of SPIRE sectors over the period 2021-2050 above average GDP growth in the European Union

2021
Kick-off Horizon Europe

2030
key technologies of SPIRE Vision 2050 ready for deployment (TRL9)

2050

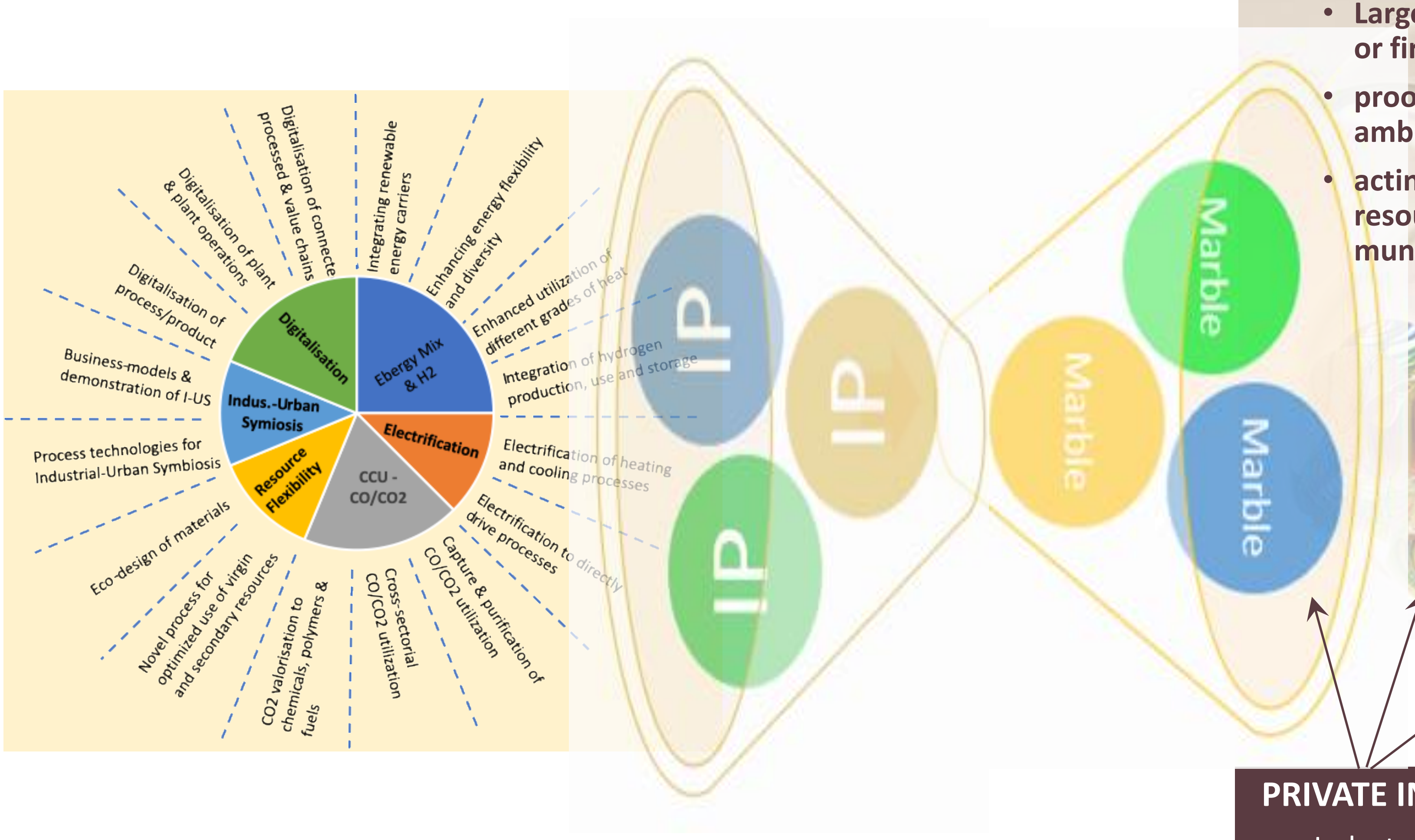
SPIRE 2050 FUNNEL towards first-deployment

Sustainable Process Industry through Resource and Energy Efficiency

14 Innovation Areas

36 Innovation Programmes

The "Marbles"



- Large-scale demonstrators, pilot or first-of-a-kind plants
- proof the feasibility of highly ambitious CO2 abatement plants
- acting as Hubs of bulk amounts of resources from industry and the municipalities.

PRIVATE INVESTMENTS

- Industry commitment
- When technical and economic feasibility is proved
- Public support needed to de-risk

WATER IN PROCESS4PLANET 2050 ROADMAP

SPIRE
Sustainable Process Industry through Resource and Energy Efficiency

Towards near zero wastewater discharge by 2050:
Enabling increased/full recycling of wastewater and its components

DEDICATED IP: A-10.d Wastewater Valorisation

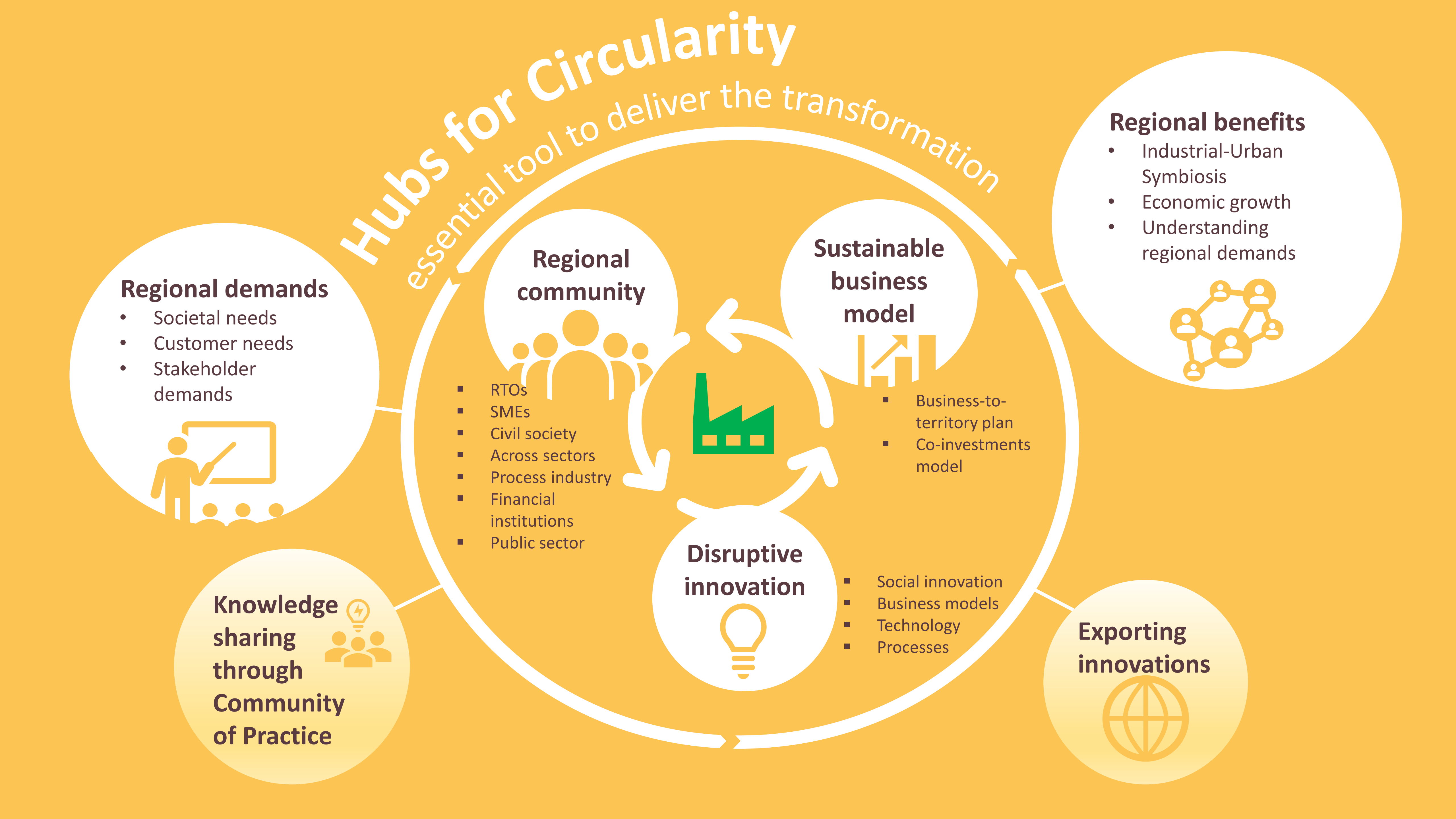
- **Separation technologies for the water components**, captured in innovative, energy-efficient and cost-efficient manners
- **Increased valorisation of solutes from wastewater treatment**. Ambition: 25% of the solutes recovered from wastewater by 2030 and 100% by 2050. Including innovative conversion technologies and modular solutions.
- **Increase valorisation of solids from wastewater treatments into new materials or recovery for energy production:** cellulose toilet paper, recovery of biopolymers, photocatalytic techs, etc…
- **Optimise recovery of the energy value in wastewater**; optimal cascading of wastewater streams, electrodialysis technology (co-digestion of organic municipal waste, biogas technologies, low temperature heat systems, reductive processes…)
- **Develop optimised wastewater treatment for freshwater substitution**. Ambition: 40% acquisition of fresh water in 2030 and full recycling of water by 2050
- **Develop alternative processes with reduced water use** (cooling water systems, solid state fermentation processes)
- **Improve sensors and monitoring of water quality** for fast (semi) automatic decision making and reliable prediction
- Develop robotics for inspection and maintenance in water systems

Estimated investment level needed:

€1,7 bn

Building on the results of:

- **INSPIRE WATER**: (water recycling systems to TRL7)
- **SPOTVIEW** (techs to reduce freshwater intake for pulp and paper and steel industry)


Hubs for Circularity
essential tool to deliver the transformation
Regional demands
• Societal needs
• Customer needs
• Stakeholder demands
Regional community
▪ RTOs
▪ SMEs
▪ Civil society
▪ Across sectors
▪ Process industry
▪ Financial institutions
▪ Public sector
Sustainable business model
▪ Business-to-territory plan
▪ Co-investments model
Disruptive innovation
▪ Social innovation
▪ Business models
▪ Technology
▪ Processes
Regional benefits
• Industrial-Urban Symbiosis
• Economic growth
• Understanding regional demands
Knowledge sharing through Community of Practice
Exporting innovations

WHY JOIN A.SPIRE

Sustainable Process Industry through Resource and Energy Efficiency

Teaming up to address the challenges of Climate Change, Circular Economy and Competitiveness together

LARGER INDUSTRIES:

- Continuous dialogue on R&I across SPIRE sectors and beyond
- Channel to raise your voice on R&I for HEU & other programmes
- Access to a pool of knowledge & talent (in Universities, research centres….)
- Direct access to SME providers
- Collaboration with the innovation ecosystem and value chain
- Access to developments by other projects, SMEs, universities…
- Protection of intellectual property
- Dialogue with the EC, MS, regions, MePs & other stakeholders

Further benefits to other members

SMEs:

- Direct Access to growth opportunities
- Direct Access to new markets
- Direct Access to large industry customers

RTOs, NGOs Innovation agencies et al.:

- Direct Access to applied innovation
- Link to deliver impact to society and regions
- Collaboration for disruptive innovations

A.SPIRE upcoming events / meetings 2020

- **23 January:** A.SPIRE at Public Hearing on Partnerships at the European Parliament – Brussels/Belgium
- **March**
  - Roadmap shared with members
  - Board Meeting + IRIAG Meeting
- **March to June:**
  - Webinars on Added Value for membership
  - Webinars to develop the first topics of Horizon Europe (only for members)
  - On line dialogues with regions & relevant stakeholders on the H4C
- **May:** BoD meeting + IRIAG meeting + Meeting with DG R&I
- **24 June 2020: A.SPIRE General Assembly, Brussels + SET PLAN Networking event (tbc)**
- **Sept- Oct** (date tbc): Topics workshop in Brussels or on line (only for members)
- **27-28 October**: INDTECH – Mainz/Germany + side event / meeting on H4C & German Presidency
- **November: BoD** meeting in Poland (tbc) + side Processes4Planet event (tbc)
- **Oct- Dec 2020: Signature of new SPIRE MoU** + BoD meeting
- **Nov. – Dec 2020**, Brussels: **launch of Processes4Planet partnership + SPIRE projects day** (date tbc)

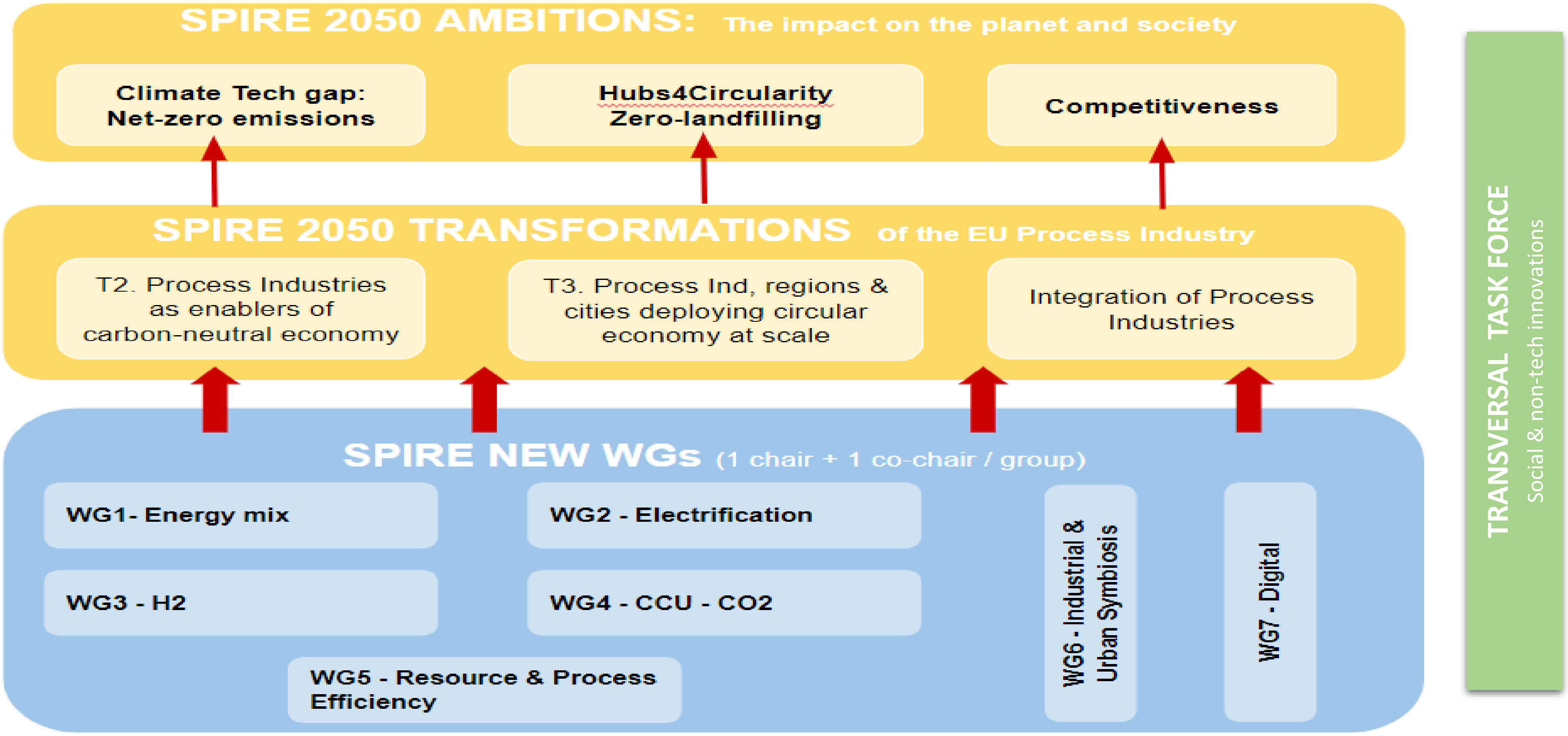
MAIN ACTIONS ALONG 2020:

- **Review and update of roadmap** (with members and new sectors in A.SPIRE)
- Preparation of Guidance Document (how the new Partnership will work
  - April 2020: members consultation + open consultation
- **Preparation of the first set of Processes4Planet topics for the first Work Programme of HORIZON EUROPE**
  - March – April: First list proposal (Advisory Group – IRIAG)
  - May – June: Second draft proposal discussed with the European Commission (Partnership Board / IRIAG)
  - Working Groups and IRIAG develop the topics content further + Discussions with the EC, MS and relevant regions
  - Sept- Oct: Topics workshop in Brussels or on line (date tbc)
- **A.SPIRE contributes to SET PLAN #6 new Implementation Plan**
  - IRIAG and WGs to develop proposals of content

SPIRE 2050 ROADMAP – NEW WGs

BE PART OF IT: JOIN US TO DEFINE THE FIRST TOPICS OF HORIZON EUROPE

Sustainable Process Industry through Resource and Energy Efficiency



CONTACT OUR EXECUTIVE DIRECTOR:

aor@spire2030.eu

www.spire2030.eu

SPIRE

Sustainable Process Industry through Resource and Energy Efficiency

Connected across borders and to citizens

A very brief introduction to:

INSPIRE WATER

Innovative **S**olutions in the **P**rocess **I**ndustry for next generation **R**esource **E**fficient **Water** management

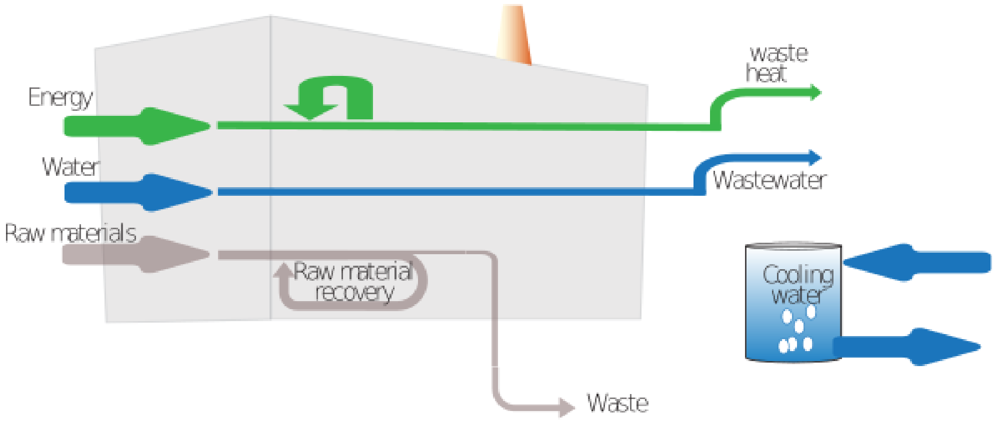
staffan.filipsson@ivl.se
agata.andersson@ivl.se

ivl
Swedish Environmental Research Institute

What was INSPIREWATER about?

Supporting the transformation of water management from linear…

Steel industry



Chemical industry

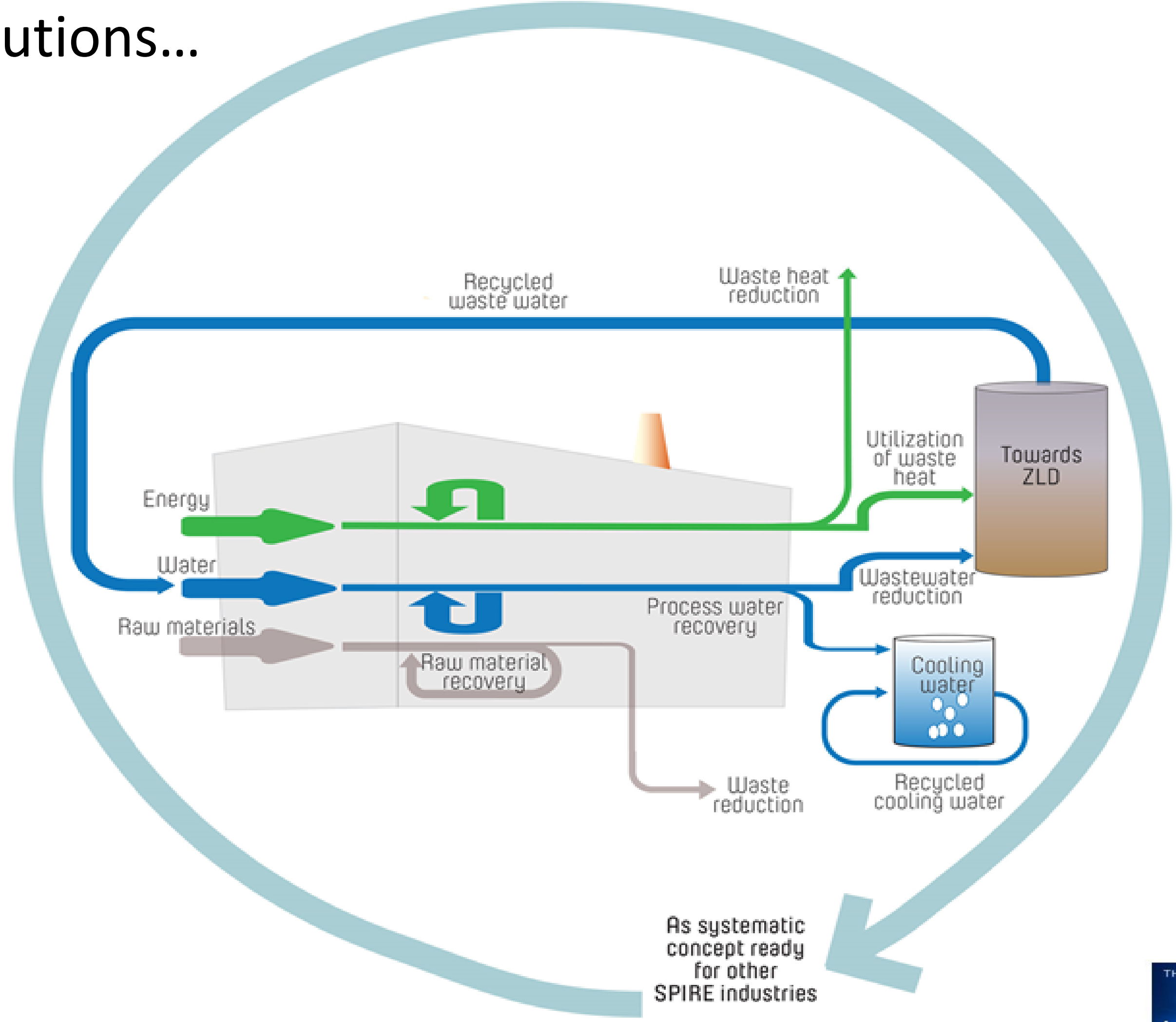
Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

What was INSPIREWATER about?

...to more circular solutions...

Steel industry



Chemical industry

Swedish Environmental Research Institute

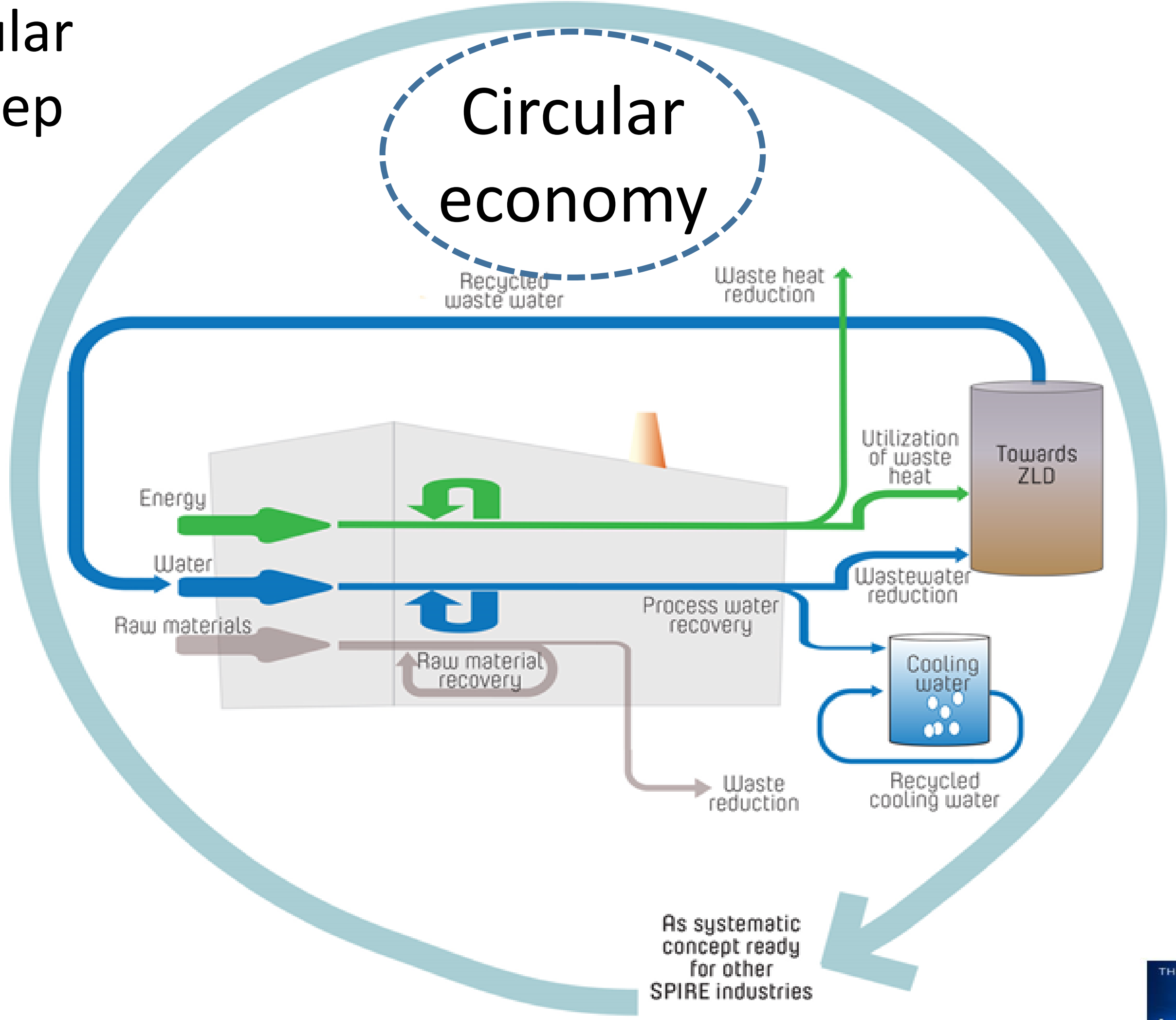
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

What was INSPIREWATER about?

INSPIRE WATER

...that helps the circular economy to take a step towards reality

Steel industry



Chemical industry

Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

Background and insights

…that lead us to the INSPIREWATER approach:

- It is crucial for industry to develop efficient water technologies
- Water use is closely linked to energy, chemicals and raw materials
- Process-integrated systems could:
  - minimize: Waste and wastewater volumes
  - maximize: Recovery of valuable materials including water
- A holistic approach is needed to avoid sub-optimisation

Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION HORIZON 2020

The aim

…of INSPIREWATER was:

- To reduce the demand for water, energy and chemicals
- To reduce production of waste
- To underpinned a holistic water management framework
- To support implementation of new efficient innovative technologies and concepts
- To support Europe to become the leader in the industrial water treatment market

Swedish Environmental Research Institute

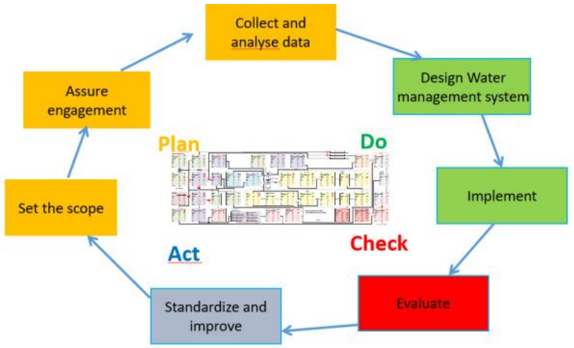
The concept

…of INSPIREWATER was based on:

- Integrating and exploiting new solutions into company structures at two levels:

<u>The first level:</u> - Water management

- Demonstrate a generic framework
- Provide a more holistic and life-cycle based approach
- Include resource efficiency as key performance indicator
- Include facilitation of technology implementation



<u>The second level:</u> - New solutions for different treatment challenges

- Demonstration and exploitation of new solutions
- Enable the solutions for other sectors

Swedish Environmental Research Institute
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

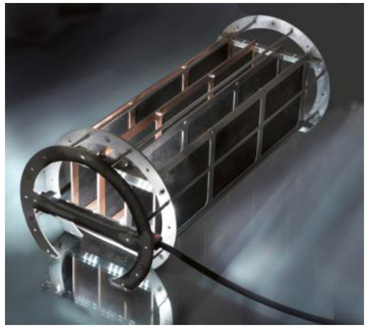
Demonstration of innovative technologies

In steel industry:

- Magnetic separator for metal removal
- Biocide free control of microorganisms
- Nanofiltration for pickling bath recovery

In chemical industry: towards Zero-liquid-discharge

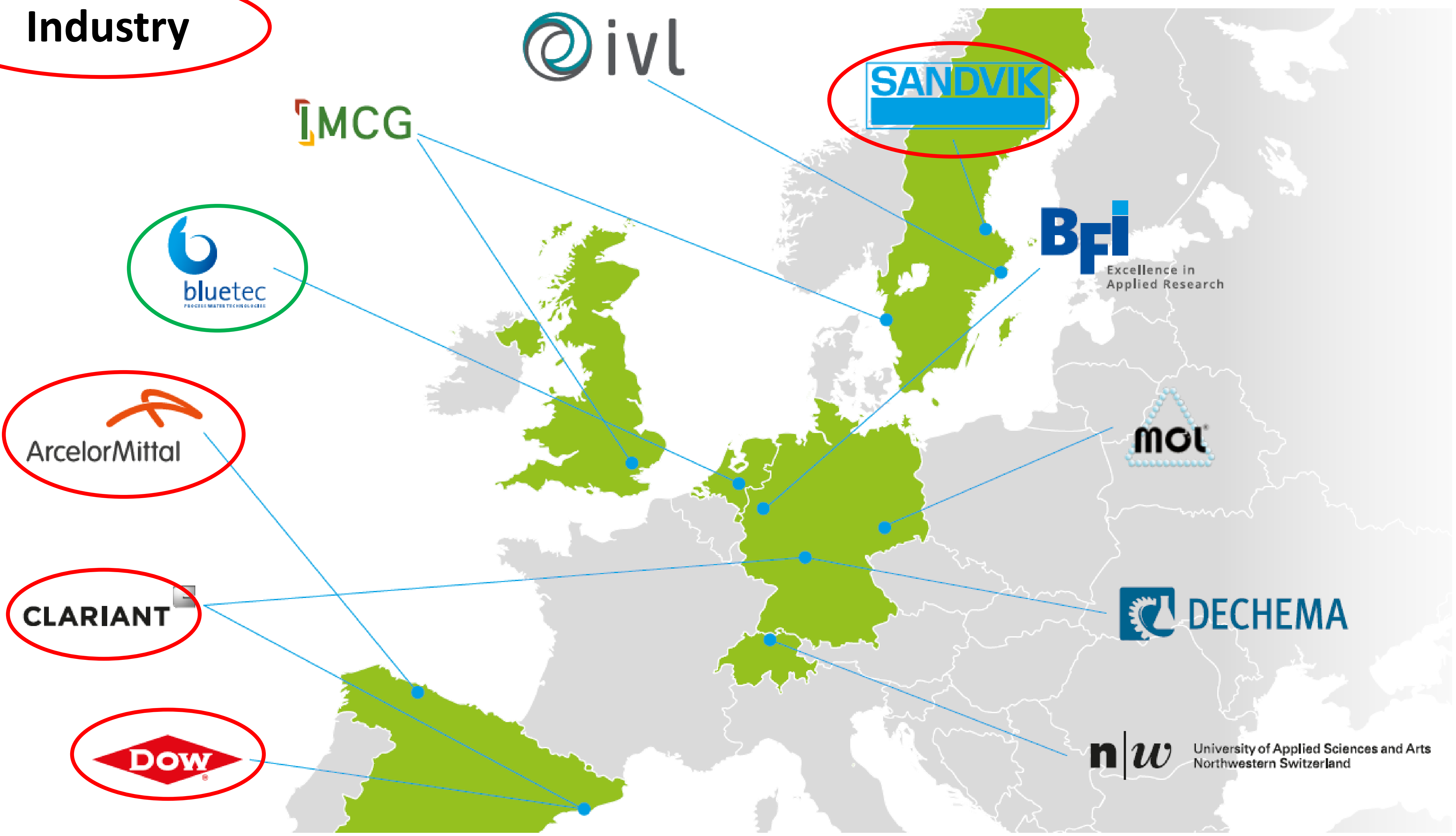
- Membrane filtration including both Forward osmosis and Reverse osmosis
- Catalyst technology for fouling control



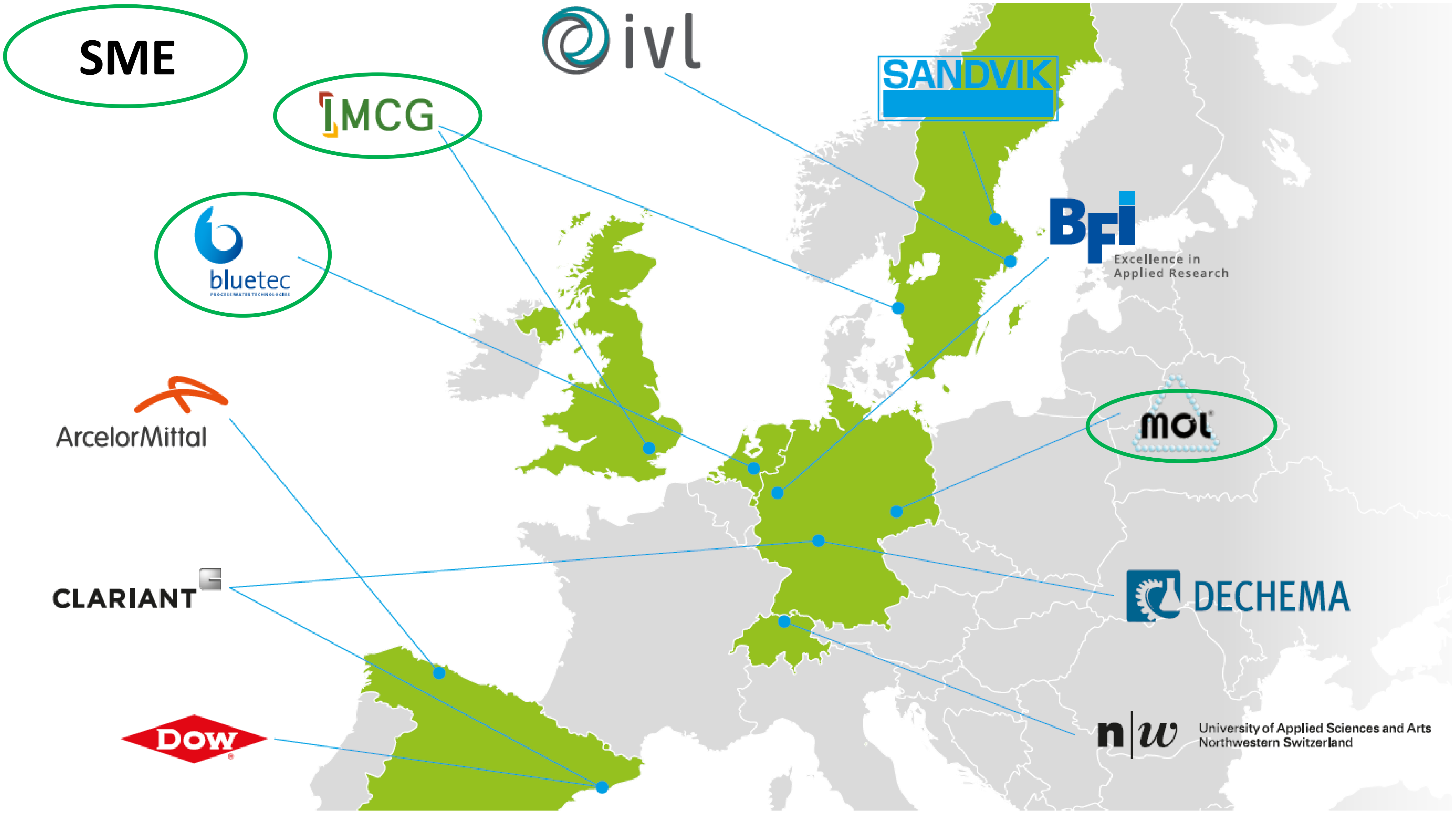
Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

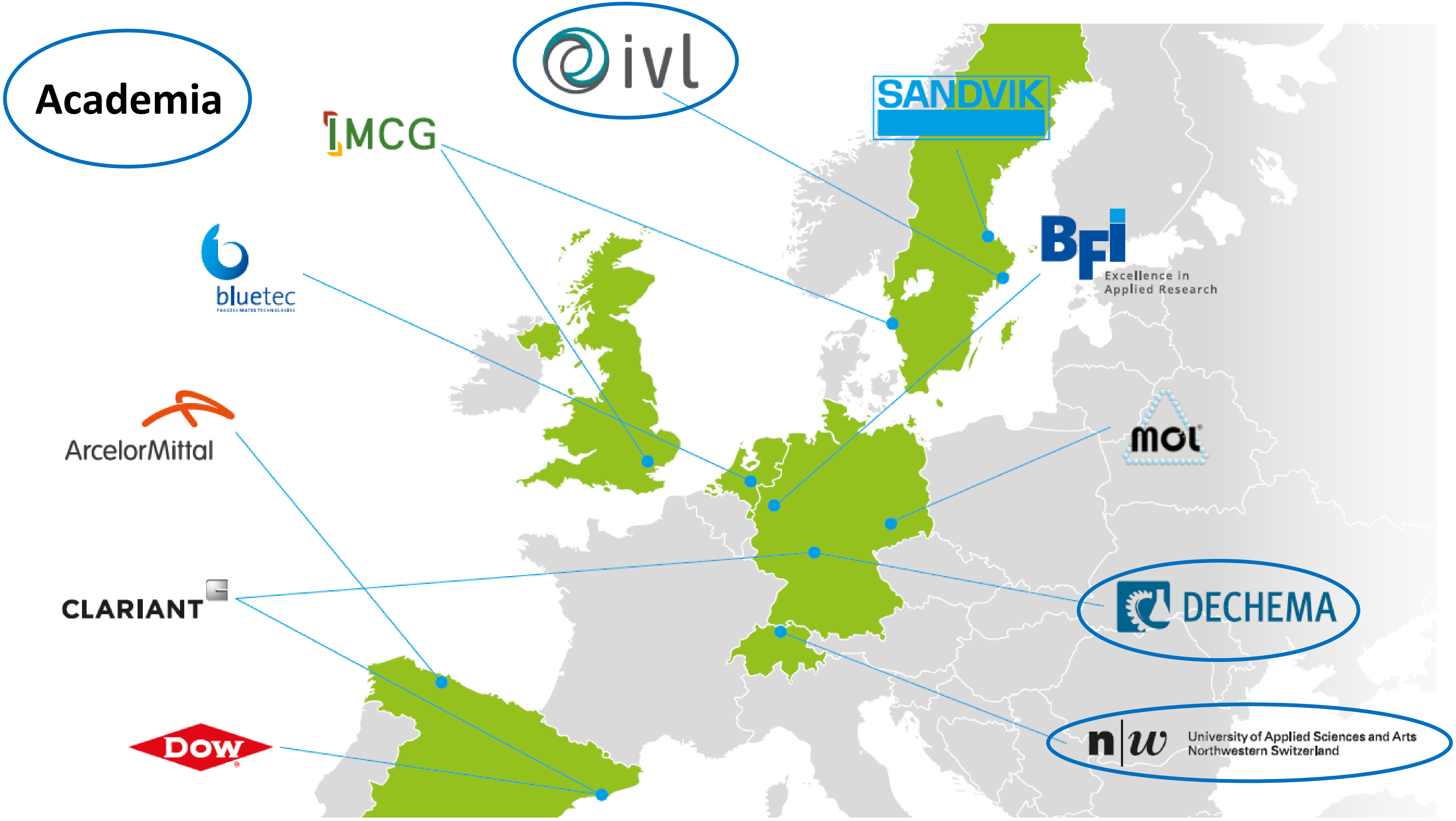
Industry

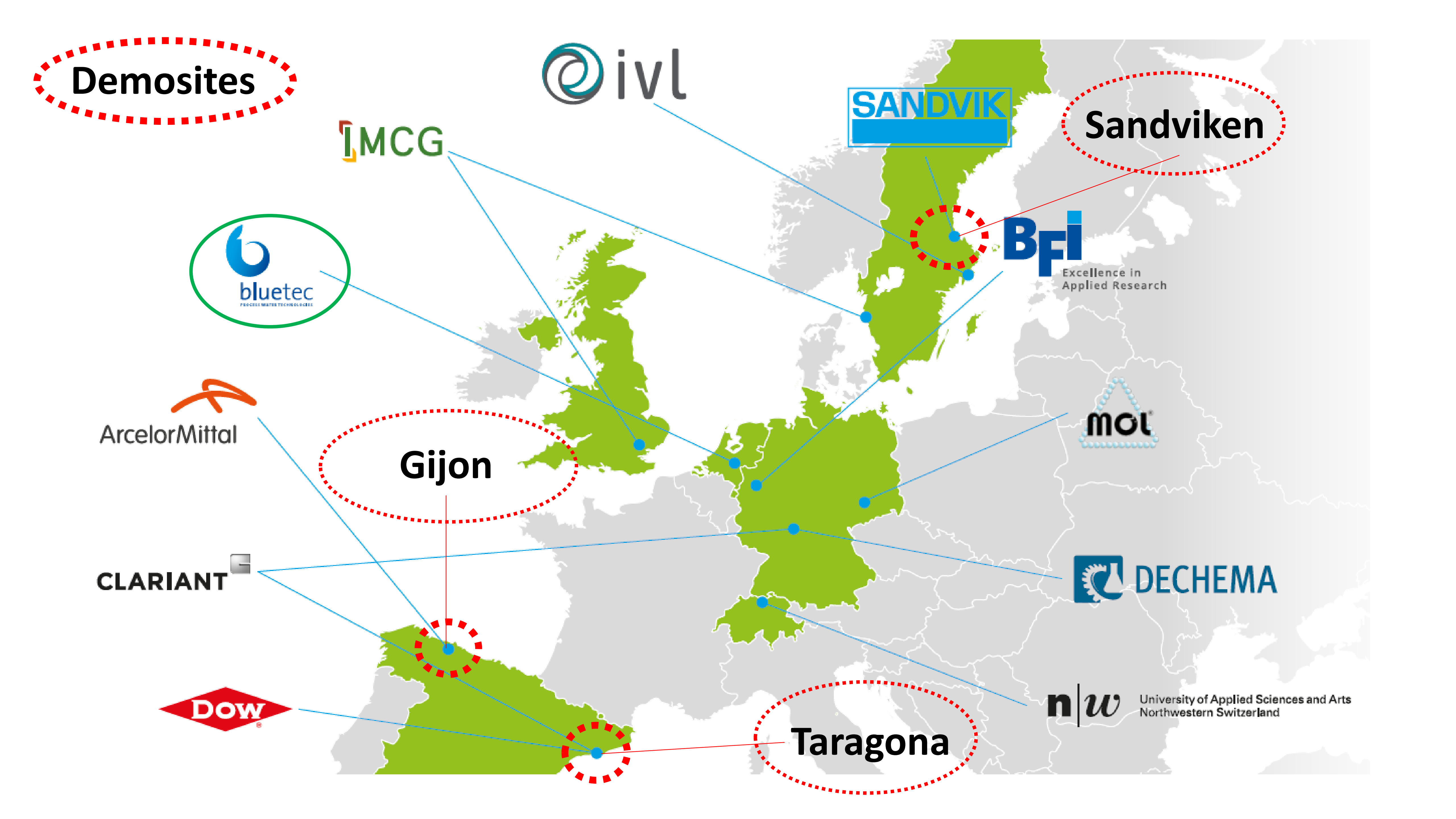


ivl
IMCG
SANDVIK
bluetec
BFI
Excellence in
Applied Research
ArcelorMittal
mol
CLARIANT
DECHEMA
n|w
University of Applied Sciences and Arts
Northwestern Switzerland
DOW



SME
ivl
IMCG
SANDVIK
bluetec
BFI
Excellence in
Applied Research
ArcelorMittal
mol
CLARIANT
DECHEMA
DOW
n|w
University of Applied Sciences and Arts
Northwestern Switzerland


Academia
ivl
IMCG
SANDVIK
bluetec
BFI
Excellence in
Applied Research
ArcelorMittal
mol
CLARIANT
DECHEMA
DOW
n|w
University of Applied Sciences and Arts
Northwestern Switzerland



Demosites
ivl
SANDVIK
Sandviken
IMCG
bluetec
BFI
Excellence in
Applied Research
ArcelorMittal
Gijon
MOL
CLARIANT
DECHEMA
DOW
n|w
University of Applied Sciences and Arts
Northwestern Switzerland
Taragona

The results

✓ A framework for a holistic water management approach was developed

✓ Key performance indicators (KPI) were defined that support the activities within water saving and process optimisation

✓ A life-cycle assessment (LCA) was carried out that clearly shows the reduction in total environmental impact of the solutions developed

✓ Adaptable innovative water solutions were demonstrated in three case studies

Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

The results

- ✓ Existing selective separation processes were combined with new technologies
- ✓ Innovative technologies were demonstrated and developed
- ✓ Conclusions and recommendations has been delivered to the industry

Swedish Environmental Research Institute

The impact

- Reduction of:
  - fresh water use (40 – 80 %)
  - use of resources/chemicals (up to 55 %)
  - wastewater production (80 – 99 %)
  - energy use (15 ->75 %)

- Adding economic benefits
  - due to less resource and energy consumption

- Process optimisation
  - achieved by the holistic water management approach and the KPI’s

Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION HORIZON 2020

We have shared quite a lot…

INSPIRE WATER

ivl
Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

…and we have learned a lot from each others…

INSPIRE WATER

ivl
Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

… and we will take the opportunity to thank all our colleagues of the great INSPIREWATER team!

INSPIRE WATER

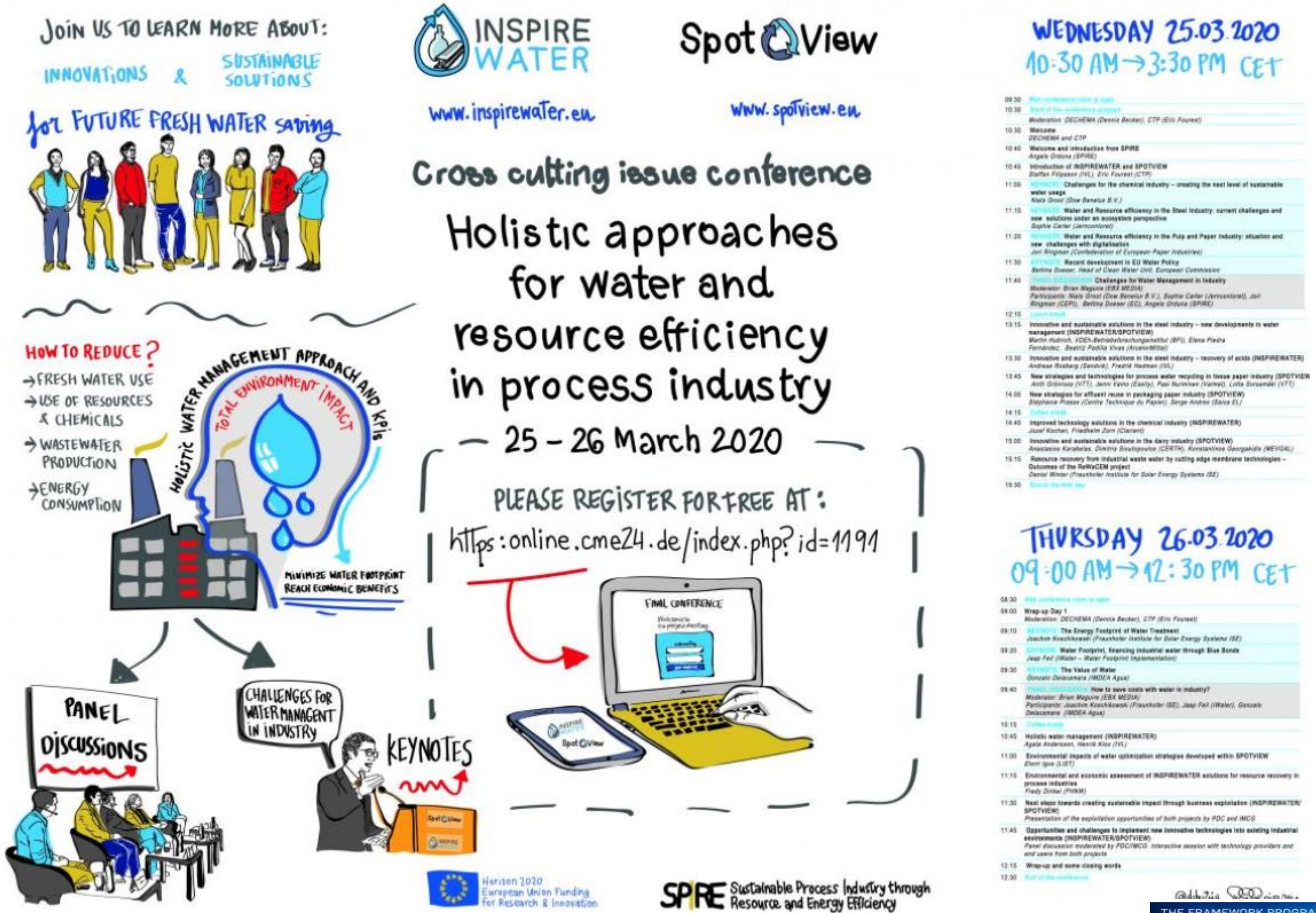
Swedish Environmental Research Institute

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

HORIZON 2020

So very welcome to the conference and we wish you a very exciting time!

staffan.filipsson@ivl.se



agata.andersson@ivl.se

Swedish Environmental Research Institute

InspireWater - SpotView final web conference:
“Holistic approaches for water and resources efficiency in process industry”

Sustainable Processes and Optimized Techniques for Industrially Efficient Water use

March 25th, 2020

Eric Fourest – Centre Technique du Papier (CTP, France)

SpotView

Horizon 2020
European Union Funding
for Research & Innovation

SPIRE PROJECT

Concept of the project

- **Objectives:**
  - To develop and demonstrate innovative, sustainable and efficient processes and technology components, in order to **optimize the use of natural resources, especially water,** in three industrial sectors (**Dairy, Pulp and Paper and Steel**)

  - 14 **existing and new technologies** will be assessed, including solid/liquid separation, ultrafiltration, deionization, biological treatment, disinfection and chemical heat pump
  - 9 **water management practices** assessed in simulated or operational environment for in the three industrial sectors
  - 7 **selected technologies demonstration** in industrial environment

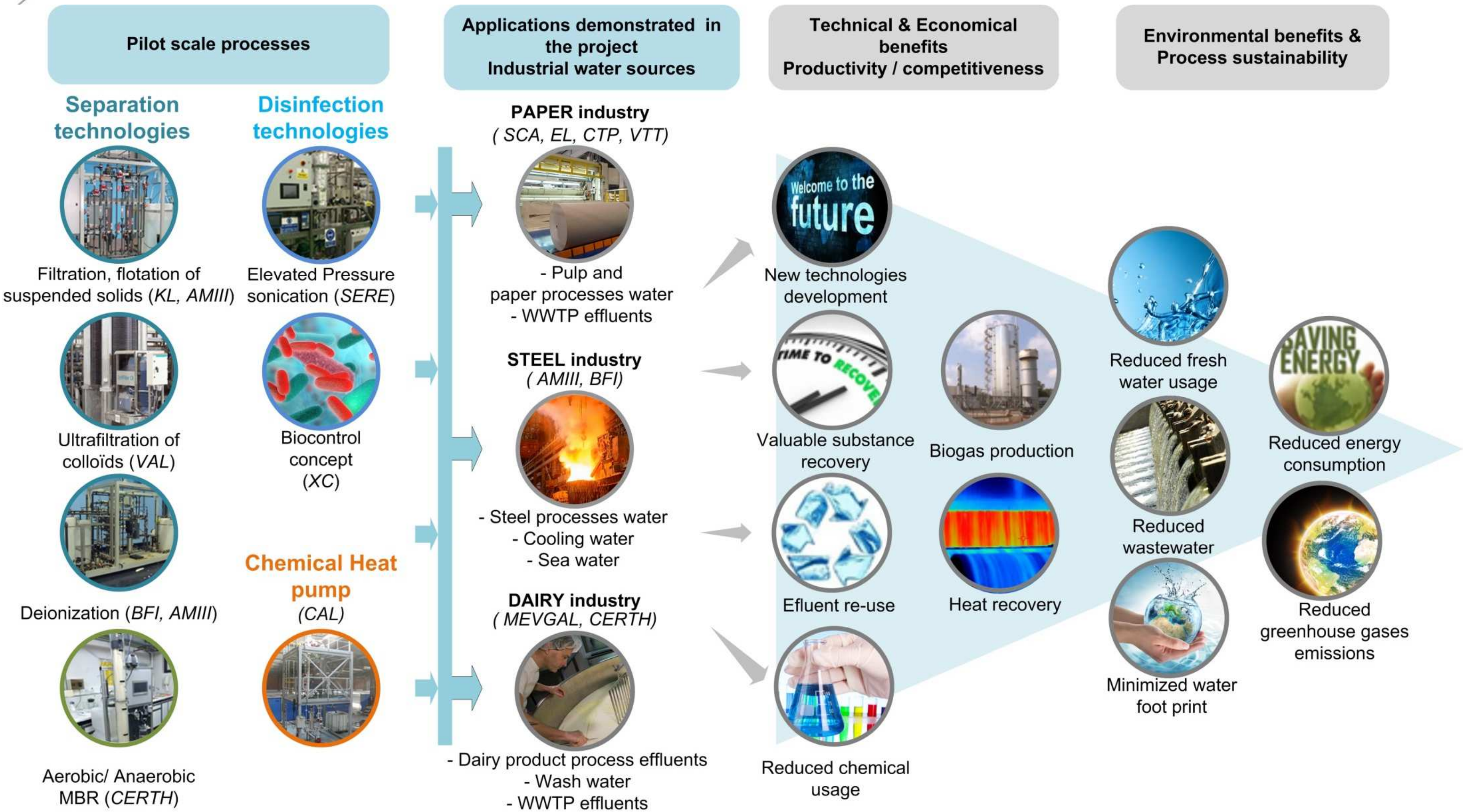
European consortium

The XV of Europe

Knowledge Providers → New Technologies developers → Technologies suppliers → Technologies end users

from 9 EU countries

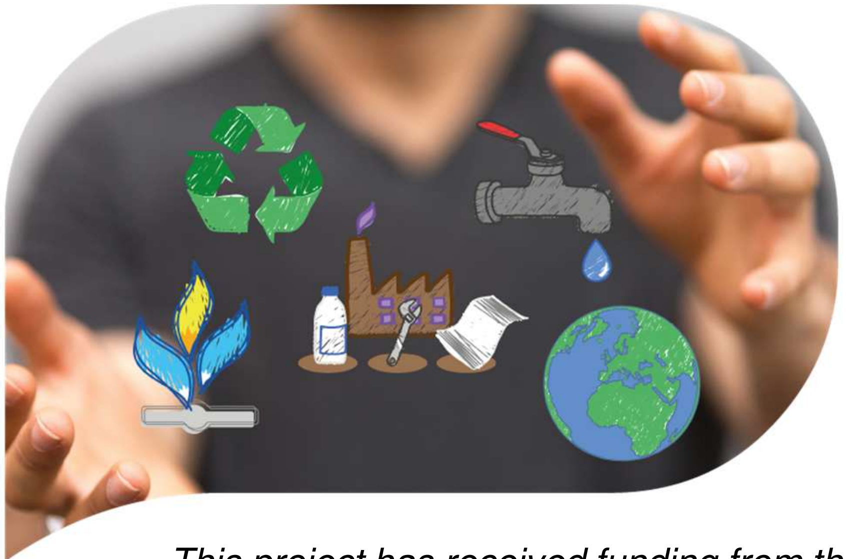
Concept of the project



Task 6.2 – Innovation outreach

- SpotView results Video

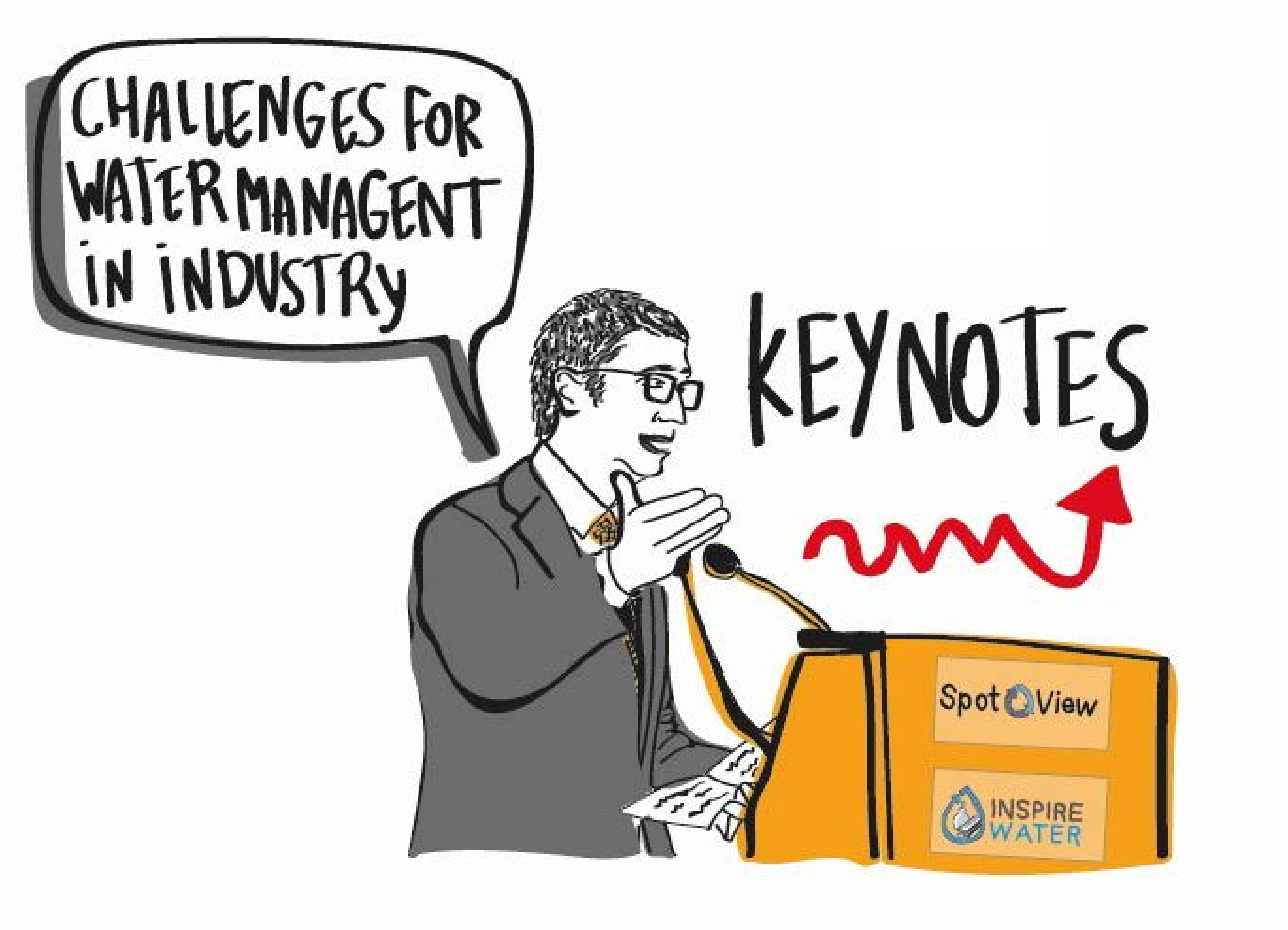
Thank You !



Contact:
Eric.Fourest@webCTP.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723577

KEYNOTE SESSION DAY 1

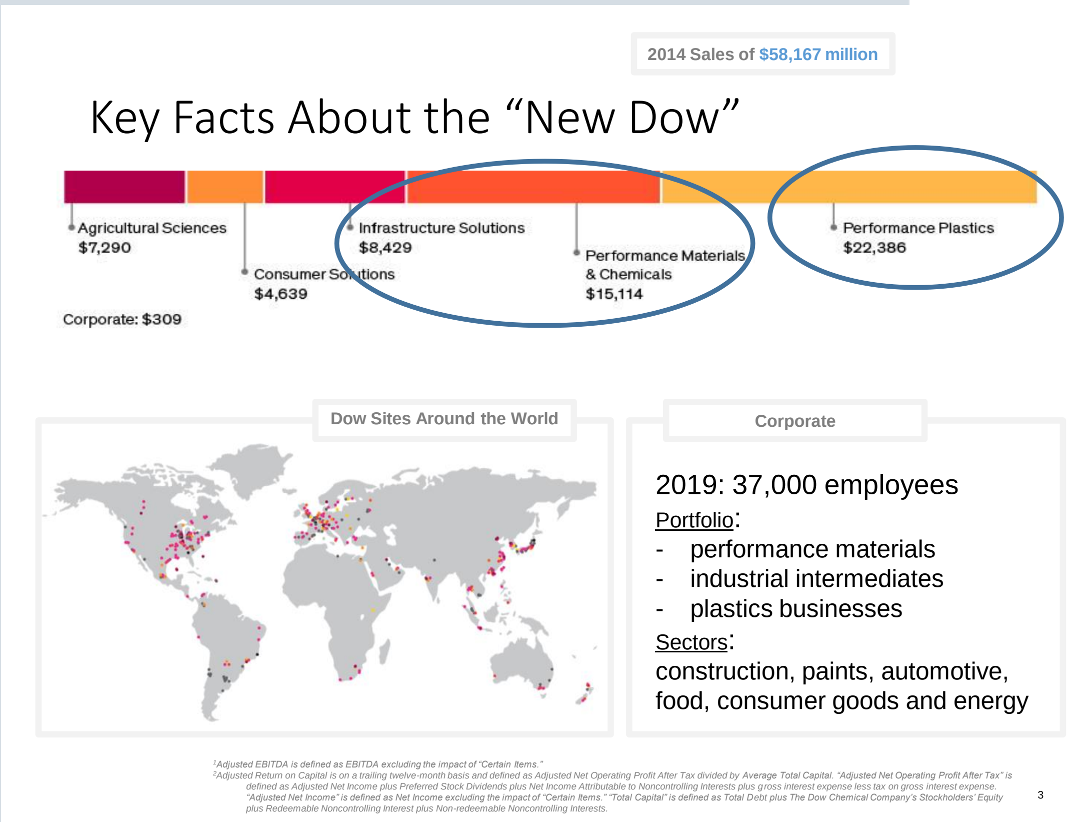


Challenges for the chemical industry

CREATING THE NEXT LEVEL OF SUSTAINABLE WATER USAGE

INSPIREWATER Final Conference – March 25th 2020

Niels Groot
Dow Benelux BV
Environmental Technology Center



Touch points:

Dow's water vision & strategy

Challenges and expectations

Approach

Concluding remarks

Which are these industrial challenges?

Raw material and Energy transition

- Climate change related objectives (CO_2, fossil fuels)
- Exhaust of fossil raw materials
- Striving for circularity
- Food provision (soil, emissions)
- Industry, agriculture, urban areas

Europe's quest to meet the Paris agreement

- Dutch targets for CO_2 reduction are 49% in 2030 and 95% in 2050
- Circularity (raw material and energy transition for industry and agriculture)

Fresh water availability and supply (climate change / sealevel rise)

Plastic waste / microplastics

Reliable and robust operation (can we raise the bar)

What does this mean for **WATER ????**

Dow’s Approach

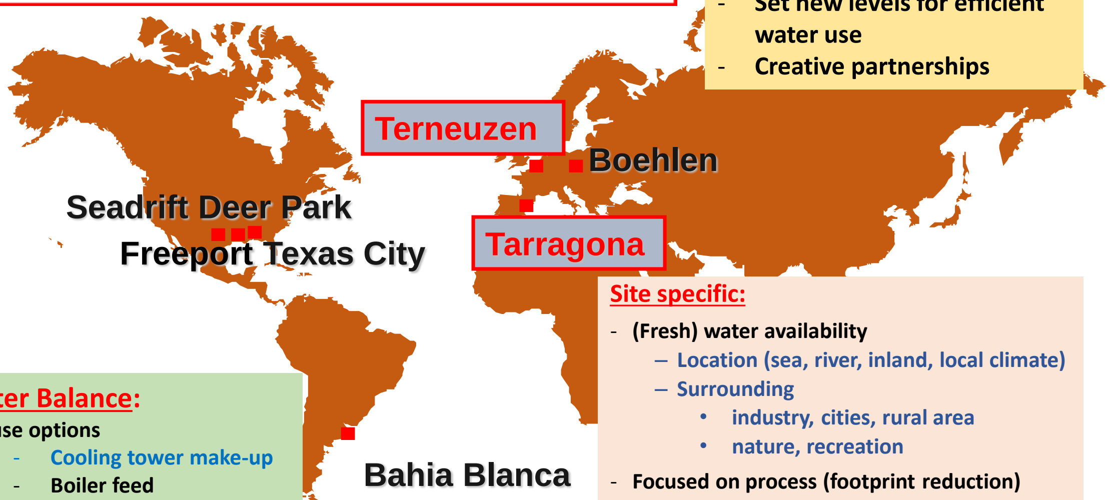
- Identify gaps and demand per site and business unit
- Generate knowledge that can be used and leveraged
- Internal R&D (core and business) and Technology Centers
- Cooperate “over the fence” in non-competitive areas both regional, national, and international

Dow’s priority water stressed sites

WBCSD “water tool” – 2011, www.wbcsd.org

Dow’s Sustainability Goal #7: World-Leading Operations Performance

By 2025, Dow **will reduce its freshwater intake intensity** at key water stressed sites and its waste intensity footprint **by 20 percent**.



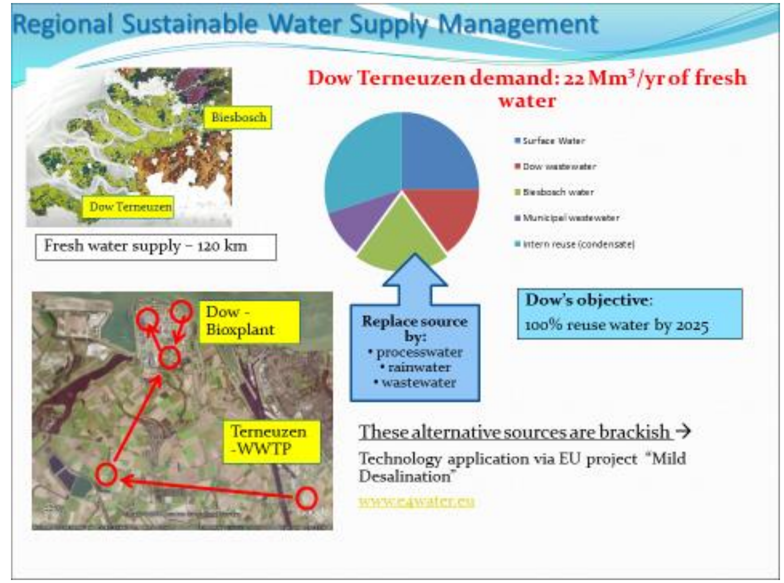
Dow’s water vision:
- Sustainable water use and managament
- Innovative technologies
- Set new levels for efficient water use
- Creative partnerships

Site specific:
- (Fresh) water availability
  - Location (sea, river, inland, local climate)
  - Surrounding
    - industry, cities, rural area
    - nature, recreation
- Focused on process (footprint reduction)
- Minimize wastewater to be treated
- Zero liquid discharge (when it makes sense)

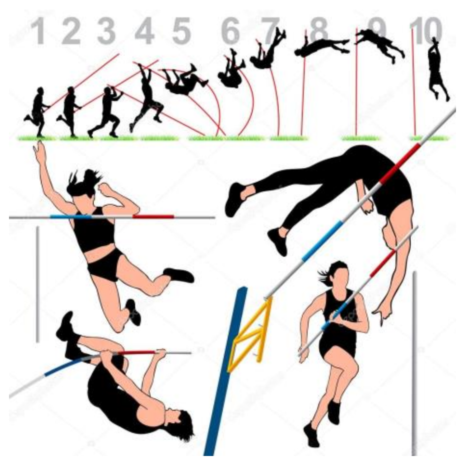
Water Balance:
- Reuse options
  - Cooling tower make-up
  - Boiler feed
  - Cascading
- Miscellaneous (service, firewater)
- Potable

Initiatives and results

- Water reuse examples:
  - Terneuzen
  - Tarragona
- Regional cooperation on raw materials, waste, by-products, and energy
  - Transfer of hydrogen between Dow and Yara
  - Pilot projects among chemical and steel to reuse CO, CO2, H2 for producing a new generation of feedstocks
- Reliable & Robust operation
  - Meet business expectations
  - Regulatory requirements
  - How strong is the chain?



Smart Delta Resources

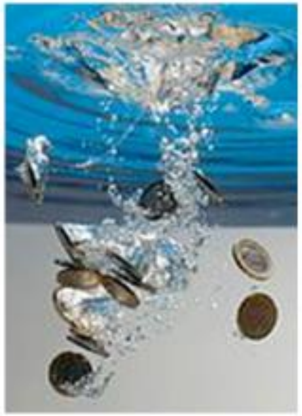


Concluding remarks

- The chemical industry embraces water sustainability objectives
- Over the fence collaborations are excellent vehicles to create benefits for multiple stakeholders
- True value of water for industry is in long term robust risk management generating sound business cases – new smart data management tools (Industry 4.0) are key enabler
- Short term success and image building are great, but not the ultimate solution for water and circularity

You can spend your money only once...

Make the right choices



Seek Together™

Water and Resource Efficiency in the Steel industry
Current challenges and new solutions under an ecosystem perspective

Sophie Carler, Ph. D., Senior Advisor
Jernkontoret - The Swedish Steel Producers´ Association

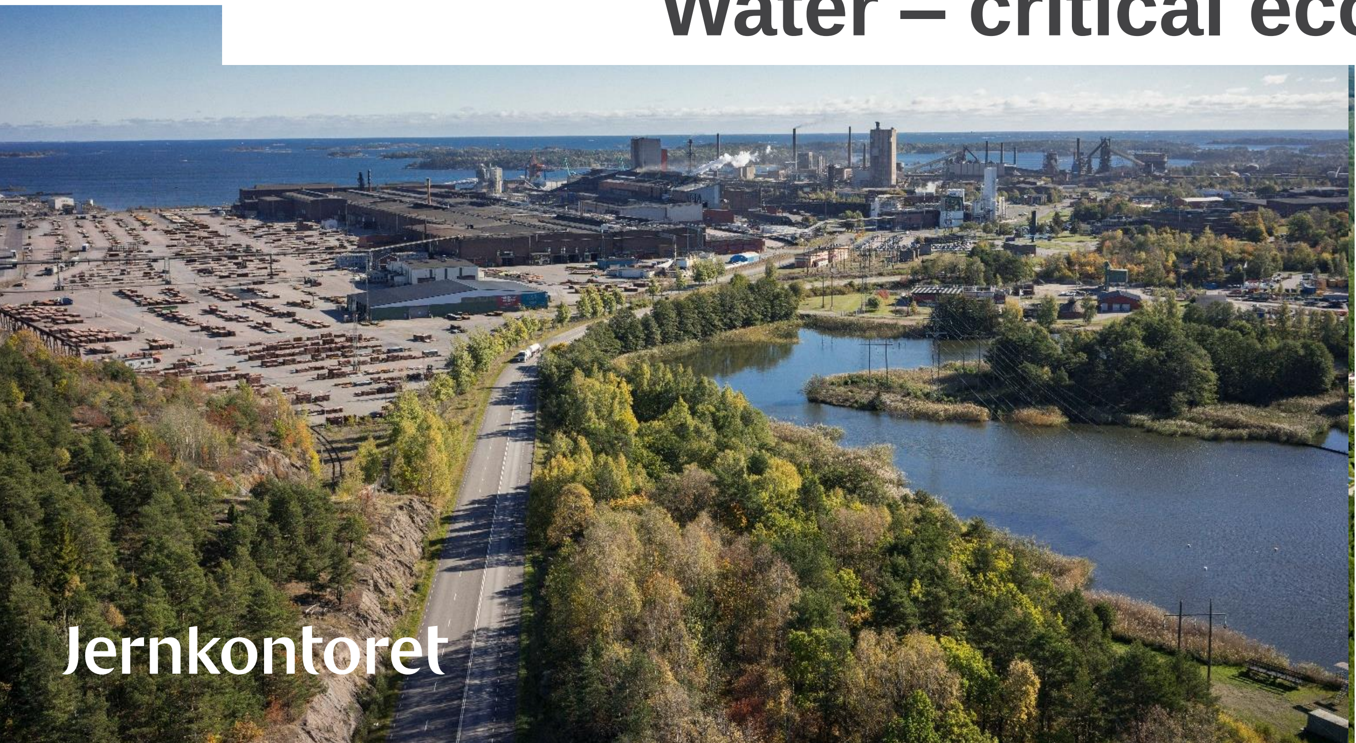
Facts about the steel industry

- Steel is produced via blast furnaces (integrated route using iron ore), and via electric arc furnaces (scrap-based steel plants)
- Most production processes are hot and water is used to cool down the processes and to control the quality of the steel – water affects final quality of steel product
- Part of the water intake is returned back to source uncontaminated, another part goes into steelmaking process and is therefore cleaned before return

  - both quality and quantity of water matters

Jernkontoret

Water – critical ecosystem service



Challenges from the Swedish perspective it´s about resource efficiency altogether – some examples

- Allocate resources for expensive water treatment technique when it´s time to shift technique towards fossil-free production (ex HYBRIT) – *economical*
- New infrastructure not compatible with old industrial sites - *technical*
- Disproportionate costs high in relation to actual effects. Possible negative effects on compliance – *regulatory*
- Change in water quantity and water quality due to climate change - *a challenge on it´s own*

- Need to think outside the box
  - ➢ Ecosystem perspective
  - ➢ Nature-based solutions

Jernkontoret

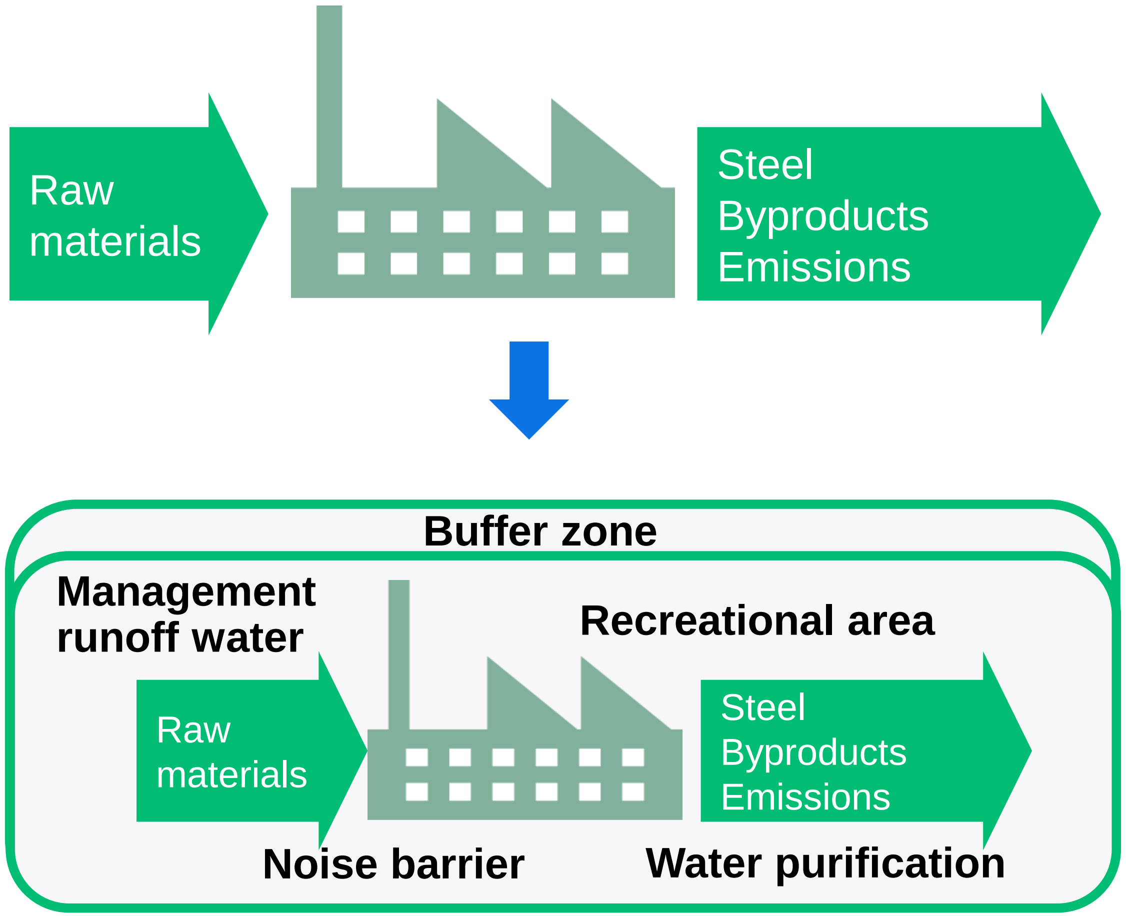

Examples of innovative water solutions


Jernkontoret

How to face new planetary challenges – climate change

- Need for increased knowledge, new methods/tools and governance models
- Apply a holistic perspective
- Coherence with European policy framework
- Strong collaboration between researchers, policymakers, and companies

From ”old” to new & systemic perspective




Cepi
RENEWABLE
RECYCLED
RESPONSIBLE
EUROPEAN PAPER

Confederation of European Paper Industries

Jori Ringman, Director General
25 March 2020

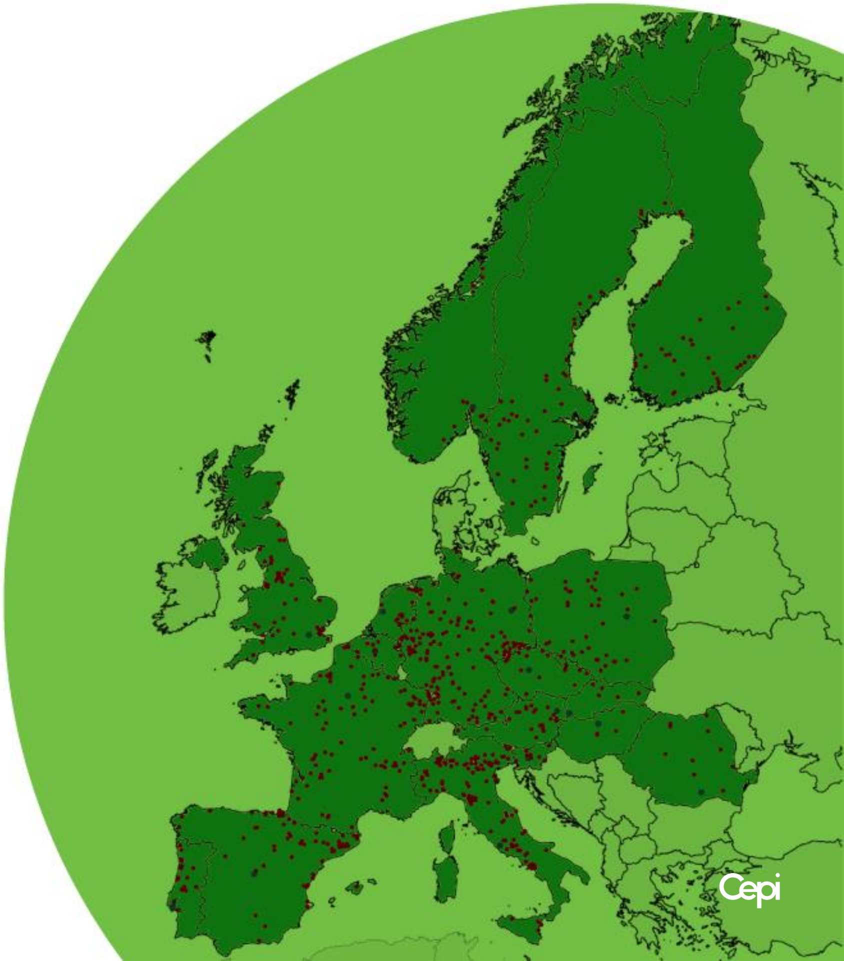
Water and Resource efficiency in the Pulp and Paper Industry: situation and new challenges with digitalisation

About Cepi

Represents in Brussels
500 pulp, paper and board producing companies
895 mills across Europe
180000 people employed directly
18 member countries

95% of the European production
22% of the world production

Working across the value chain –
from forest owners to converters
and along the whole life cycle



About Cepi

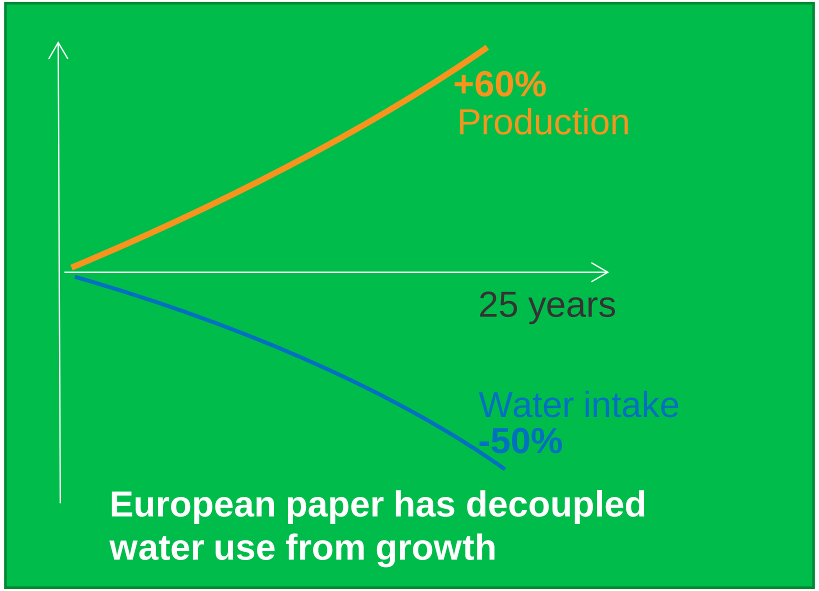
**We are renewable and recyclable,
sourced and made in Europe,
a responsible industry towards the environment,
its customers and workers**

Transforming pulp wood into cellulose and bio-based products >92% of our raw materials is sourced in Europe and certified as sustainable

Keeping the fibres in the loop >72% recycling rate of EU paper-based products

Producing
Pulp & fibres
Nano-cellulose
Bio-energy
Green chemistry
Print & graphic paper
Packaging solutions
Hygiene and tissue
Speciality papers

Starting point as an industry leader



- Pioneers in water stewardship
- Leaders in circularity, including
  - 91% of the water we use is returned to the environment, in good condition
  - All production sites have multiple water recycling loops, some closed loop
  - Also pioneered reuse of treated municipal waste water

But: Paper cannot be made without
- **Paper = Fibres + Water (+ Energy)**

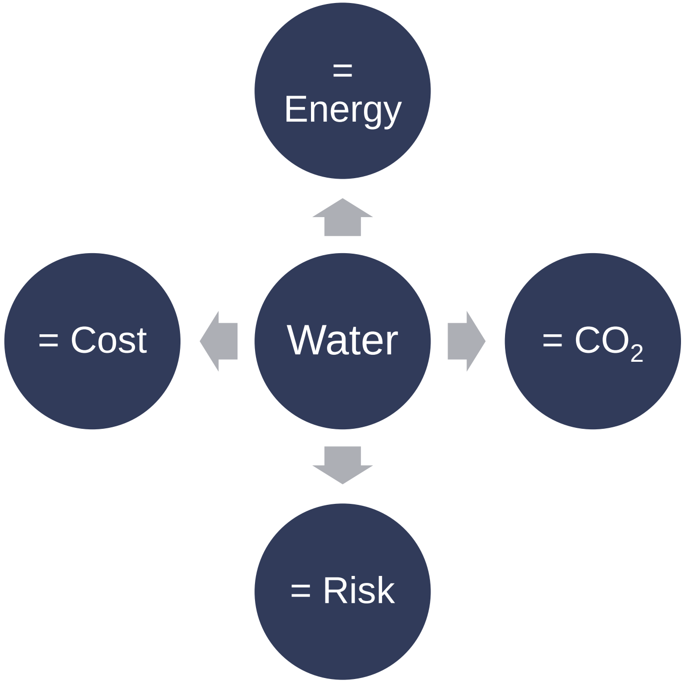
When starting with already a remarkable performance and considering it a necessity, it is difficult to improve further…

Cepi

LCA perspectives

- Spot View result from LCA: water recycling or reuse strategies for reducing direct fresh water have low impact on
  - **net fresh water consumption**, and
  - on **overall water footprint** that highly depends on indirect water use for raw material, energy and additives production.

Water has many other sustainability implications



...which may be addressed with the increasingly digital and artificial intelligence-based process systems

- More agile adjustments
- **Better process optimisation** between use of raw materials, energy and water

...and solutions found in

- Extracting valuable components from effluent
- Operating according to **industrial symbiosis**

...until we find the **breakthrough** in waterless papermaking

Cepi RENEWABLE • RECYCLED • RESPONSIBLE
EUROPEAN PAPER

If you print this presentation, please recycle it.
Paper is recyclable and the natural support of ideas.

Cepi aisbl
Confederation of European Paper Industries
Avenue Louise 250, box 80
B-1050 Bruxelles
+32 2 627 49 11
cepi.org @CEPI_paper Cepi

Recent developments in EU water policy

European Commission
DG ENV C.1 – Clean Water

Various uses, demands, pressures and impacts

Water is a cross-cutting issue

European Commission

EU Freshwaters – instruments

Groundwater Directive
Specifies requirements for groundwater

Strategic approach to pharmaceuticals in the environment
(non-binding strategy)

Other related instruments:
- Marine Strategy Framework Directive
- Plastics Strategy
- Industrial Emissions Directive
- …

Environmental Quality Standards Directive
Specifies requirements for chemical pollutants in water

Water Framework Directive (WFD)
Ensure all surface and groundwaters meet a range of quality and quantity requirements

Water re-use Regulation
Minimum criteria for urban waste water reused in agriculture

Nitrates Directive
Limit use of nitrates in agriculture

Sewage sludge Directive
Safe use of sewage sludge in agriculture

Bathing Water Directive
Minimum criteria for good bathing water

Floods Directive
Ensure flood risks are identified, mapped and managed

(Recast) Drinking Water Directive
Minimum criteria for drinking water

Urban Waste Water Treatment Directive
Collection and treatment of urban waste water

Recently evaluated

EC proposal in inter-institutional process

Recently adopted

European Commission

Stock-taking process of EU waters

1. EEA Reports: ‘European waters – assessment of status and pressures’ (July 2018); ‘The European environment — state and outlook 2020’ (December 2019)

2. Commission’s 5th implementation report on WFD and FD (February 2019)

3. Fitness Check of Water Framework Directive and Floods Directive and Evaluation of Urban Waste Water Treatment Directive (December 2019)

EU water law under evaluation

Fitness check of the Water Framework Directive and the Floods Directive

SWD (2019)439 final

- Water Framework Directive (**WFD**) – Dir 2000/60/EC
- Environmental Quality Standards Directive (**EQSD**) – Dir 2008/105/EC
- Groundwater Directive (**GWD**)
  – Dir 2006/118/EC
- Floods Directive (**FD**)
  – Dir 2007/60/EC

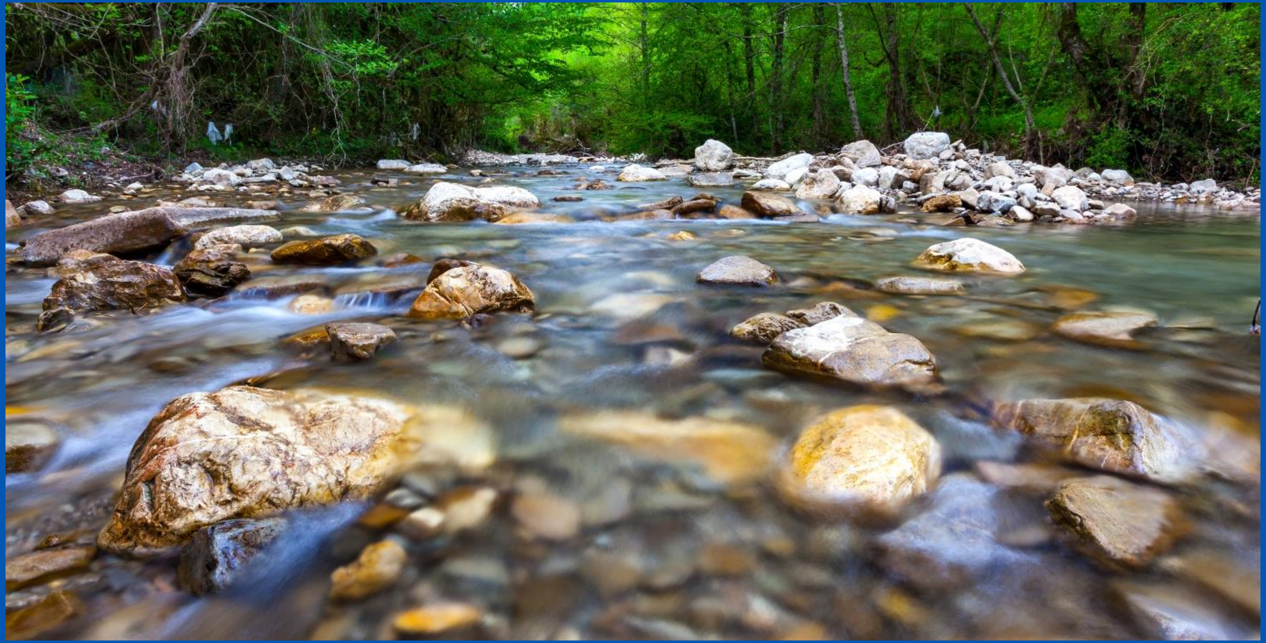
Evaluation of the Urban Waste Water Treatment Directive

SWD (2019)700 final

- (**UWWTD**) Dir 91/271/EEC

Fitness Check of the Water Framework Directive and the Floods Directive

SWD (2019)439 final



Conclusions: *Broadly fit for purpose, with room for improvement*

Water Framework Directive

- Governance structure set up for integrated water management; deterioration of water status slowed down; pollution reduced
- BUT implementation significantly delayed and less than half of EU's water bodies in good status (despite 2015 deadline)
- The objectives have not yet been reached fully largely because of:
    1) Slow implementation
    2) Insufficient funding
    3) Insufficient integration of environmental objectives in sectoral policies

Floods Directive

- Too early to draw conclusions (first implementation cycle started only in 2016) but analysis shows flood risk management has improved
- Further efforts needed to strengthen awareness and improve co-ordinated flood prevention, in line with climate change projections

European Commission

Lessons learnt

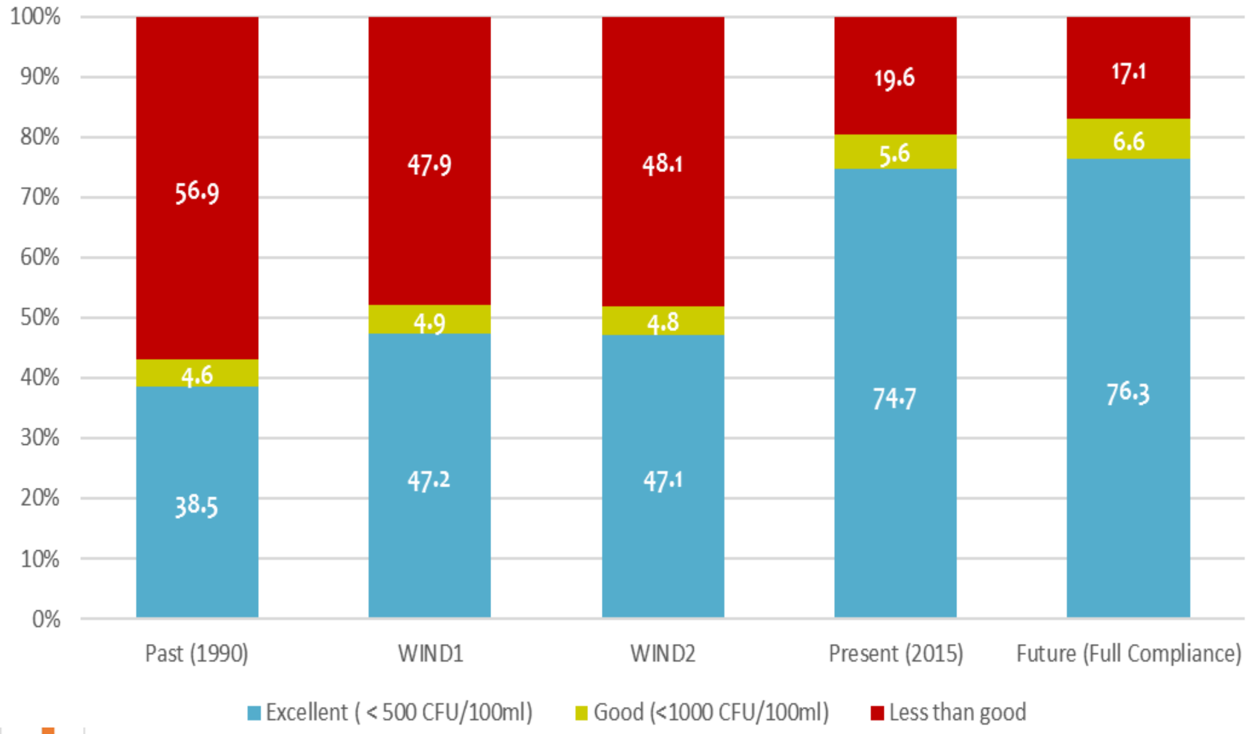
Progress towards good status remains slow but steady	The Directives are prescriptive and flexible to address new challenges	Implementation needs to accelerate substantially and become more effective	Room for improvement in chemicals	Integration of the Directives with other policy areas needs to be advanced	The financing gap needs to be addressed	Limited room for simplification and reduction of administrative burden
Results are slow *One-out-all-out* principle can make showing progress challenging	Climate change Pollutants of emerging concern (pharmaceuticals micro-plastics)	3rd RBMPs due in 2021 will be crucial Less room for exemptions of Art. 4 WFD Joint implementation: cooperation Commission – Member States Enforcement measures included	Differences between Member States and River Basins Mixtures and combined effects not assessed Lengthy process to update the list of priority substances	Agriculture Energy - hydropower Waterborne transport	Investments and operation and maintenance financing Sources: National funding; EU funding; international financial institutions Cost-recovery principle Art. 9 WFD	Streamlining of monitoring and electronic reporting Digitalisation ongoing

European Commission

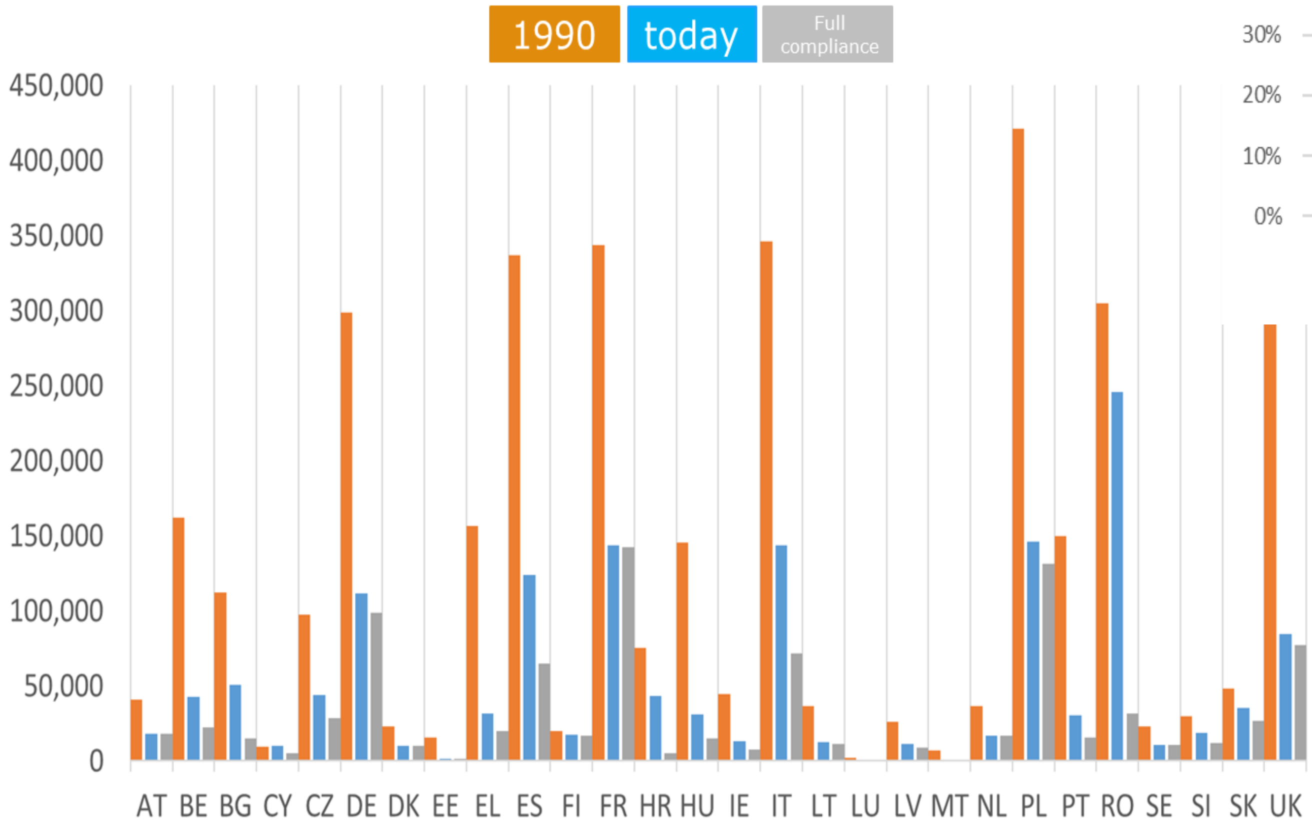
Evaluation of the Urban Waste Water Treatment Directive

SWD(2019)700 final

Main Conclusions



Conditions of EU inland freshwaters with regard to bathing water standards under different scenarios



Biochemical Oxygen Demand (BOD) loads *(tonnes/year in treated waste water)*

The UWWTD has delivered on the reduction of loads and thereby contributed to the improvement of water quality.

Source: JRC Science for Policy, 2019.

European Commission

Main Lessons & Room for improvement

Main lessons learnt

- Effective tool – Tangible effects
- Simple and targeted instrument
- Carrot and stick
- Costs <<< Benefits

Room for improvement

- Remaining pollution
- Contaminants of emerging concern
- Energy use, sludge management
- Governance – planning/enabling conditions, transparency/reporting, investments/affordability

European Commission

KEYNOTE SESSION DAY 1

INSPIRE WATER · SpotView

PROGRAMME

WEDNESDAY, 25 MARCH 2020

09:30	Web conference room is open
10:30	Start of the conference program
	Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)
10:30	Welcome *DECHEMA and CTP*
10:40	Welcome and introduction from SPIRE *Angels Orduna (SPIRE)*
10:45	Introduction of INSPIREWATER and SPOTVIEW *Staffan Filipsson (IVL), Eric Fourest (CTP)*
11:00	KEYNOTE: Challenges for the chemical industry – creating the next level of sustainable water usage *Niels Groot (Dow Benelux B.V.)*
11:10	KEYNOTE: Water and Resource efficiency in the Steel Industry: current challenges and new solutions under an ecosystem perspective *Sophie Carler (Jerncontoret)*
11:20	KEYNOTE: Water and Resource efficiency in the Pulp and Paper Industry: situation and new challenges with digitalisation *Jori Ringman (Confederation of European Paper Industries)*
11:30	KEYNOTE: Recent development in EU Water Policy *Bettina Doeser, Head of Clean Water Unit, European Commission*
11:40	PANEL DISCUSSION: Challenges for Water Management in Industry *Moderator: Brian Maguire (EBX MEDIA)* *Participants: Niels Groot (Dow Benelux B.V.), Sophie Carler (Jerncontoret), Jori Ringman (CEPI), Bettina Doeser (EC), Angels Orduna (SPIRE)*
12:15	Lunch break
13:15	Innovative and sustainable solutions in the steel industry – new developments in water management (INSPIREWATER/SPOTVIEW) *Martin Hubrich, VDEh-Betriebsforschungsinstitut (BFI), Elena Piedra Fernández, Beatriz Padilla Vivas (ArcelorMittal)*
13:30	Innovative and sustainable solutions in the steel industry – recovery of acids (INSPIREWATER) *Andreas Rosberg (Sandvik), Fredrik Hedman (IVL)*
13:45	New strategies and technologies for process water recycling in tissue paper industry (SPOTVIEW) *Antti Grönroos (VTT), Jenni Vaino (Essity), Pasi Nurminen (Valmet), Lotta Sorsamäki (VTT)*
14:00	New strategies for effluent reuse in packaging paper industry (SPOTVIEW) *Stéphanie Prasse (Centre Technique du Papier), Serge Andres (Saica EL)*
14:15	Coffee break
14:45	Improved technology solutions in the chemical industry (INSPIREWATER) *Jozef Kochan, Friedhelm Zorn (Clariant)*
15:00	Innovative and sustainable solutions in the dairy industry (SPOTVIEW) *Anastasios Karabelas, Dimitris Sioutopoulos (CERTH), Konstantinos Georgakidis (MEVGAL)*
15:15	Resource recovery from industrial waste water by cutting edge membrane technologies – Outcomes of the ReWaCEM project *Daniel Winter (Fraunhofer Institute for Solar Energy Systems ISE)*
15:30	End of the first day

THURSDAY, 26 MARCH 2020

PROGRAMME

08:30	Web conference room is open
09:00	Wrap-up Day 1 *Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)*
09:10	KEYNOTE: The Energy Footprint of Water Treatment *Joachim Koschikowski (Fraunhofer Institute for Solar Energy Systems ISE)*
09:20	KEYNOTE: Water Footprint, financing industrial water through Blue Bonds *Jaap Feil (iWater – Water Footprint Implementation)*
09:30	KEYNOTE: The Value of Water *Thomas Track (DECHEMA e.V.)*
09:40	PANEL DISCUSSION: How to save costs with water in industry? *Moderator: Brian Maguire (EBX MEDIA)* *Participants: Joachim Koschikowski (Fraunhofer ISE), Jaap Feil (iWater), Thomas Track (DECHEMA e.V.)*
10:15	Coffee break
10:45	Holistic water management (INSPIREWATER) *Agata Andersson, Henrik Kloo (IVL)*
11:00	Environmental impacts of water optimization strategies developed within SPOTVIEW *Elorri Igos (LIST)*
11:15	Environmental and economic assessment of INSPIREWATER solutions for resource recovery in process industries *Fredy Dinkel (FHNW)*
11:30	Next steps towards creating sustainable impact through business exploitation (INSPIREWATER/SPOTVIEW) *Presentation of the exploitation opportunities of both projects by PDC and IMCG*
11:45	Opportunities and challenges to implement new innovative technologies into existing industrial environments (INSPIREWATER/SPOTVIEW) *Panel discussion moderated by PDC/IMCG. Interactive session with technology providers and end users from both projects*
12:15	Wrap-up and some closing words
12:30	End of the conference

www.inspirewater.eu / www.spotview.eu

"The projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No 723577 and No 723702"

Innovative and sustainable solutions in the steel industry: new developments in water management

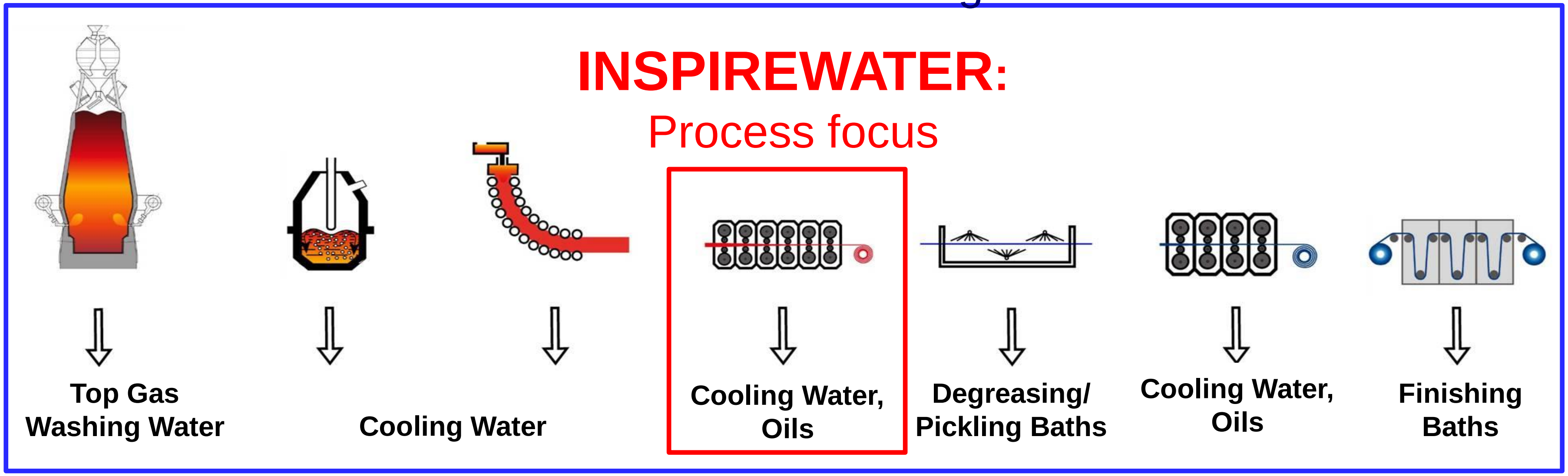
Martin Hubrich, Matthias Kozariszczuk, **BFI**

Beatriz Padilla Vivas, Elena Piedra Fernández, **AMI3**

Situation - Solutions

Water use in steel industry

SPOTVIEW: Holistic view of a site including water sources



Water use in steel industry

- Cooling applications (material: casting, hot rolling; machines): 75%
- Gas washing (blast furnace, basic oxygen furnace): 13%
- Material conditioning (e.g. slag granulation): 12%

Situation - Challenge - Solution

Situation

- Process related intake of solids and organic causing wear and biological activity
- Concentration of salts/hardness components leading to corrosion and scaling
- Addition of treatment chemicals: corrosion inhibitors, antiscalants and biocides
- Decreasing/stronger limited water availability in semi-aride areas

Challenge

- Complex and varying water matrix causing insufficient economic/technical levels of available water treatment technologies and preventing water reuse
- Components mostly inhibiting water reuse: chloride, sulphate, hardness, oil, solids and possible interactions of technologies with treatment chemicals

Solution

- Use of innovative technologies as capacitive deionisation, precipitation reactor (softening, disinfection), magnetic separator and water management (cascade)
- Determination of concerted combinations of water treatment chemicals (e.g. flocculent, biocide), solid removal and desalting/softening technologies

Aims / Focus
INSPIREWATER - SPOTVIEW

Global project aims

- Saving of fresh water and reduction of waste water
- Decoupling of production and fresh water demand

INSPIREWATER- focused view on a selected circuit

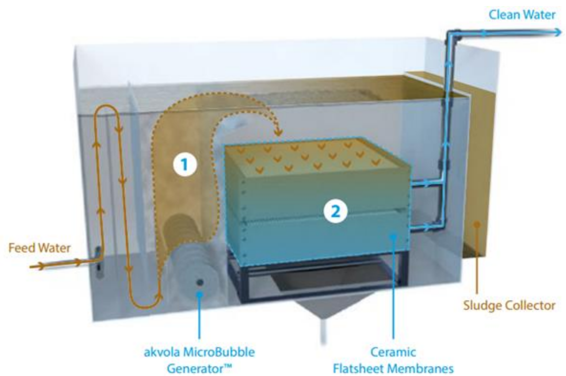
- Decrease of corrosion and scaling by use of suitable technologies for longer water use reducing the freshwater demand/waste water occurrence

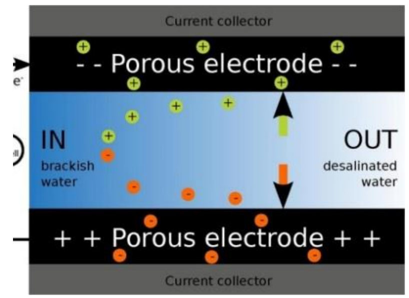
SPOTVIEW - holistic view of a site including water sources

- Reuse of low loaded waste/process water in a cascade considering the required water qualities
- Recycle of loaded waste/process waters as e.g. back wash water from sand filters by e.g. solid and salt removal for an internal reuse
- Use of alternative water sources (sea / rain water) or optimization of river water treatment by innovative desalting technologies as capacitive deionization

Innovative technologies

Investigated Innovative Technologies





Magnetic separator:

Chemical free and pressure less solid removal with permanent strong field magnets

Combined flotation / microfiltration

Oil and suspended solid removal by flotation with rotating discs followed by microfiltration

Capacitive Deionisation

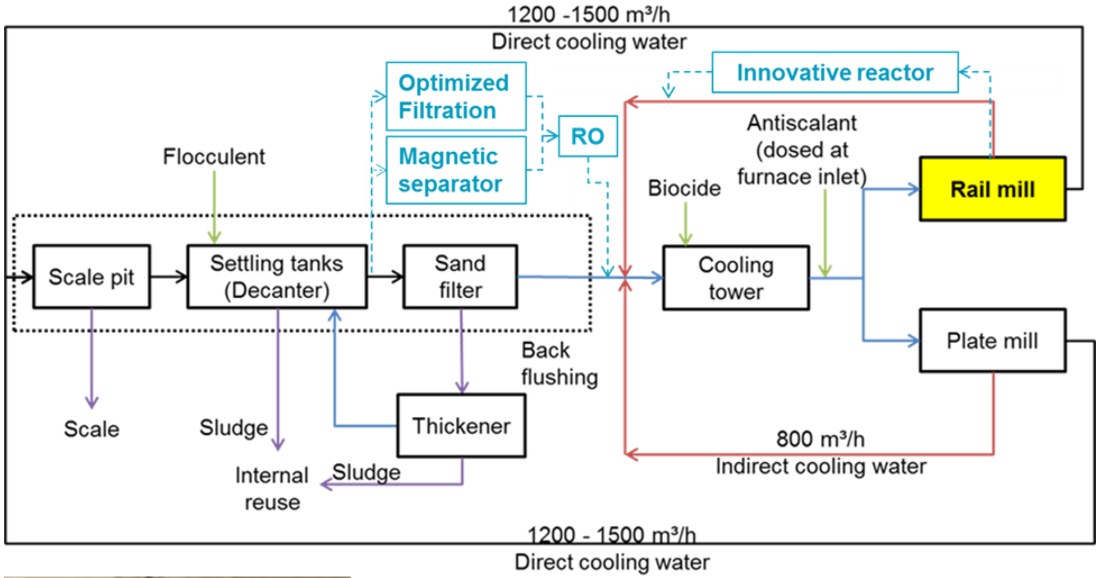
Ion removal by electrostatic adsorption at electrodes and subsequent desorption during regeneration

Innovative Reactor

Input of high-frequency electrical pulses to hindrance bacteria adaptation and changes of forces of repulsion balance for “not sticking dust”

Results

Demonstration of selected technologies at AM Gijon



Selection in lab trials

- Magnetic separator
- 3layer-filtration
- Reverse Osmosis
- Innovative reactor

Magnetic separator

3layer filtration

Reverse Osmosis

Innovative Reactor

Summary of technical results - INSPIREWATER-

Magnetic separator:

- Treatment of approx. 31,000 m^3 cooling water
- Outlet solid contents down to 10–15 mg/L (LOD: 10 mg/L) even in case of about factor 3 -5 varying inlet solid contents
- High solid contents in sludge between 19–31 wt.-% compare to 0.2 wt.-% at 3layer-filtration or operations and filter
- Low ratio of back flush water to treated volume with 0.001 - 0.006% compared to 1.2 – 4.3% for 3-layer-filtration or operations and filter

3layer filtration:

- Confirmation of lab results achieving outlet solid contents below 10 mg/L.
- Increased removal efficiency from 65% to 96% by 3layers of different filter material compared to operational sand filter or up to 83% by decreasing velocity

Reverse osmosis:

- Flux up to 50 lm^2/h possible in case of pH-adjustment and concentration factor 4
- Significant decrease of corrosion potential compared to untreated water

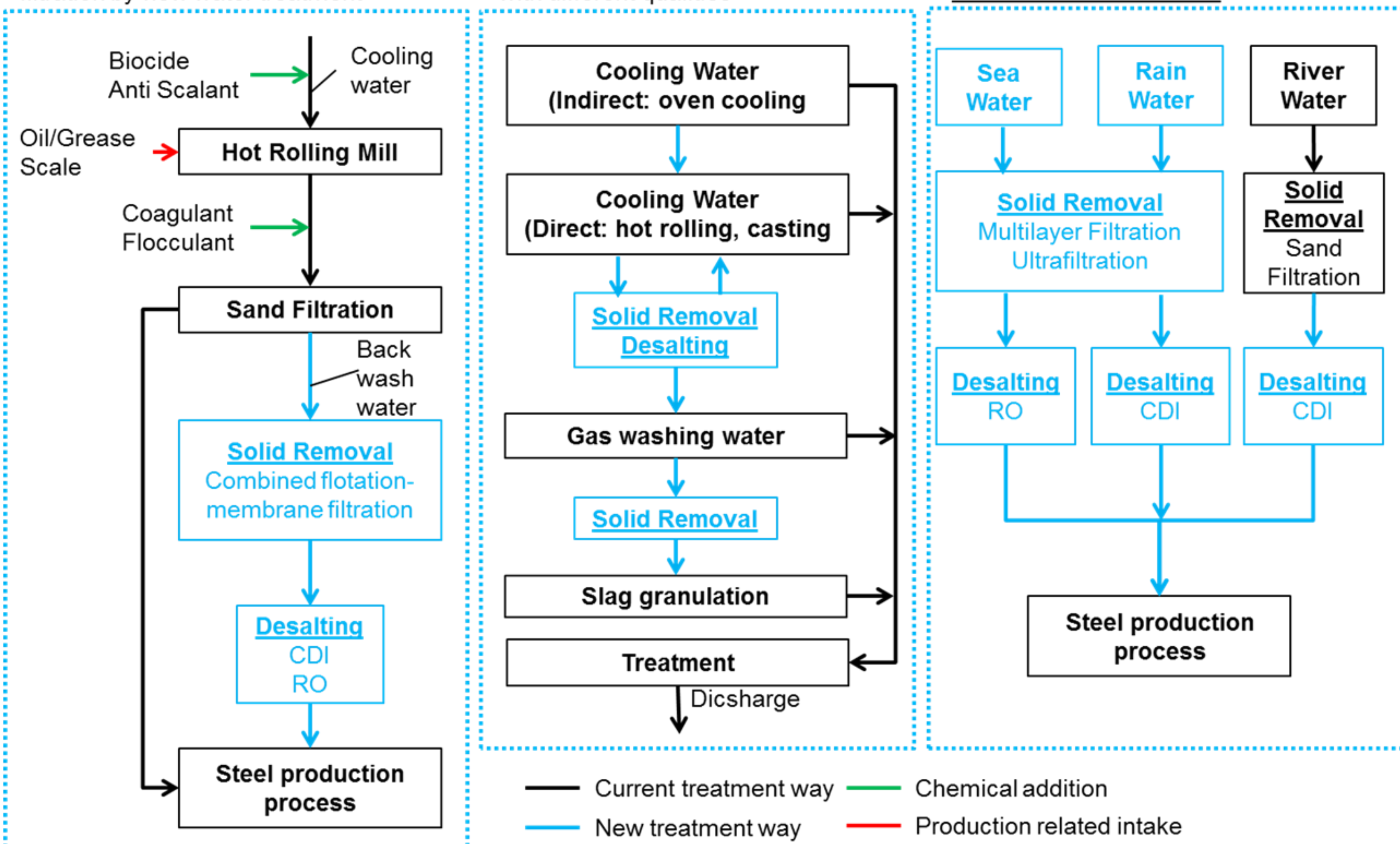
Innovative reactor: Inconclusive results in field and lab trials

Investigated approaches and applications SPOTVIEW

Recycling of back wash water of sand filtration by new water treatment

Cascade reuse of process waters with different qualities

Saving of fresh water by use of alternative water sources



Applications for reuse back wash / river water /sea water

Spot View

Horizon 2020 European Union Funding for Research & Innovation

		Back wash water	River water	Sea Water
Hot Rolling Mill	Reheat furnaces	pH adjustment		
	Equipment cooling			
	Direct cooling	pH adjustment necessary		
Continuous Casting Circuits	Mould cooling			
	Contact cooling			
Electric Arc Furnace (EAF)	Indirect closed cooling	Further softening required		
	Open cooling			
Converter Circuits	Indirect cooling			
Blast Furnace Circuits	Indirect cooling			

- **CDI treated river and two steps RO treated sea water** can be directly for all applications beside indirect closed loop cooling at the electric arc furnace
- **Direct use of CDI treated back wash water** in: cooling processes in hot rolling mill, EAF and blast furnace possible - pH-adjustment from 6.5 to 7 or 7.5 necessary for further applications

Summary of technical results - SPOTVIEW-

Spot View

Horizon 2020 European Union Funding for Research & Innovation

SPIRE PROJECT

Back washing water treatment

- Suitable combination: flotation/microfiltration (oil/solid removal) flowed by CDI or RO for desalting/softening in 3 month field trials

Technology	Water Recovery [%]	Energy Demand [kWh/m^3]	Quality
Flotation with MF	89	0.3	TSS< 3mg/L
CDI	78	0.95	Fulfilling AM requiremrents: Conductivity: < 200 µS/cm Chlorides: < 50 mg/L
RO	85	1.4	

River water treatment

- CDI: fulfillment of AM requirement with water recovery of 79% and 0.95 kWh/m^3 - same as RO/IX

Sea water

- Multimedia and Ultrafiltration fulfills turbidity requirement (< 1NTU).
- Two RO passes required (water recovery: 40%, energy demand: 4 kWh/m^3)

Cascadic Water Reuse – 9 possible applications in the area cooling water

- 10 - 31% water saved from direct reuse applications without any treatment.
- CDI treated back wash water: direct in 4/9 or after pH-adjustment in 2/9 cooling water applications - treated river water in 8/9 cooling water applications

Summary of technical results and evaluation

Evaluation of project results

INSPIREWATER

- 66% energy saving by use of pressure less magnetic separator for solid removal compared to pressurized sand filter
- 80% blow down saving and up to 13% fresh water saving by RO treatment of the blow down waste water reduction by removal of solids, salts and hardness components

SPOTVIEW

- Between 10 and 30% fresh water saving by reuse process water and further 38% by desalination technologies.
- 89% reduction of backwash water by solid and desalination to recycle back into the process.
- Reduction of dependency on fresh water availability and minimization of fresh water use per ton of steel of 50% by using alternative water resources.

Contact

Contact

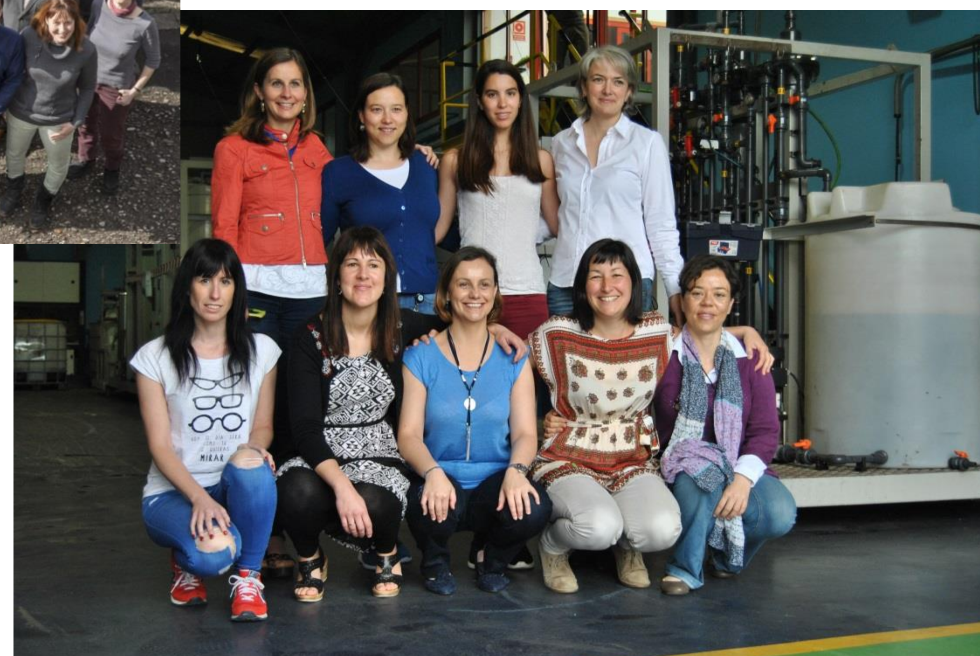
INSPIREWATER

Martin Hubrich	martin.hubrich@bfi.de	+49 211 6707 343
Matthias Kozariszczuk	matthias.kozariszczuk@bfi.de	+49 211 6707 494
Beatriz Padilla Vivas	beatriz.padilla-vivas@arcelormittal.com	+34 985 12 66 44

SPOTVIEW

Elena Piedra Fernández	elena.piedra@arcelormittal.com	+34 985 12 66 44
Martin Hubrich	martin.hubrich@bfi.de	+49 211 6707 343
Matthias Kozariszczuk	matthias.kozariszczuk@bfi.de	+49 211 6707 494

Thank You For Your Attention



Innovative and sustainable soutions in the steel industry – Recovery of acids (INSPIREWATER)

Andreas Rosberg, Sandvik Materials Technology

March 25, 2020

Brussels, Belgium

Swedish Environmental Research Institute

SANDVIK

Background

- Pickling of high-alloy tubes
  - Phosphoric-sulphuric acid used for pickling
  - Life of acid limited by metal content (Fe, Cr, Ni)
- Rinsing in tap water
  - 3 different baths
  - Water is changed regularly to keep a low amount of acid
- Waste management
  - Picking acid to landfill at Landøya in Norway
  - Rinse water to wastewater treatment plant

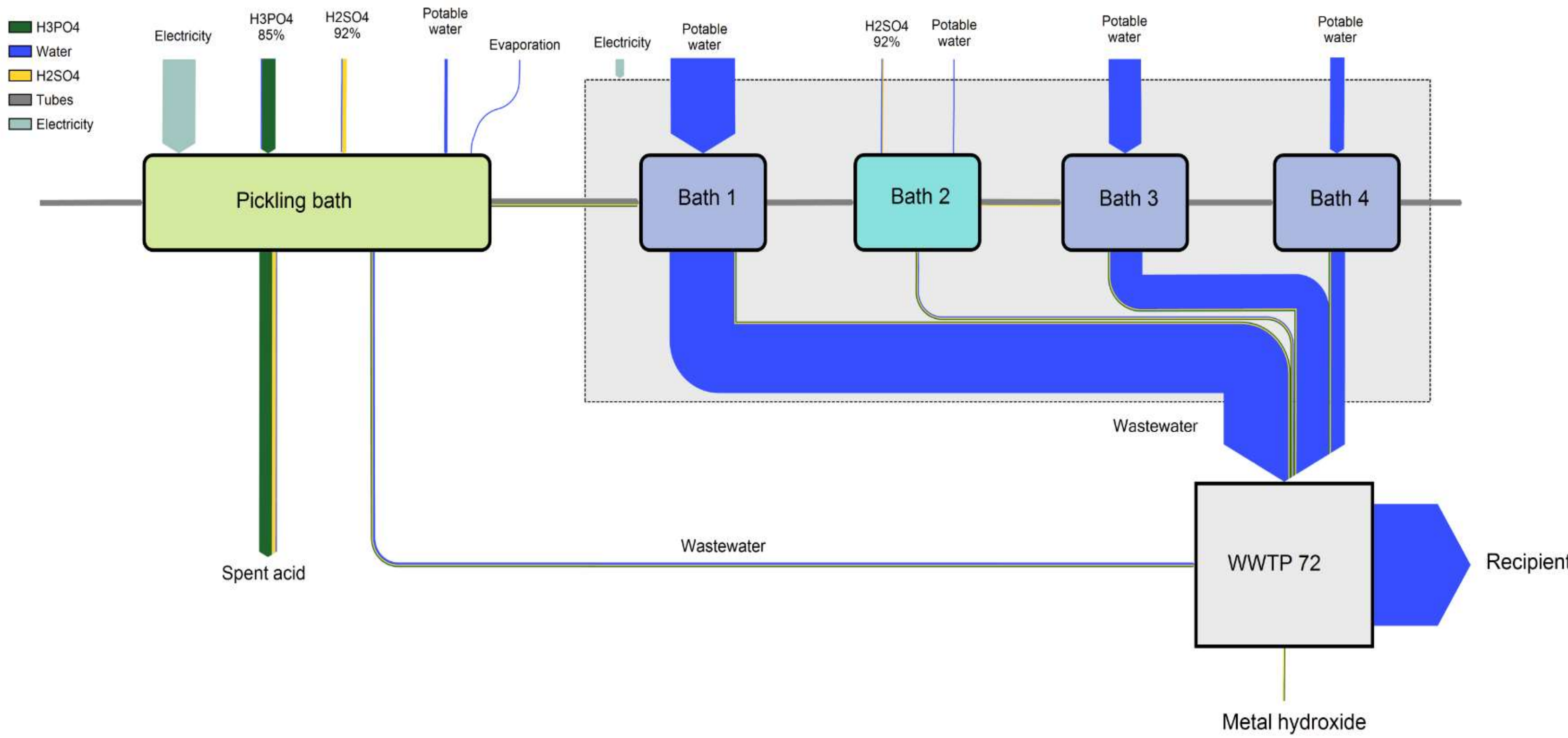
SANDVIK

ivl Swedish Environmental Research Institute

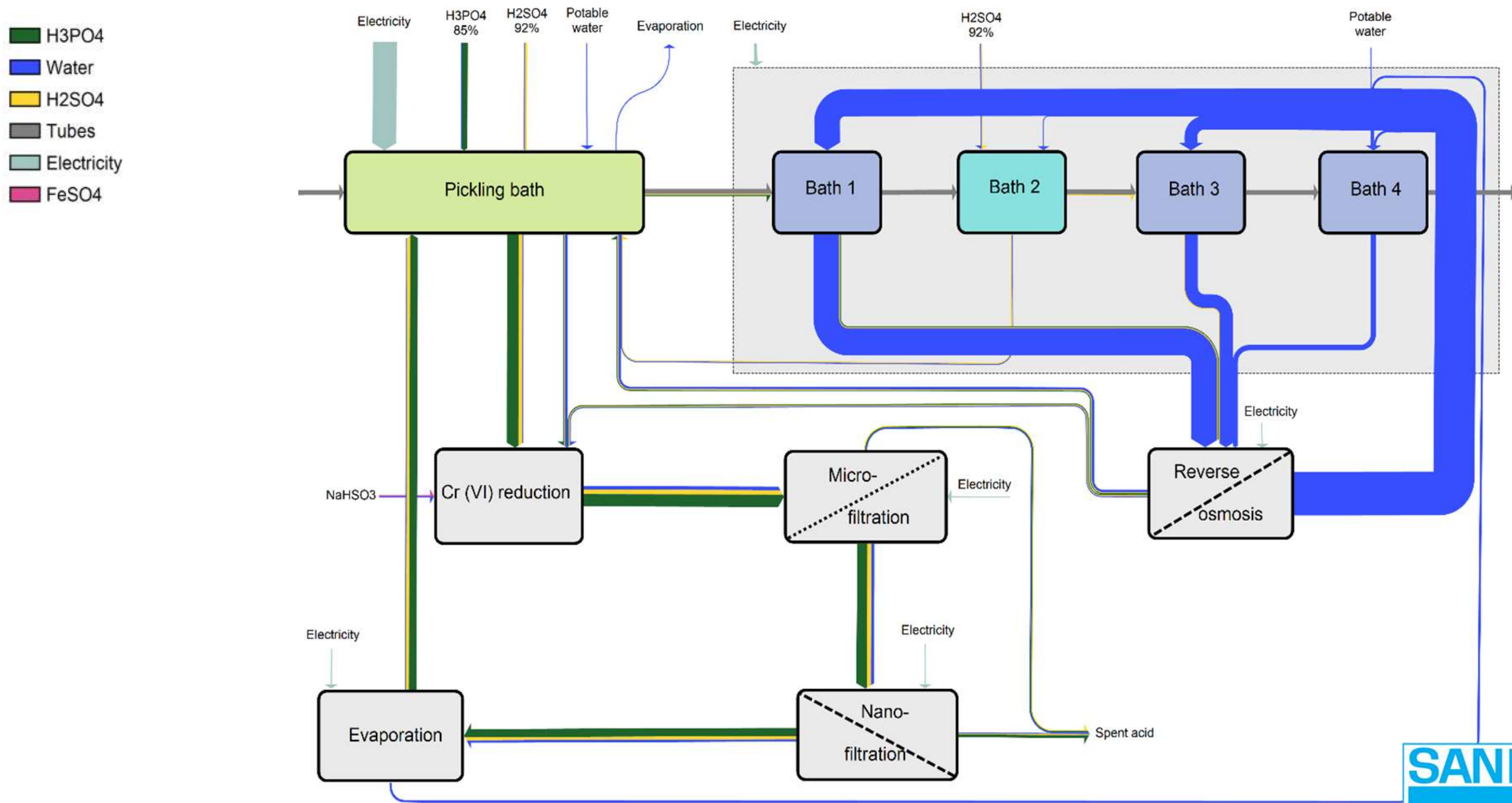
Goal and Purpose of the project

- Demonstrate the recovery of phosphoric- and sulphuric acid from a mixed acid solution used for pickling of stainless and high-alloy tubes
- Demonstrate a rinse water recovery aiming for zero liquid discharge
- Investigate long-term behaviour in the process

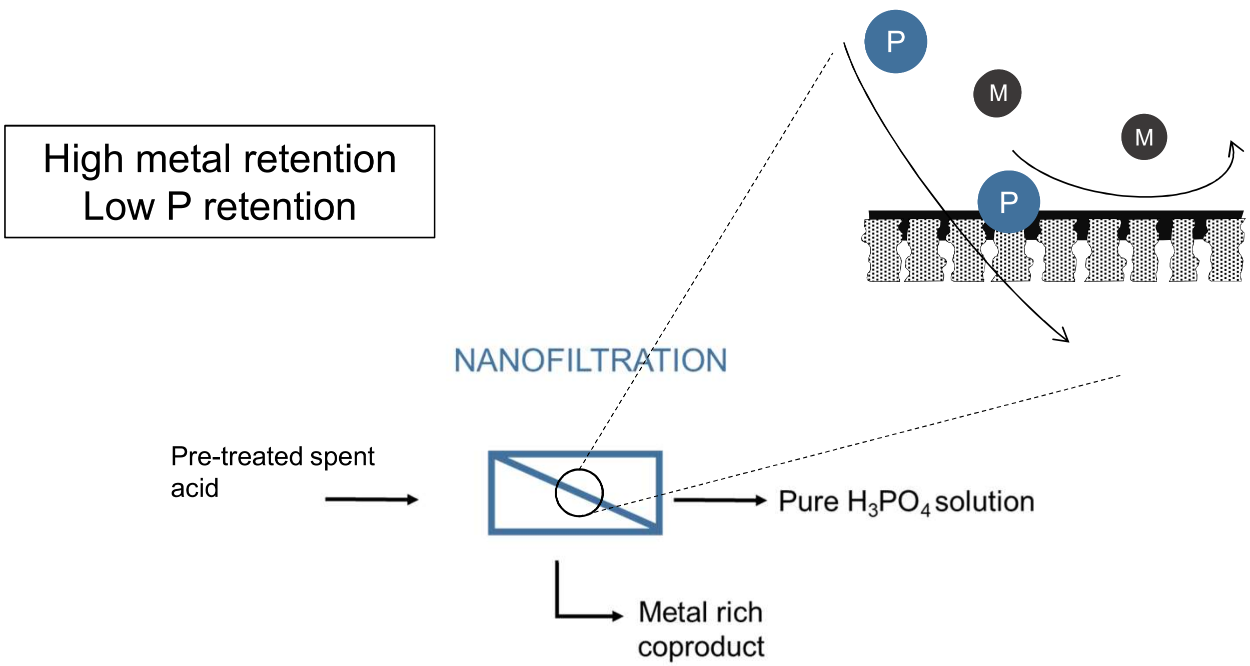
Present situation



The INSPIREWATER solution

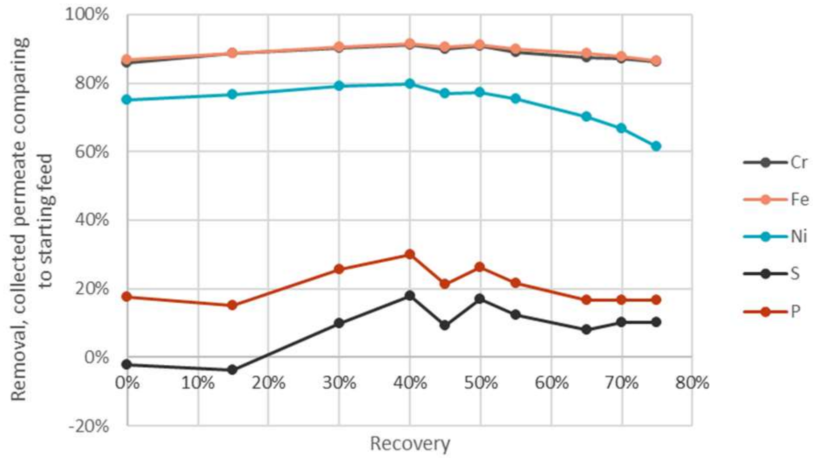


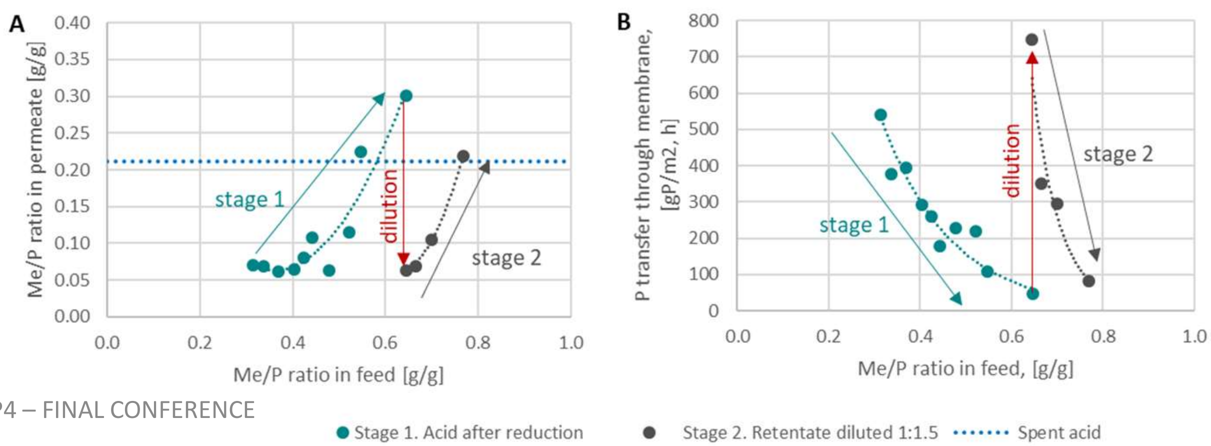
Acid recovery by nanofiltration



- Introduction to technology
- Reduction
- Pre-filtration
- Nanofiltration
- Evaporation

Nanofiltration results

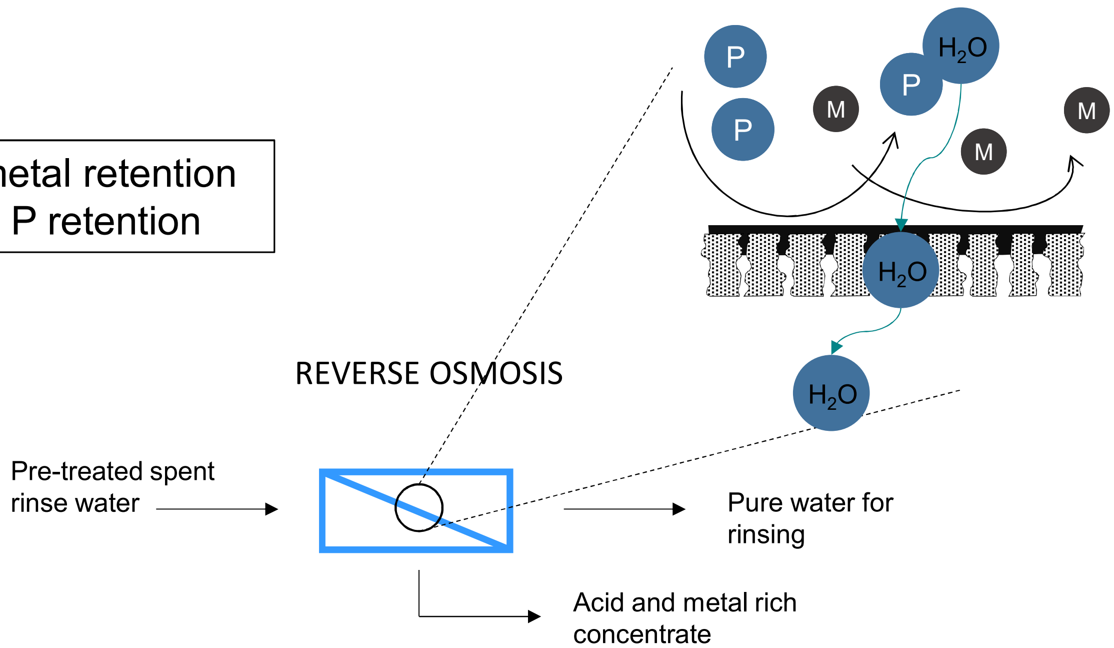




- AMS 3012 membrane operated at 70 bar and 40 °C
- Up to 75% permeate recovery
- Dilution was demonstrated as a way to increase yield

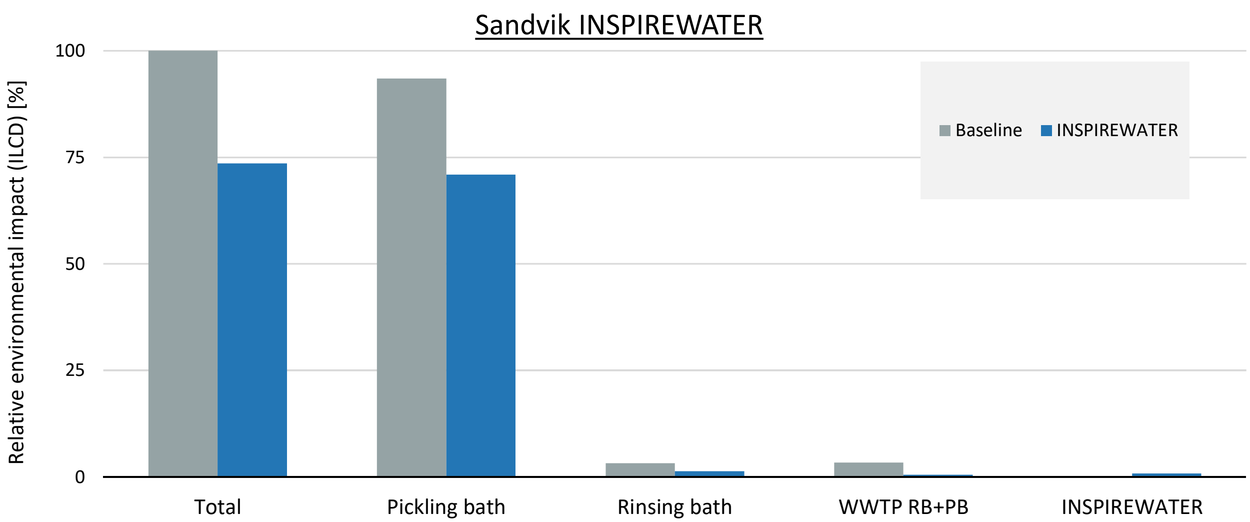
Rinse water recovery by reverse osmosis

High metal retention
High P retention



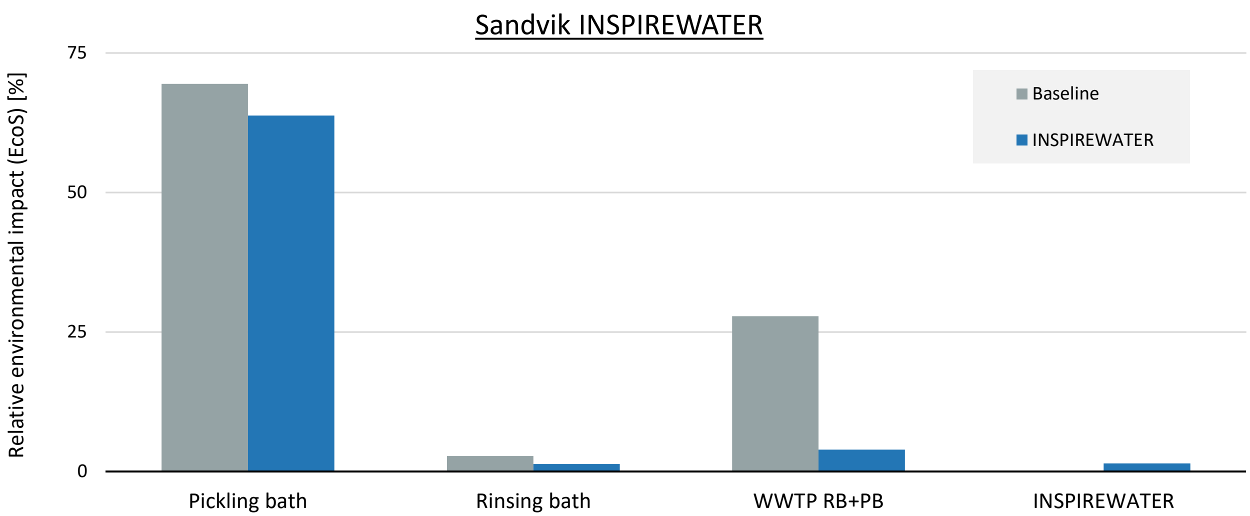
- Introduction to technology
- Reduction
- Pre-filtration
- Reverse osmosis

INSPIREWATER Results LCA - ILCD



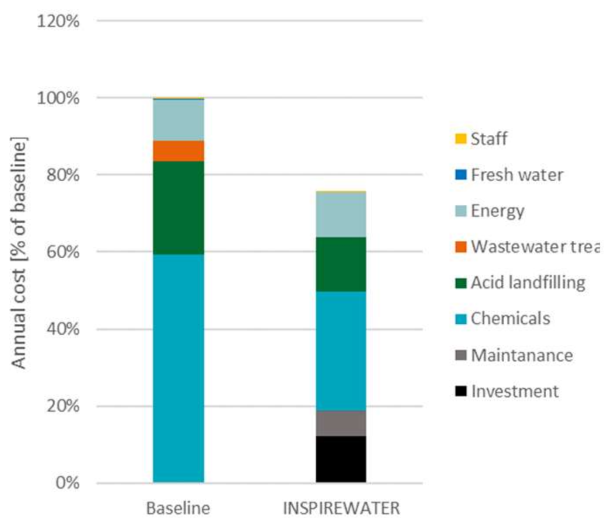
- Calculated on 20% reduced phosphoric acid consumption
- Reduced environmental impact 20%
- Reduced consumption of phosphoric acid 52%

INSPIREWATER Results
LCA - EcoS

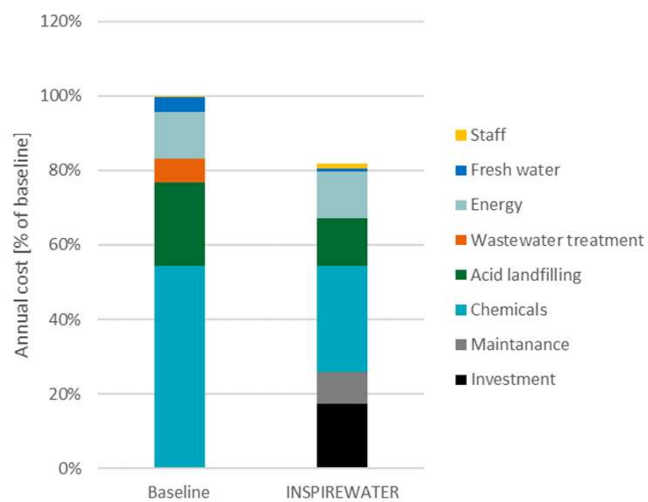


- Calculated on 20% reduced phosphoric acid consumption
- Reduced environmental impact 30%
- Reduced consumption of phosphoric acid 52%

INSPIREWATER Results
LCC



Pickling acid recovery



Pickling acid and rinse water recovery

- Reduced consumption of phosphoric acid with 52% and 61% for sulphuric acid

Summary

- Successful process for acid recovery demonstrated
  - Reduction of use of phosphoric acid – over 50% savings of phosphoric acid possible
  - Amount of landfill can be significantly reduced
  - Cost reductions is feasible as well as enhancement of sustainability
- Reduction of water usage and amount of wastewater
  - Almost closed loop water recycling technically possible
- Continuation of the project
  - Sandvik interested in taking the process to full scale operation
  - Study of implementation to be initiated

InspireWater - SpotView final web conference:

“Holistic approaches for water and resources efficiency in process industry”

New Strategies and Technologies for Process Water Recycling in Tissue Paper Industry

March 25th, 2020

Antti Grönroos (VTT Technical Research Centre of Finland Ltd), Jenni Vaino (Essity), Pasi Nurminen (Valmet), Lotta Sorsamäki (VTT)

SpotView

Horizon 2020
European Union Funding
for Research & Innovation

SPIRE PROJECT

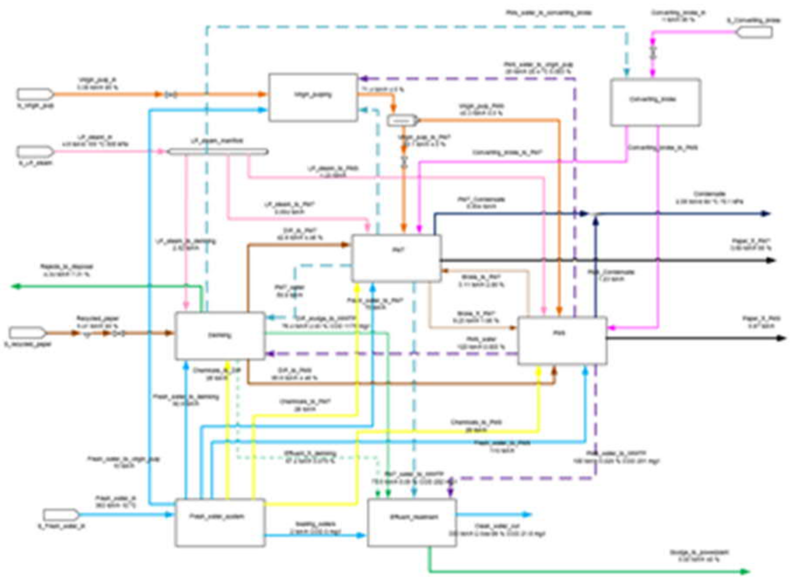
Presentation outline

- Sustainable strategies for process water and reuse in tissue paper industry
- Background of the case mill - Essity Nokia tissue
- Target and scope of the process simulation work
- The process simulation work - Case definitions
- Valmet Ultrafiltration T / High Technology Ultrafiltration
- Process water reuse strategy with kidney technology – How we did it?
- Reuse water production by CR1010/30 – Results of Essity Nokia
- Process simulation work - Results; new water balances of Essity Nokia
- Conclusions

Sustainable strategies for process water and reuse in tissue paper industry

SpotView
Horizon 2020
European Union Funding
for Research & Innovation
SPIRE PROJECT

- The objective of the work was to establish **sustainable process water reuse strategies for tissue mills**
- Strategies were created based on process **modelling and simulation** of process circuits
- The **kidney technologies, Valmet Ultrafiltration T,** were the main technologies in the strategies



Background of the case mill - Essity Nokia tissue

- Essity is a global hygiene and health company manufacturing products and solutions such as tissue paper, baby diapers, feminine care, orthopedics and wound care.
- Water usage of Essity Nokia has decreased over the years, however the age of the mill, combined with the prominent deinking and paper making process means that water use is still fairly high.
- **Annual water consumption of fresh water is approx. 2.4M m3/year i.e. around 380 m3/h.**
- Essity Nokia is aiming towards lower total fresh water consumption by
  - **realizing rearrangements in water circuits in deinking plant (DIP) and paper machines (PM)**
  - **implementing a CR-filter to produce clean shower water from white water**
- **The target of the work was to decrease the total fresh water consumption by 30%**

Target and scope of the process modelling and simulation work

- To verify mill wide the influence of Essity's predefined and realized water reduction changes on the
  1. **Fresh water consumption**
  2. **TSS-level and**
  3. **Soluble COD level**.
- To evaluate new strategies aiming **for reduced fresh water consumption**.
- **Three cases** were evaluated and compared with **the Reference case** presenting the state of the mill before any water reduction changes were made.
- During SpotView project, four measurements campaigns were performed in Essity Nokia mill to study the operation of the mill before and after the water loop changes.
- Used tool**: Balas® stady-state simulation software**

The process simulation work - Case definitions

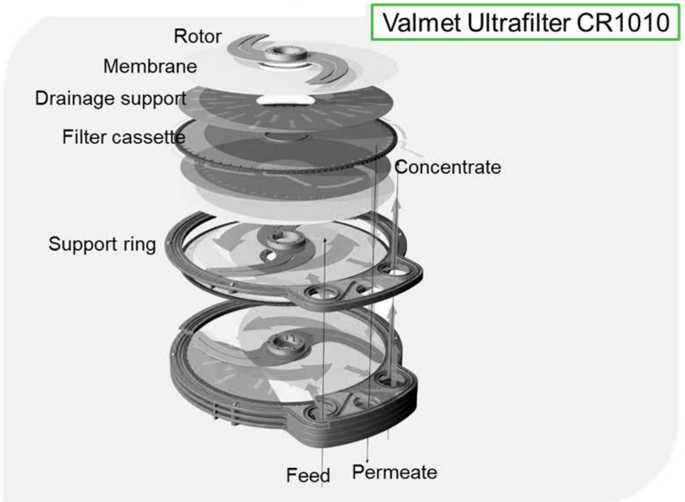
1. Reference case
   - Essity Nokia mill **until the end of 2017:** no water reduction changes made.
2. Case 1
   - Nokia Essity mill **since January 2018:** Re-arrangements in water circuits both in DIP and in PMs.
3. Case 2
   - Nokia Essity mill **since September 2018**
   - Same process configuration as in Case 1
   - Implementation of one pilot-scale Valmet Ultrafilter to PM7
     - The ultrafilter treats part of PM7’s white water → used as shower water
4. Case 3
   - Nokia Essity mill **potential future setup**
   - Same process configuration as in Case 1
   - Implementation of two pilot-scale ultrafilters to PM7 and one to PM9
     - The ultrafilter treats part of PM7’s and PM9’s white water → used as shower water and in chemical dilutions

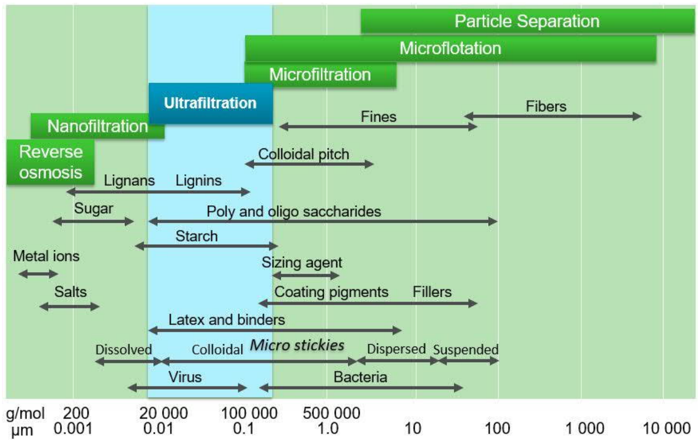
Valmet Ultrafiltration T / High Technology Ultrafiltration

SpotView
Horizon 2020
European Union Funding
for Research & Innovation
SPIRE PROJECT

- Valmet Ultrafiltration T process is designed to produce colloidal and bacteria free ultrapure water from Tissue mill white waters to
  - **Reduce fresh water consumption**
  - **Improve tissue machine runnability and efficiency**
- Compact and modularized process
  - Includes all needed components for fully operational process
- Based on Membrane Technology with Valmet Ultrafilter CR

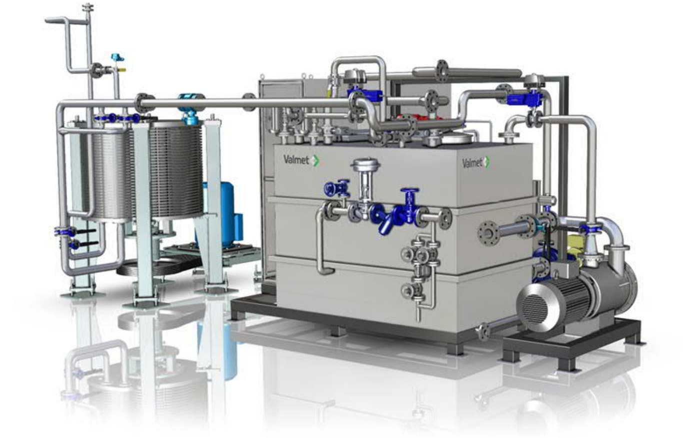
Valmet





Process water reuse strategy with kidney technology – How we did it?

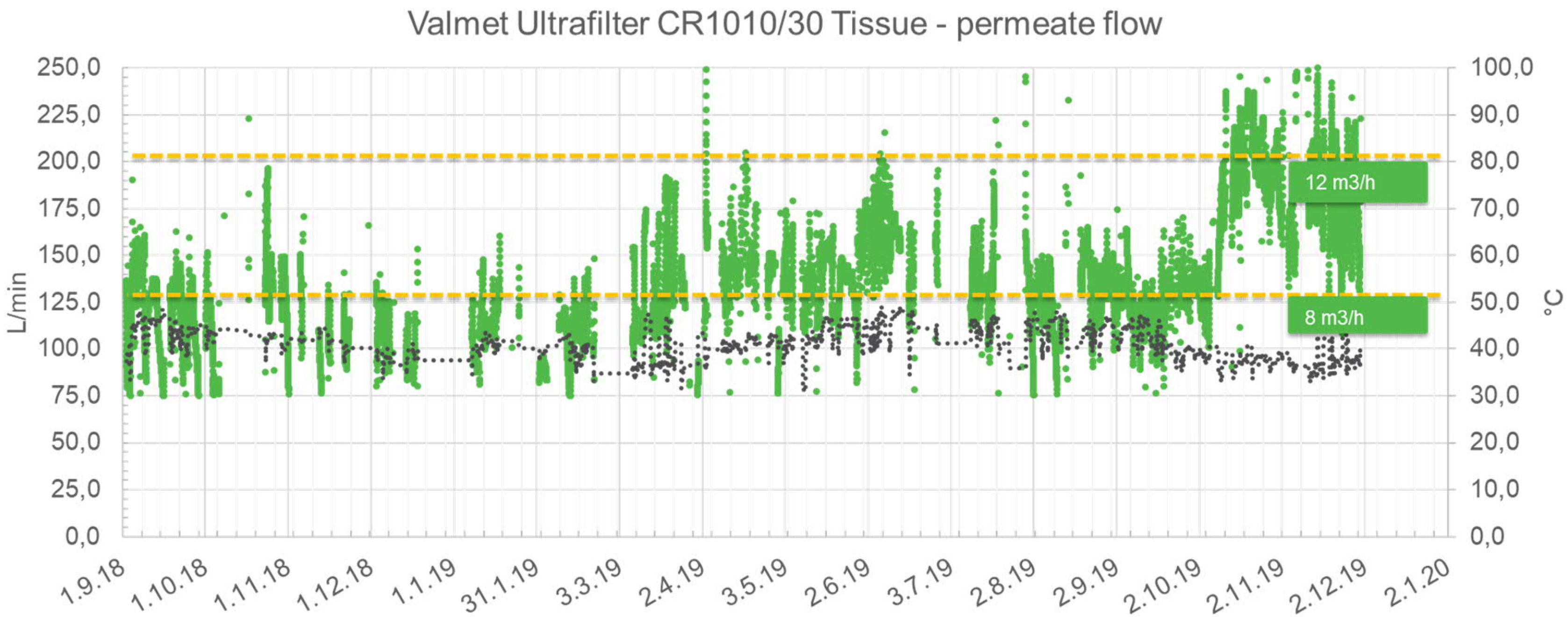
- Semi pilot trials with lab scale Valmet Ultrafilter CR250 for membrane and water selection
- Road map of Valmet Ultrafilter CR1010/30 proto for Tissue
  - Building, testing, construction, updating, …
  - Installation to mill, …
  - Long pilot scale trials in Nokia Essity (Sept. 2018 →



Membrane area	42 m²
Membrane diameter	1 000 mm
Filter cassettes	30 pcs
Membranes	60 pcs
Motor	45 kW (input power < 30 kW)
Size, ca	1,8 x 2,1 x 1,4 m
Membrane pore size	0.02–0.1 µm

Reuse water production by CR1010/30 - Results of Essity Nokia

- Pure water for reuse from clear filtrate 8 m^3/h
- Pure water for reuse from cloudy filtrate 12 m^3/h
- PM7's high pressure showers need 8 m^3/h fresh water – **Great!**



Process simulation work - Results; new water balances of Essity Nokia

SpotView

Horizon 2020
European Union Funding
for Research & Innovation

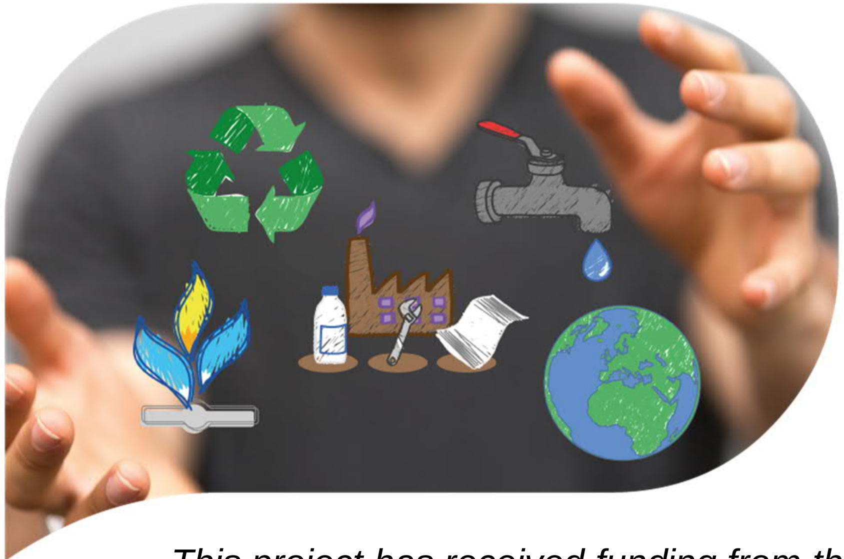
SPIRE PROJECT

	REF	CASE 1		CASE 2		CASE 3	
TOTAL	**m^3/h**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**
Fresh water	375	292	-22%	283	-25%	261	-31%
Effluent	361	276	-24%	267	-26%	244	-32%
DIP	**m^3/h**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**
Fresh water	90	13	-86%	13	-86%	13	-86%
PM7 water	91	102	+12%	102	+12%	102	+12%
PM9 water	95	108	+14%	108	+14%	108	+14%
Effluent	189	118	-37%	118	-37%	118	-37%
PM7	**m^3/h**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**
Fresh water	85	85	0%	76	-11%	67	-21%
Effluent	70	63	-10%	54	-23%	41	-42%
PM9	**m^3/h**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**	**m^3/h**	**Vs.Ref**
Fresh water	110	104	-5.5%	104	-5.5%	95	-14%
Effluent	100	93	-7.2%	93	-7.2%	84	-17%

Conclusions

- Sustainable water reuse strategies for Tissue paper industry were done
- The water reuse strategies were created based on process modelling and simulation of process circuits together with kidney technologies
- By exploiting water circuit rearrangements and kidney technology for producing ultrafiltrated process water to substitute fresh shower and chemical dilution water in both paper machines, a reduction of 31% in total fresh water consumption in Essity Nokia tissue mill was achieved
- Used simulation tool “Balas® stady-state simulation software” is a part of VTT’s simulation and modelling platform
- Kidney technology used “Valmet Ultrafiltration Tissue process” is a part of Valmet Water Management portfolio and thus available through on sales activities.
- Both “tools” are available for sustainable water reuse strategies for Tissue paper industry as well as other Pulp and Paper industry all over the Europe/World

Thank You !



Contact:

antti.gronroos@vtt.fi

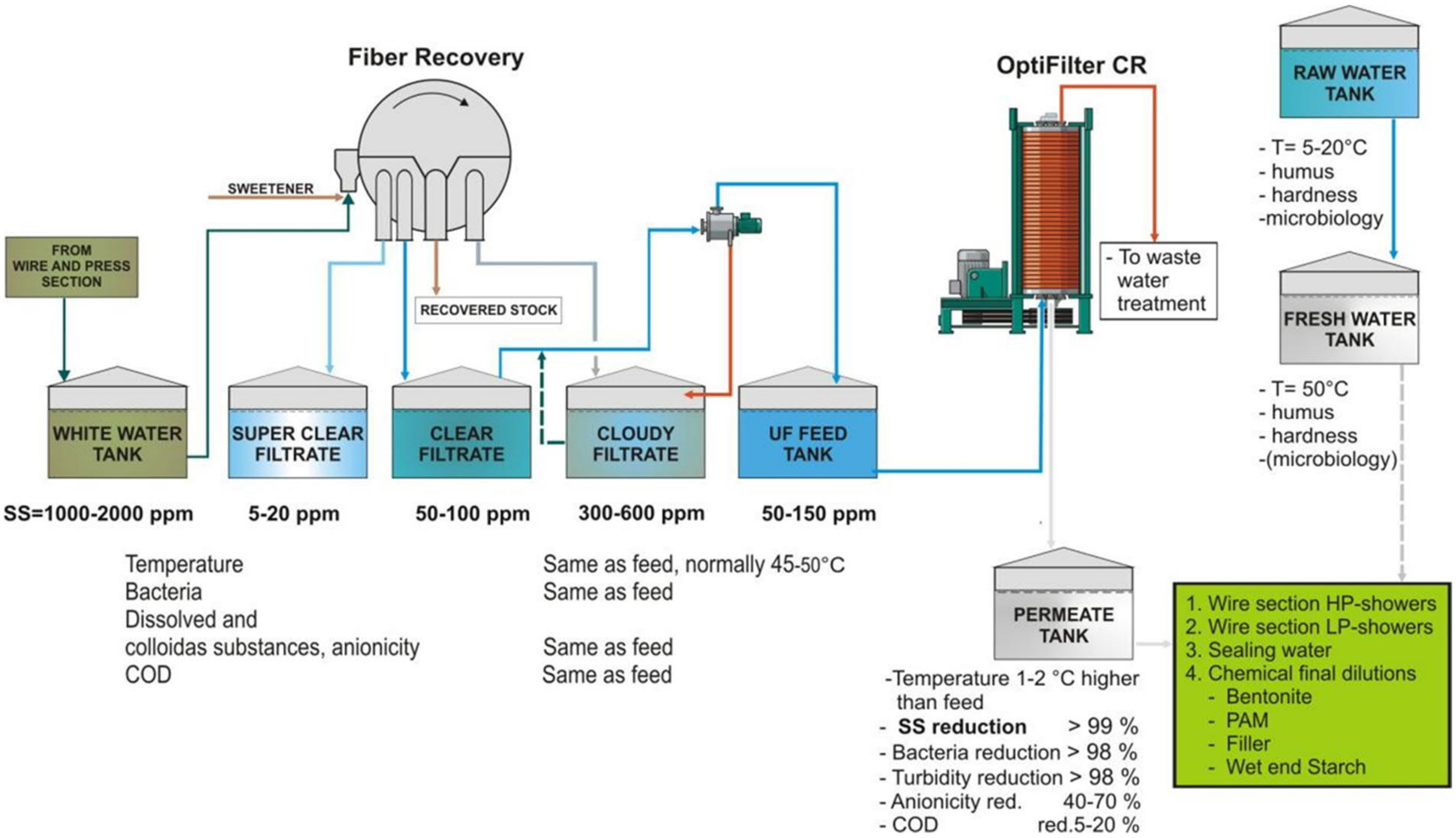
Horizon 2020
European Union Funding
for Research & Innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723577

Case mill – Essity Nokia tissue mill

- Essity is a global hygiene and health company manufacturing products and solutions such as tissue paper, baby diapers, feminine care, orthopedics and wound care.
- Essity has approximately 90 production sites, 47 000 employees and net sales of ~€11.6bn as of 2018. Sales are conducted in approx. 150 countries under the leading global brands Lotus, Tena, Tork, Plenty and Cushelle among others.
- Essity Finland's Nokia mill operation includes a deinking plant, two paper machines, six converting lines and an effluent treatment plant.
- The BREF Pulp, Paper and Board defines the water consumption of a tissue mill with integrated deinking plants around 10-25 m3/t tissue. Essity Nokia mill is currently in the level of ~35 m3/t tissue.

CR1010/30 proto connection – Case Essity Nokia



Final web conference: “Holistic approaches for water and resources efficiency in process industry”

New strategies for effluent reuse in packaging paper industry

25th March, 2020

Stéphanie PRASSE, Patrick HUBER, Eric FOUREST,
Jérôme LEMERCIER, Catherine DESCHAMPS, (**CTP**)
Serge ANDRES (SAICA)

SpotView

Horizon 2020
European Union Funding
for Research & Innovation

SPIRE PROJECT

Effluent reuse for fresh water reduction

- Water circuits closure is still a hot topic due to
  - environmental and regulatory constraints and
  - simultaneously Industry self commitment to further progress in sustainable papermaking processes

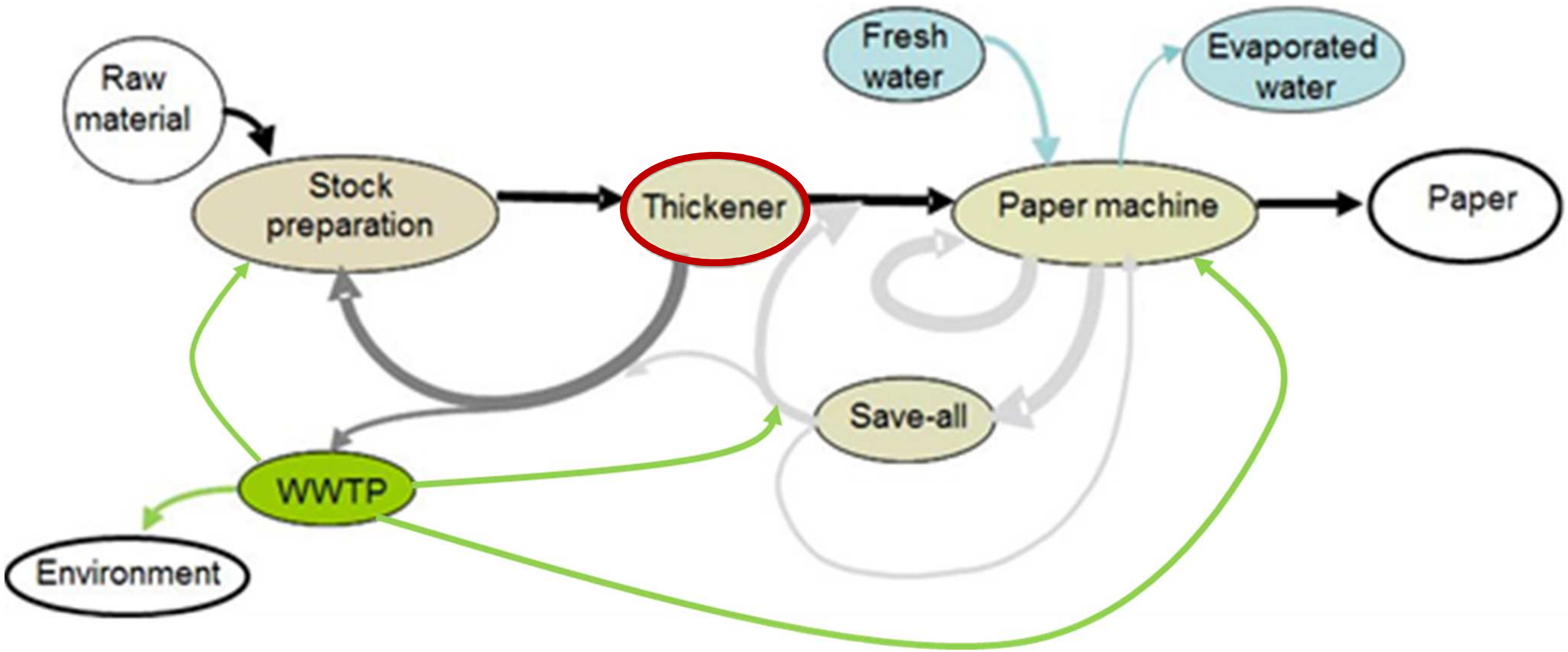
- Reducing fresh water volume has environmental and techno-economical advantages:
  - Reduction of natural resources needs, energy consumption, effluent flow,
  - Fresh water and effluent treatment cost reduction,
- But…

Fresh water reduction consequences

- **Process water load increases**:
  - Suspended fine solids not retained in paper web,
  - Organic and colloidal substances (released by raw material or produced by bacterial activity)
  - Salts build up (from raw material, chemicals, fresh water)
- Decrease in fiber bonding ability (zeta potential is crushed)
- **Temperature** increase – up a point this is beneficial
- **Oxygen** content decrease,
- **Volatile fatty acids increase and H_2 builds up** due to bacteria fermentation (anaerobic conditions) ⇨
  - pH ⇘
  - flammable explosive biogas ⇗

Water management

- Strategies to control COD build-up
  - ⇨ Water loop separation principle combined to counter-current circulation of process waters: BAT
  - ⇨ Effluent reuse after biological treatment: Kidney



Water management

- Thanks to efficient water management (BAT) , detrimental effects due to organic matters can be well controlled nowadays but **mineral salts still build up**.
- Consequences of salinity increase:
  - Additives become ineffective (retention agents, wet-ends additives, flocculants)
  - Weak fibre bonding
  - Scaling, deposits, corrosion
- What is the main source of conductivity?
  - Raw material ?
  - Fresh water ?
  - Additives?
  - Effluent reuse?

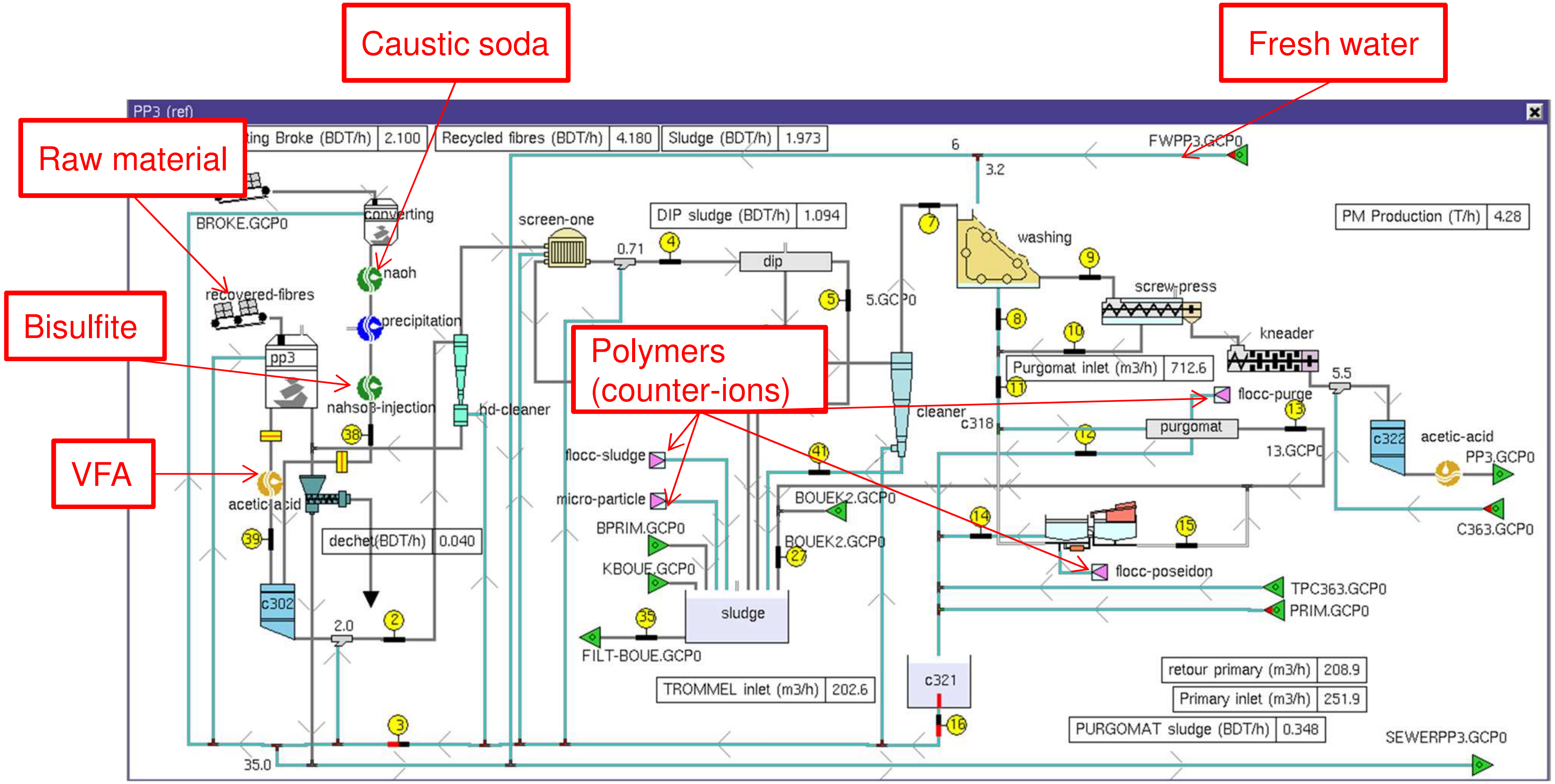
Use of modelling

Method

- Digital model of process circuit design
  - Design of flowcharts with all process equipment, inputs, outputs and the different connections between them.
  - Data collection during on-site campaigns through:
    - Data collection from DCS control system
    - On site flow measurements
    - Physico-chemical analyses on pulp and process waters
  - Design of digital model of the process circuit with CTP simulation tool (PS2000).

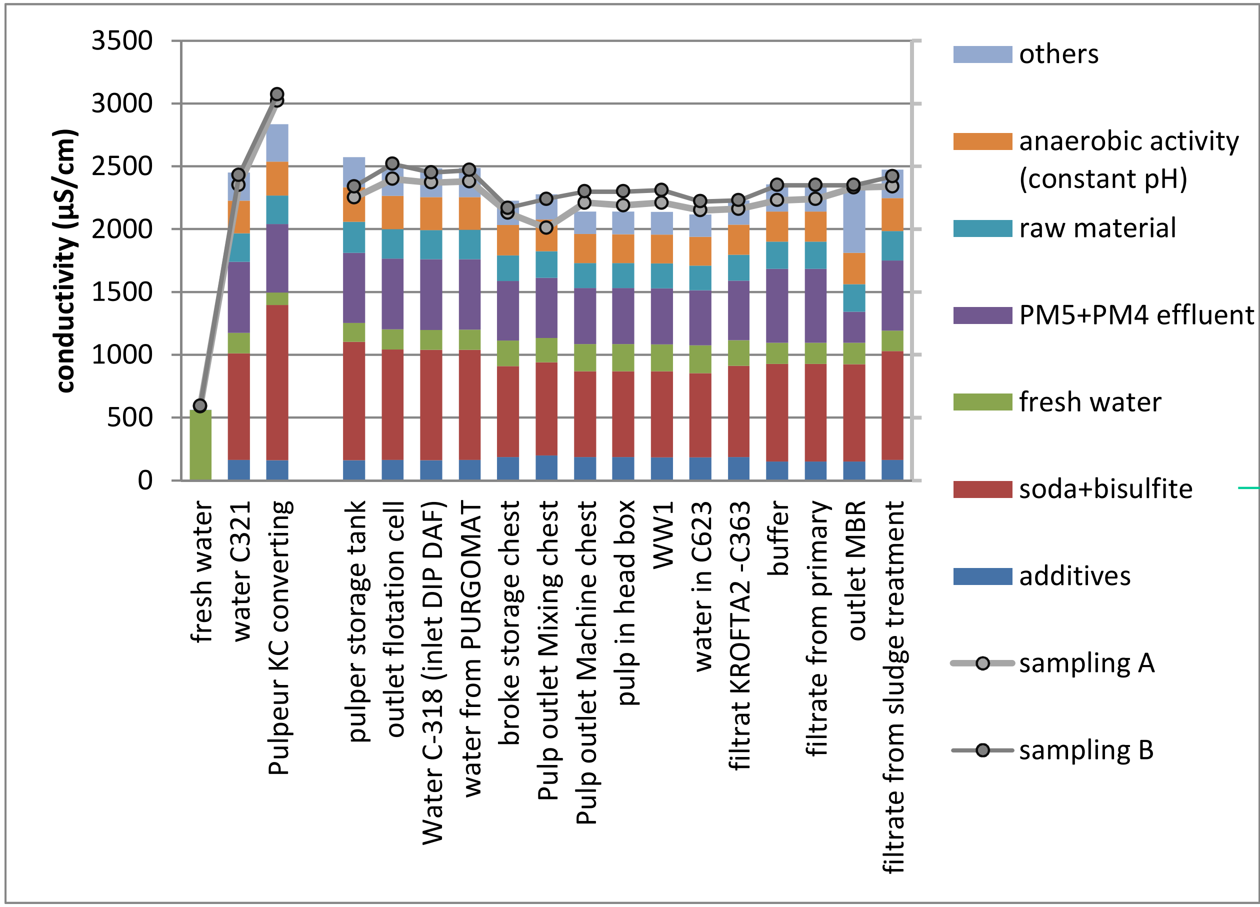
Method

- Build mass and hydraulic balances simulation of the mill (PS2000) and implement ionic sources (PhreeQC)



Conductivity sources

- Conductivity « balance »

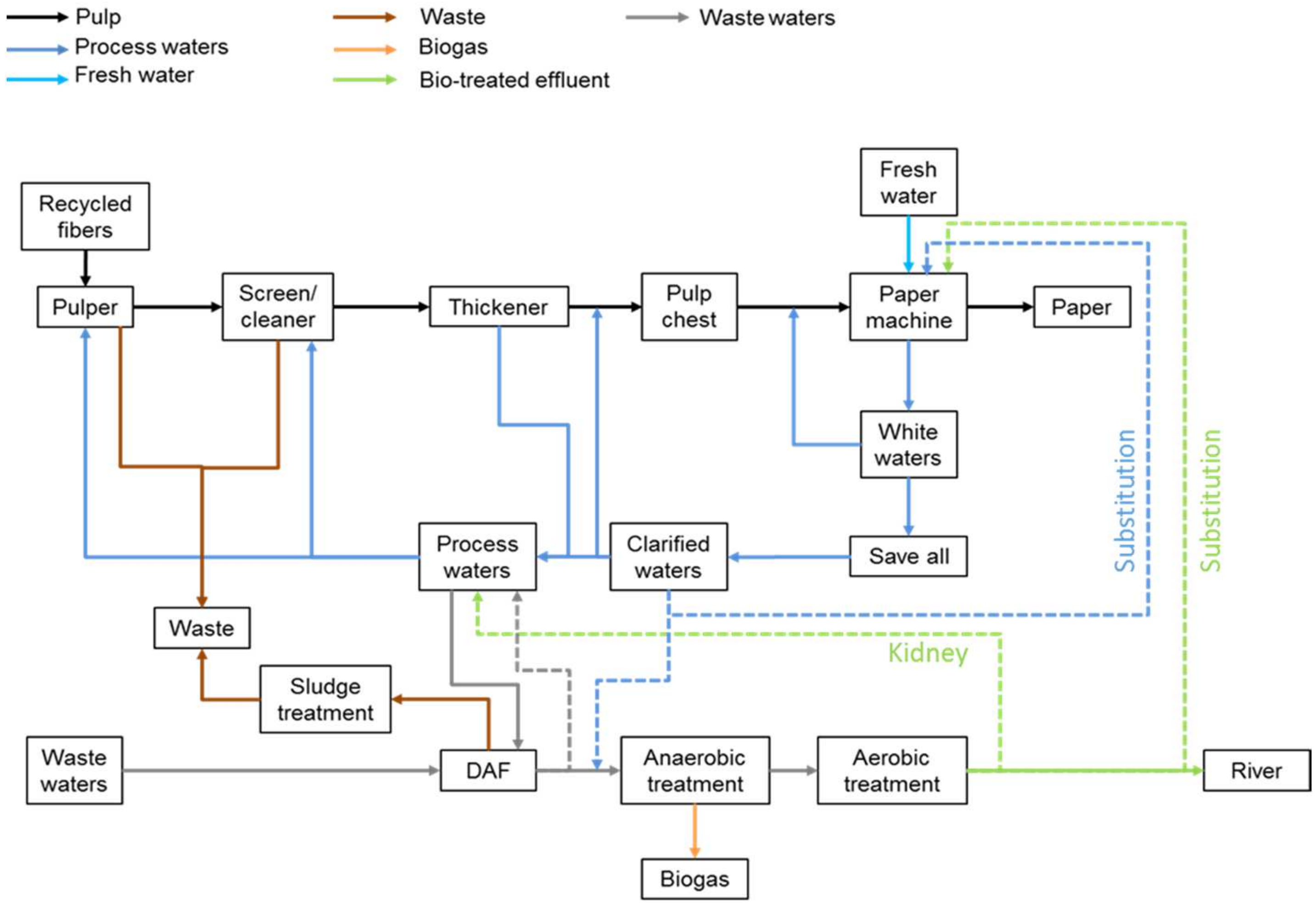


(contribution without considering reduced soda + bisulfite)

Major impact of broke repulping chemicals

Case study: Containerboard mill

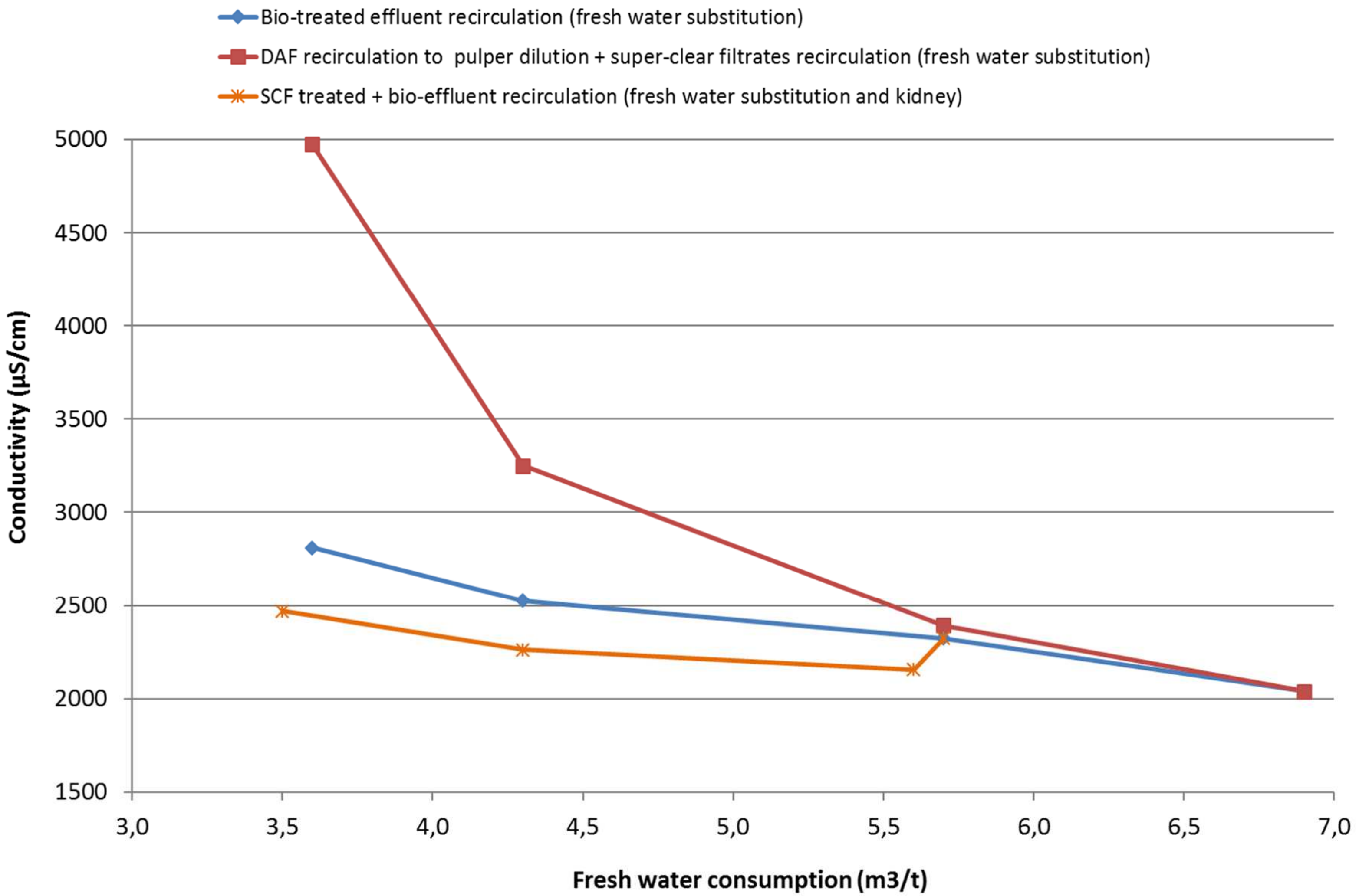
- Proposed scenarios for clarified effluent reuse



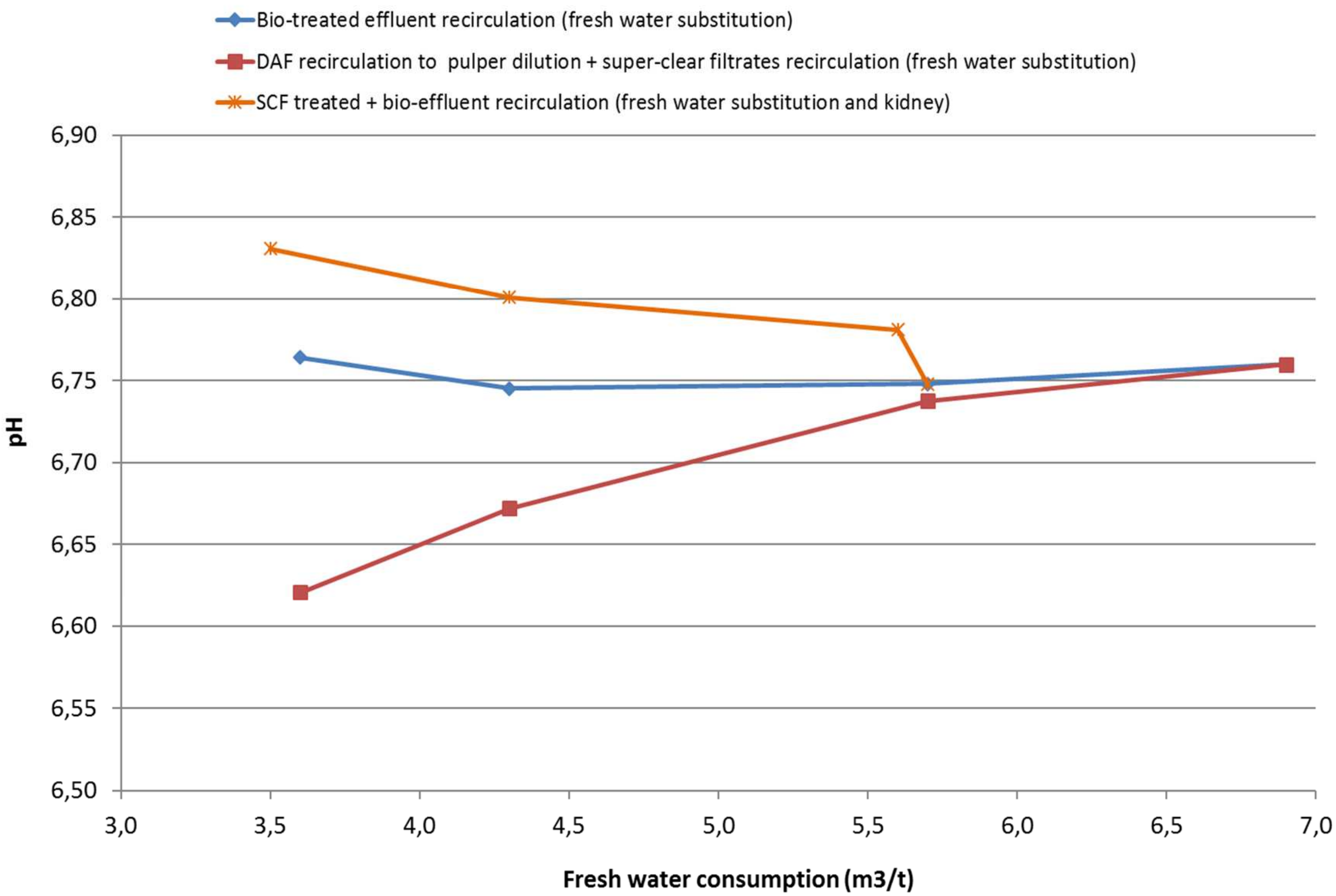
Case study: Containerboard mill

- Options for process water and effluent reuse
  - DAF effluents reuse as dilution water for stock preparation + substitution of fresh water by super-clear filtrates on some low pressure PM showers (sheet forming section)
  - Bio-treated effluent reuse as substitution of fresh water on low pressure PM showers (forming section)
  - Bio-treated effluents reuse as kidney loop in stock preparation facility + substitution of fresh water on low pressure PM showers.
    - This scenario requires to flush part of the super-clear filtrates out of the process, into the WWTP, in order to be able to increase the recirculated bio-treated flow

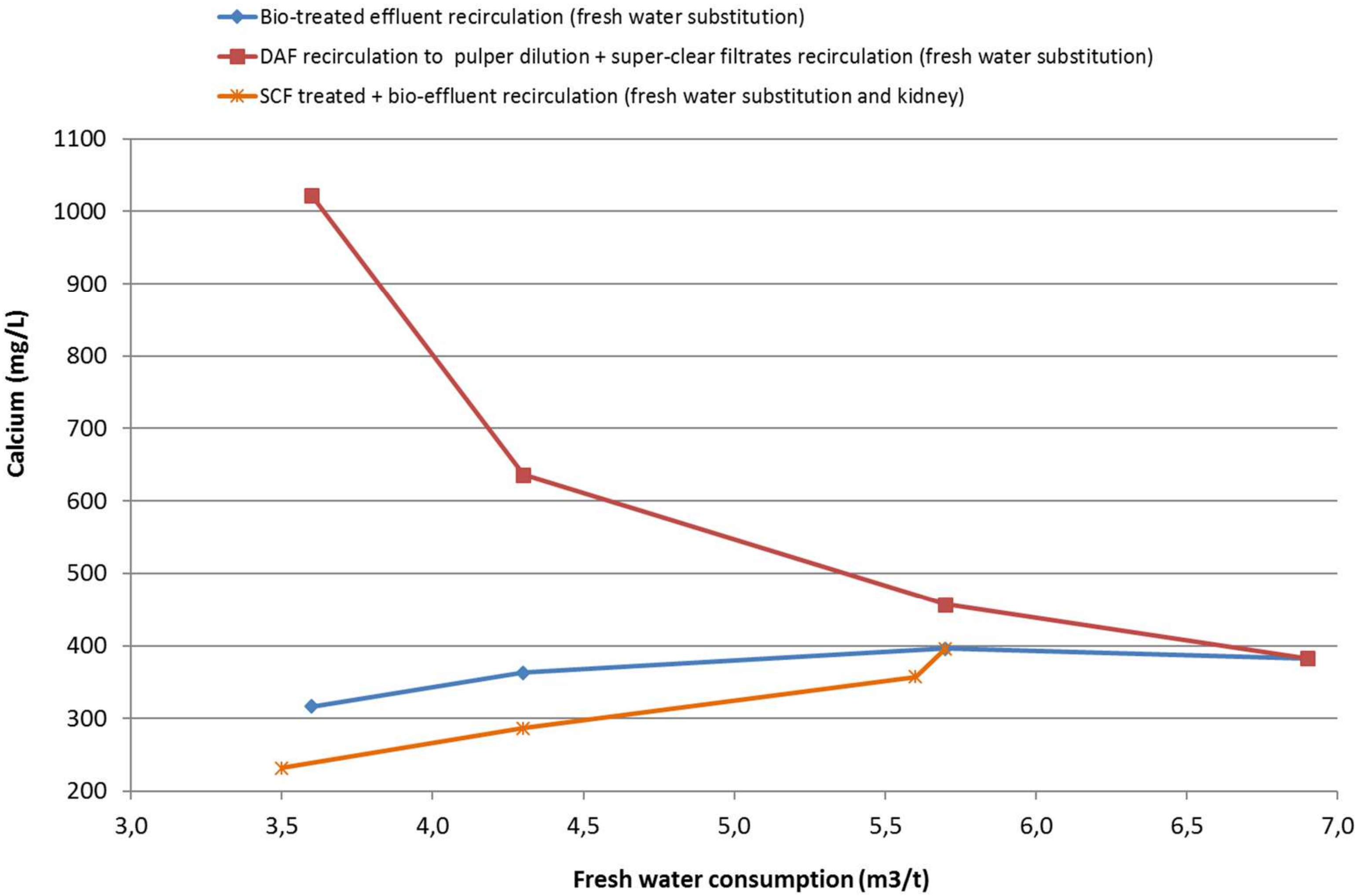
Case study: Containerboard mill



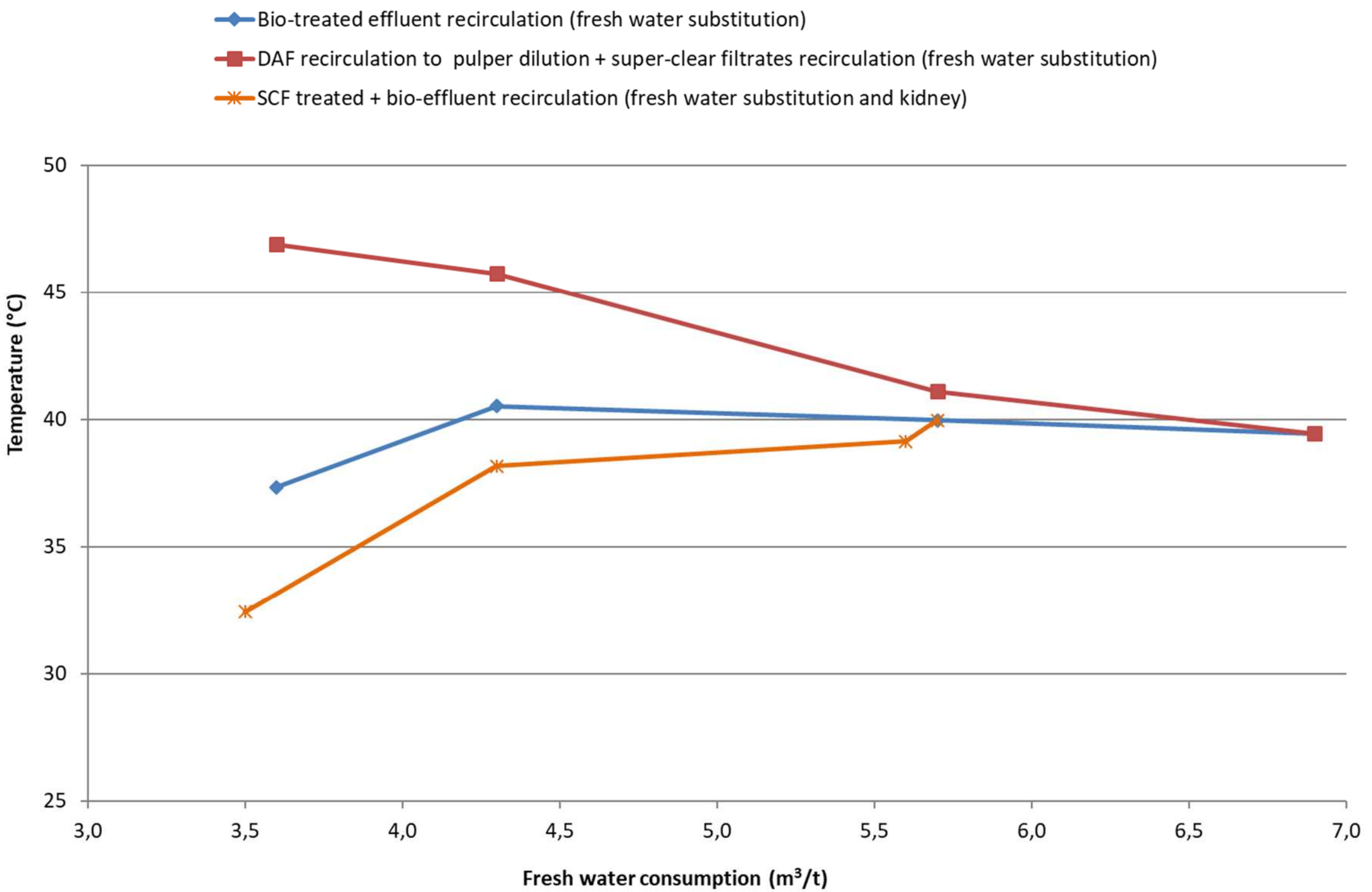
Case study: Containerboard mill



Case study: Containerboard mill



Case study: Containerboard mill



Case study: Containerboard mill

- Synthesis

	DAF recirculation to pulper dilution + SCF* recirculation (FW substitution)	Bio-effluent recirculation (FW substitution)	SCF* bio-treated + bio-effluent recirculation (FW substitution + kidney)
COD	-	+	+++
Conductivity	- - -	-	+
T°	- - -	-	- - -
pH	- -	+	++
Calcium	- - -	+	++

- Fresh water reduction from 7.0 to 3.5 m^3/t
- Temperature decrease ⇨ heat pumps implementation

Conclusion

- **To go further on fresh water reduction:**
  - Need case by case of a specific local study taking into account
    - Pulp and water process circuits, existing and retrofit program
    - Water management rules
  - Identification of chemicals sources
    - Raw materials, fresh water, chemicals
  - Modeling of the mill
    - Mass and hydraulic balances
    - Chemical equilibrium
  - Simulation of bio-effluent reuse according to different scenarios to predict COD, conductivity and pH outcomes

Exploitation's outlook in an OCC mill

- During Spotview, many scenarios concerning the reuse of water and recovery of heat have been investigated.
- From this we forecast extensive stepwise reuse of bio-treated effluent
  1. **as a kidney** to limit contaminant build-up in circuit water
  2. **as fresh water substitution**

  – Preliminary reduce pulp and water retention times in circuits to limit starch release and hydrolysis:
    - Limit tanks volumes, piping routes, storage levels…

  – Complete the water circuits rearrangement with specific additional satellite processes to overcoming rising bottlenecks:
    - Heat exchangers/pumps,
    - Sand/membrane filters
    - Deionization units,
    - Antimicrobial treatments…

Extensive reuse of clarified effluents

- Implement effluent reuse as **kidney**
  - Additional loop with high circulating flows
  - Operates specifically in the pulp preparation area.
  - Solubilised species are washed out, including starch, VFAs, COD and free calcium.
    - Washed out starch is converted into usefull biogas in WWTP
    - Free calcium settles in form of precipitated lime and is disposed of
  - Depending on circuit closure rate, this can be based on
    - current WWTP
    - or an new extra short loop with small bioreactor next to the pulp building, completed by a lime trap (to avoid calcium building up)

- Constraints
  - Significant impact on process temperature. Heat recovery is recommanded
  - Small specific bioreactor would be less impacting with regard to temperature loss

Outlook – Reuse of clarified effluents

- **Substitue Fresh water**
  - Possibly wide use in many applications with low quality requirements
    - Dilution of chemical additives and cooked starch,
    - Washing hoses around PM (house keeping),
    - Wet end showers…To be investigated case by case

- Constraints
  - Out of scope applications due to mild effluent temperature and unsecured cleanliness
    - Cooling water for air compressors or hydraulic power units (several x10 m3/h).
    - Few high demanding technical applications like HP showers on felts
  - Costs of water circuits rearrangements may increase fast.
    - Concept is easier and cheaper to implement in a mill under construction
  - Preliminary antimicrobial treatment needed

Aknowledgement

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723577

INSPIRE WATER   SpotView

PROGRAMME — WEDNESDAY, 25 MARCH 2020

09:30 Web conference room is open

10:30 Start of the conference program
Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)

10:30 Welcome
DECHEMA and CTP

10:40 Welcome and introduction from SPIRE
Angels Orduna (SPIRE)

10:45 Introduction of INSPIREWATER and SPOTVIEW
Staffan Filipsson (IVL), Eric Fourest (CTP)

11:00 KEYNOTE: Challenges for the chemical industry – creating the next level of sustainable water usage
Niels Groot (Dow Benelux B.V.)

11:10 KEYNOTE: Water and Resource efficiency in the Steel Industry: current challenges and new solutions under an ecosystem perspective
Sophie Carler (Jerncontoret)

11:20 KEYNOTE: Water and Resource efficiency in the Pulp and Paper Industry: situation and new challenges with digitalisation
Jori Ringman (Confederation of European Paper Industries)

11:30 KEYNOTE: Recent development in EU Water Policy
Bettina Doeser, Head of Clean Water Unit, European Commission

11:40 PANEL DISCUSSION: Challenges for Water Management in Industry
Moderator: Brian Maguire (EBX MEDIA)
Participants: Niels Groot (Dow Benelux B.V.), Sophie Carler (Jerncontoret), Jori Ringman (CEPI), Bettina Doeser (EC), Angels Orduna (SPIRE)

12:15 Lunch break

13:15 Innovative and sustainable solutions in the steel industry – new developments in water management (INSPIREWATER/SPOTVIEW)
Martin Hubrich, VDEh-Betriebsforschungsinstitut (BFI), Elena Piedra Fernández, Beatriz Padilla Vivas (ArcelorMittal)

13:30 Innovative and sustainable solutions in the steel industry – recovery of acids (INSPIREWATER)
Andreas Rosberg (Sandvik), Fredrik Hedman (IVL)

13:45 New strategies and technologies for process water recycling in tissue paper industry (SPOTVIEW)
Antti Grönroos (VTT), Jenni Vaino (Essity), Pasi Nurminen (Valmet), Lotta Sorsamäki (VTT)

14:00 New strategies for effluent reuse in packaging paper industry (SPOTVIEW)
Stéphanie Prasse (Centre Technique du Papier), Serge Andres (Saica EL)

14:15 Coffee break

14:45 Improved technology solutions in the chemical industry (INSPIREWATER)
Jozef Kochan, Friedhelm Zorn (Clariant)

15:00 Innovative and sustainable solutions in the dairy industry (SPOTVIEW)
Anastasios Karabelas, Dimitris Sioutopoulos (CERTH), Konstantinos Georgakidis (MEVGAL)

15:15 Resource recovery from industrial waste water by cutting edge membrane technologies – Outcomes of the ReWaCEM project
Daniel Winter (Fraunhofer Institute for Solar Energy Systems ISE)

15:30 End of the first day

THURSDAY, 26 MARCH 2020 — PROGRAMME

08:30 Web conference room is open

09:00 Wrap-up Day 1
Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)

09:10 KEYNOTE: The Energy Footprint of Water Treatment
Joachim Koschikowski (Fraunhofer Institute for Solar Energy Systems ISE)

09:20 KEYNOTE: Water Footprint, financing industrial water through Blue Bonds
Jaap Feil (iWater – Water Footprint Implementation)

09:30 KEYNOTE: The Value of Water
Thomas Track (DECHEMA e.V.)

09:40 PANEL DISCUSSION: How to save costs with water in industry?
Moderator: Brian Maguire (EBX MEDIA)
Participants: Joachim Koschikowski (Fraunhofer ISE), Jaap Feil (iWater), Thomas Track (DECHEMA e.V.)

10:15 Coffee break

10:45 Holistic water management (INSPIREWATER)
Agata Andersson, Henrik Kloo (IVL)

11:00 Environmental impacts of water optimization strategies developed within SPOTVIEW
Elorri Igos (LIST)

11:15 Environmental and economic assessment of INSPIREWATER solutions for resource recovery in process industries
Fredy Dinkel (FHNW)

11:30 Next steps towards creating sustainable impact through business exploitation (INSPIREWATER/SPOTVIEW)
Presentation of the exploitation opportunities of both projects by PDC and IMCG

11:45 Opportunities and challenges to implement new innovative technologies into existing industrial environments (INSPIREWATER/SPOTVIEW)
Panel discussion moderated by PDC/IMCG. Interactive session with technology providers and end users from both projects

12:15 Wrap-up and some closing words

12:30 End of the conference

www.inspirewater.eu / www.spotview.eu

Improved technology solutions in the chemical industry

INSPIREWATER - Innovative Solutions in the Process Industry for next generation Resource Efficient Water management

CLARIANT

INSPIRE WATER

HORIZON 2020

EU funding GA 723702

Dr. Jozef Kochan
Group Technology & Innovation

25.03.2020

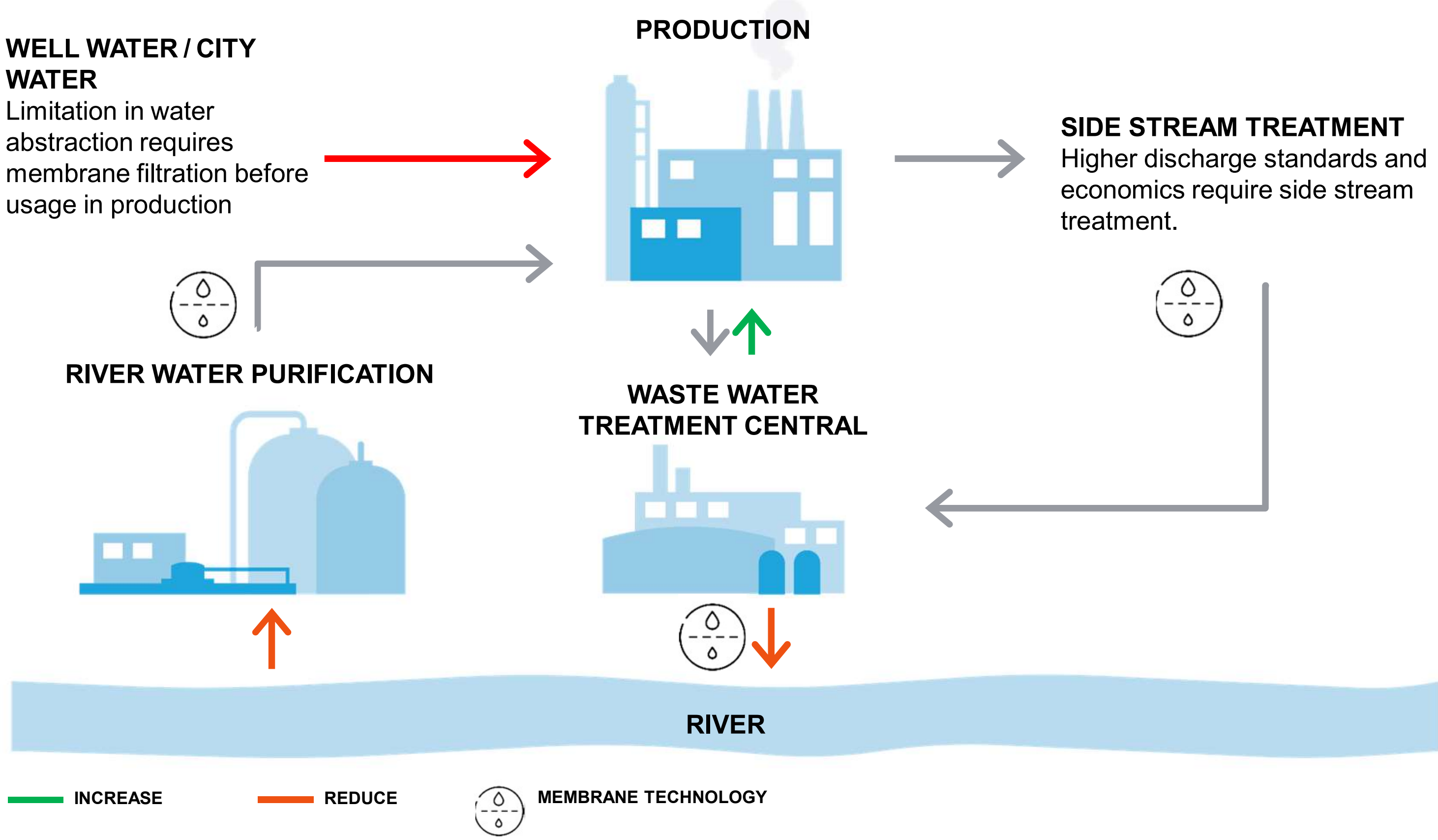
what is precious to you?

CLARIANT

Table of Contents

CLARIANT

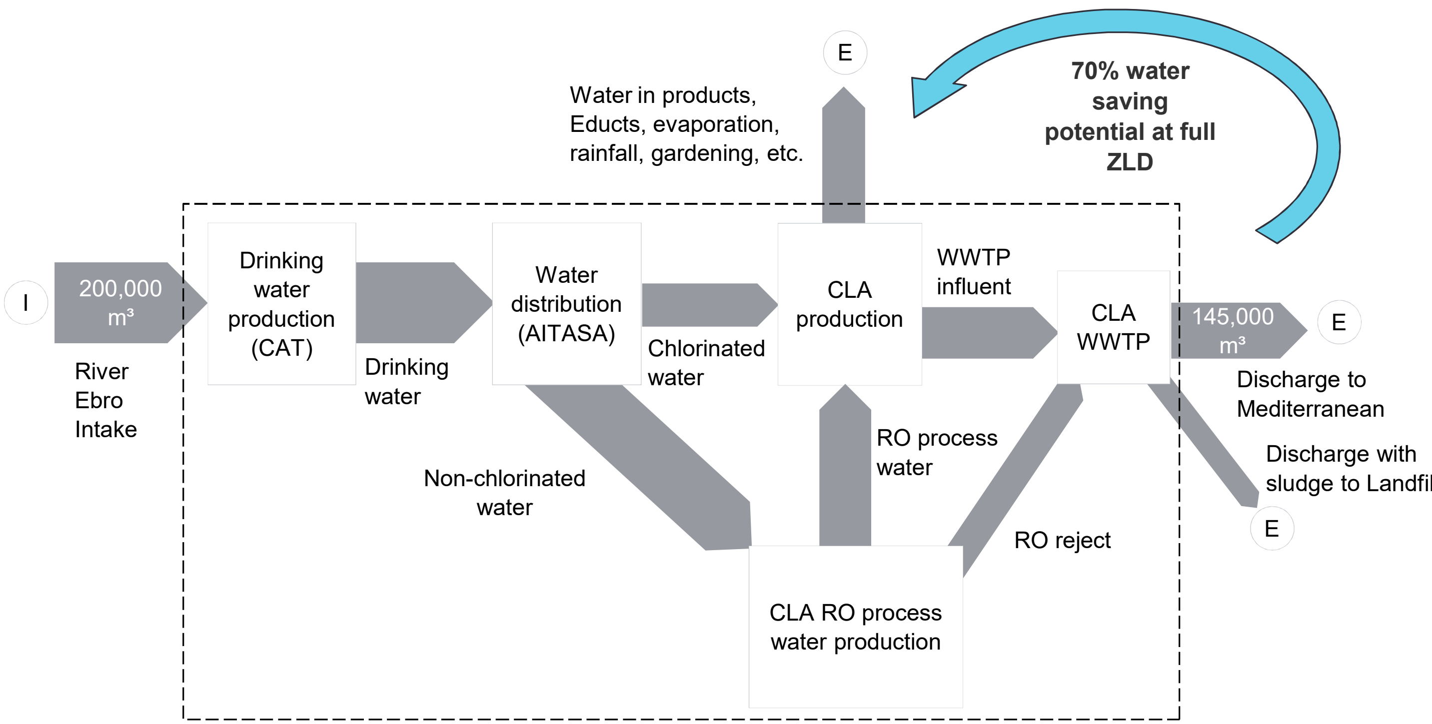
Project Motivation: Water scarcity and stricter discharge limits by governments require higher efforts and cost for WWT



CLARIANT

Towards Zero Liquid Discharge (ZLD)
Total effluent treatment in chemical industry

General aim: Demonstrate the reliability of the technological concept proposed



CLARIANT

Modular process is developed and tested at Clariant’s Tarragona site

Site Description

Production for Clariant BU’s ICS and OMS*
Production: 71 K t / year
WWTP: 60 m³/h / 5.000 TOC
Third companies: IQOXE, National Container Group and others.

Site effluent characteristics

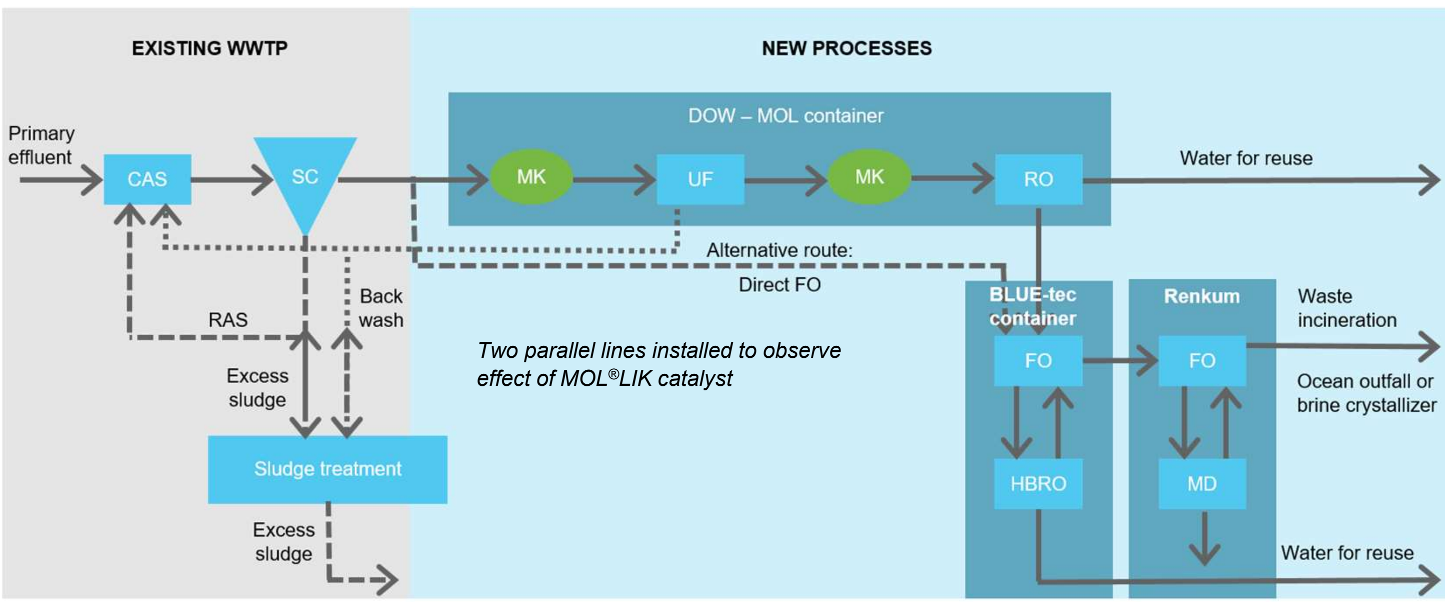
- **Secondary effluent** possesses a high fouling and scaling potential
- Discontinuous processes of 4 companies and multi-purpose pilot plant producing surfactants, detergents, polymers, emulsifiers etc.
- Significant variation in the composition

* BU = Business Unit, ICS = Industrial and Consumer Specialties, OMS = Oil and Mining Services

CLARIANT

Piloting concept tested in INSPIREWater

- Duration of pilot operation: 18 months (Q3/2017 - Q1/2019) in 24/7 operation mode
- **Treatment of secondary effluent** (real conditions) 5 m³/h
- Neutralization in the existing WWT process changed from $Ca(OH)_2$ to NaOH



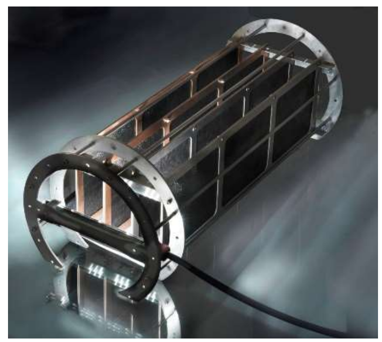
* MK = heterogeneous metal catalyst

Technologies involved in the pilot study (impressions)

- **Ultrafiltration** (IntegraFlux™ SFP-2880XP)
- **Reverse Osmosis** (FILMTEC™ FORTILIFE™ CR100)



- **MOL** catalyst

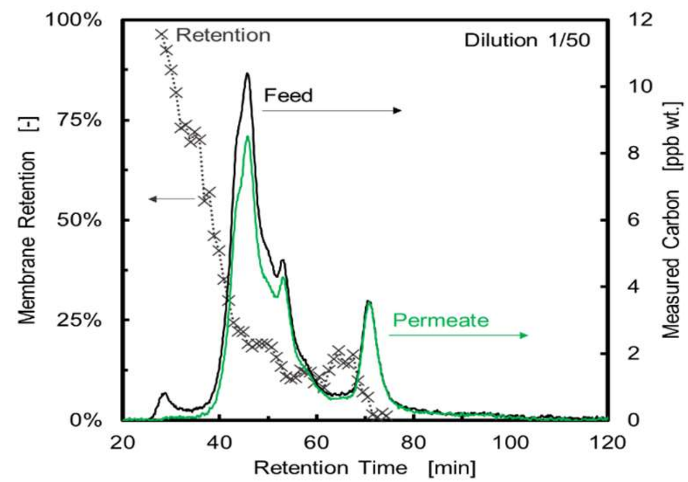


- **Forward Osmosis** incl. draw solution recovery by **RO/MD**


CLARIANT

1st piloting phase: Moderate permeate yields of the proposed concept

- Due to high organic loads on RO stage only moderate water recovery (<40%)
- Pilot concept operation instable with **frequent interruptions** (real production conditions, high variation in wastewater composition from MPPP)
  - Filtration performance deteriorated by **fouling and scaling**
  - Frequent backwashing and cleaning necessary
- RO permeate quality suitable for medium water quality applications like washing water



FAZIT: Reduction of organic load <u>inevitable</u>!

Concept to be adjusted

CLARIANT

Pre-treatment of effluent by GAC results in achieving 65% RO permeate recovery

- GAC (Organosorb 20, Desotec) reduced the COD content <100 mg/l upfront the membrane system

Installation of GAC resulted in

– More **stable operation** of membrane units

– Reduced number of cleaning and backwashing cycles

– **Higher RO permeate yields**

– Permeate quality suitable for **higher grade** recycling purposes

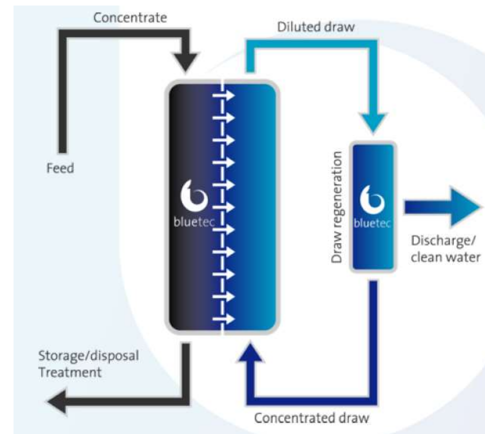
– High removal rate for 1,4-dioxane (>99%) (GAC, RO)

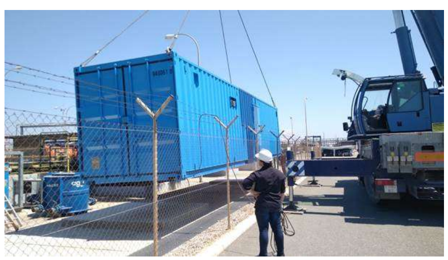
* GAC = Granular activated carbon

CLARIANT

Reverse Osmosis (RO) brine treatment by innovative BLUE-tec FO-HBRO™

- Extraction of water from RO brine through a FO membrane by osmotic pressure difference
- Subsequent water reclamation from draw solution by HBRO (installed in Tarragona) or MD (tested in Renkum NL)
- FO works at “ambient” pressure with lesser fouling propensity





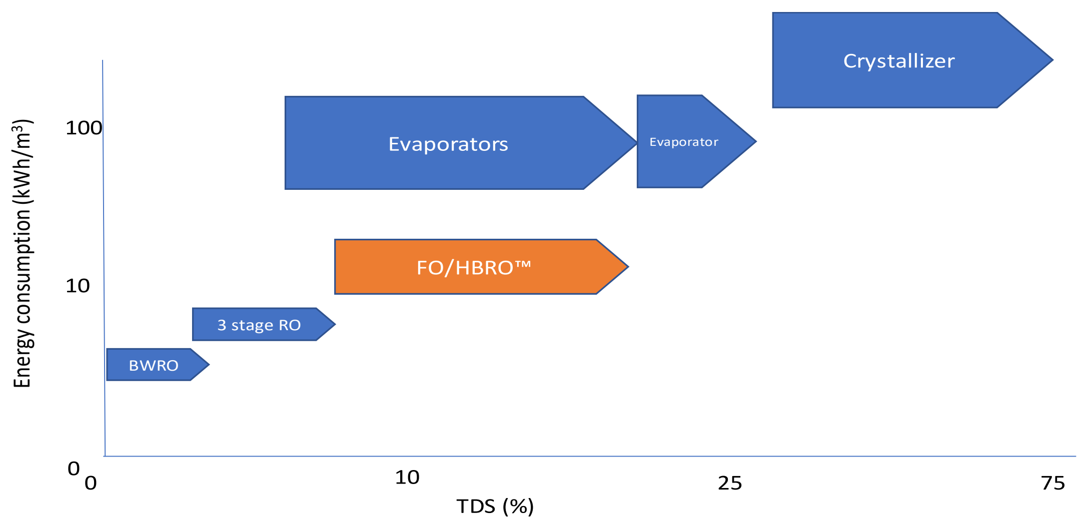
bluetec

* FO = Forward osmosis, HBRO = High brine reverse osmosis, MD = Membrane distillation

CLARIANT

Cost efficient reduction of wastewater volume through FO technology

- Vol. concentration factor (CF) of 2.3 observed meaning **additional 57% water recovery** from the RO brine (CF~9 in lab tests)
- Spec. energy FO-HBRO 36kWh/m³ estimated (20 kWh/m³ for full-scale plant with pressure recovery in place)
- TRL lifted from 4 to 5.



bluetec

CLARIANT

Conclusions

- End-of-the-pipe application of membranes for treatment of industrial water from the speciality chemicals industrial site is technically challenging
- **WATER RECOVERY of 85%** demonstrated with the piloted concept
  - Blended permeate (RO and FO) can be used for medium and low quality applications
- Removal of 1,4-dioxane to below regulatory limits
- FO-HBRO is a promising alternative for brine treatment

Acknowledgement

- F. Zorn
- J. Kochan,
- M. Pastur Romay
- J. Palacin
- P. Aragones
- D. Heitmann
- H. Maier
- V. Chittoor

- L. Barbera Campos
- C.Niewersch
- S. Vila
- O. Ruzafa

- J. Koppe
- J. R. Koppe
- H. Lausch

- L. van Dijk
- C. Patrut
- L. Luning

- R. Wünsch
- C. Kazner
- N. Rastetter

https://www.spire2030.eu/inspirewater

This work has been conducted with the financial support of the Horizon 2020 Programme of the European Commission within the framework of the INSPIREWater project (Grant Agreement Nº 723702)

CLARIANT

Dr. Jozef Kochan
Group Technology & Innovation
25.03.2020

what is precious to you?

Innovative and sustainable solutions in the dairy industry

Webconference, March 26th 2020

Dimitrios Sioutopoulos, Anastasios Karabelas (CERTH), Konstantinos Georgakidis (MEVGAL)

CROSS CUTTING ISSUE CONFERENCE

Holistic approaches for water and resource efficiency in process industry

SpotView

Horizon 2020
European Union Funding
for Research & Innovation

SPIRE PROJECT

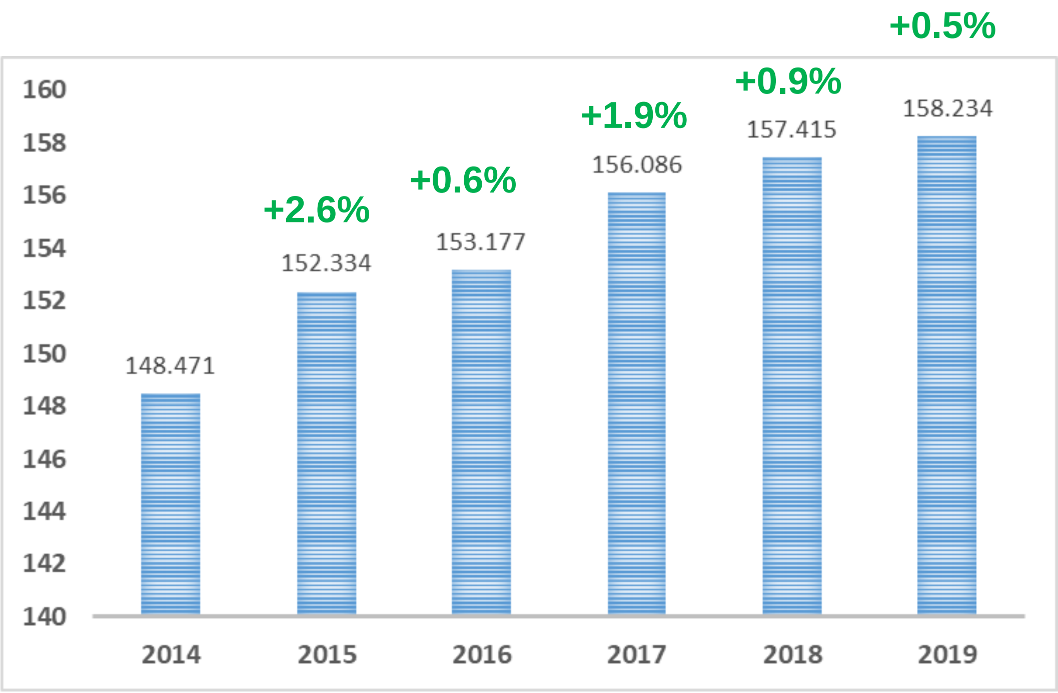
Outline

- Introduction-Dairy industry
- Technologies and results for valuable compounds recovery-Lab tests
  - Laboratory set-ups
  - Experimental procedure
  - Outcomes of lab tests
- Technologies and results for valuable compounds Pilot unit tests
  - Pilot unit description
  - Parameters of testing
  - Pilot unit tests
- Final conclusions

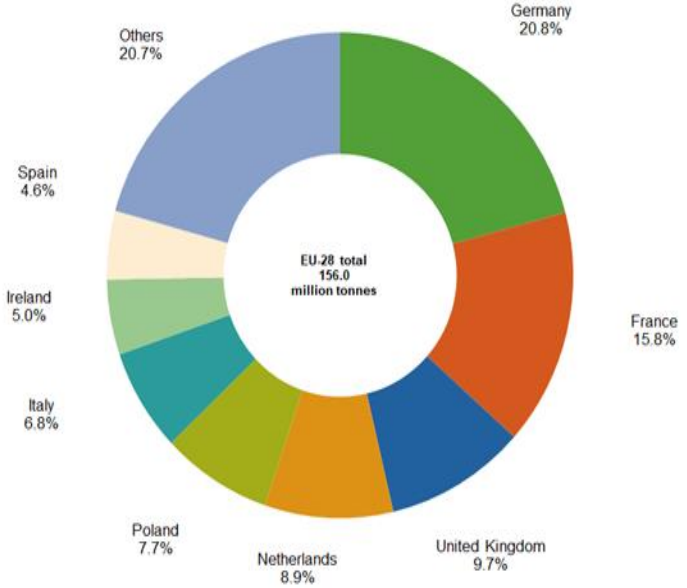
Horizon 2020
European Union Funding
for Research & Innovation

Dairy industry in EU-28

Total milk production (million tonnes)

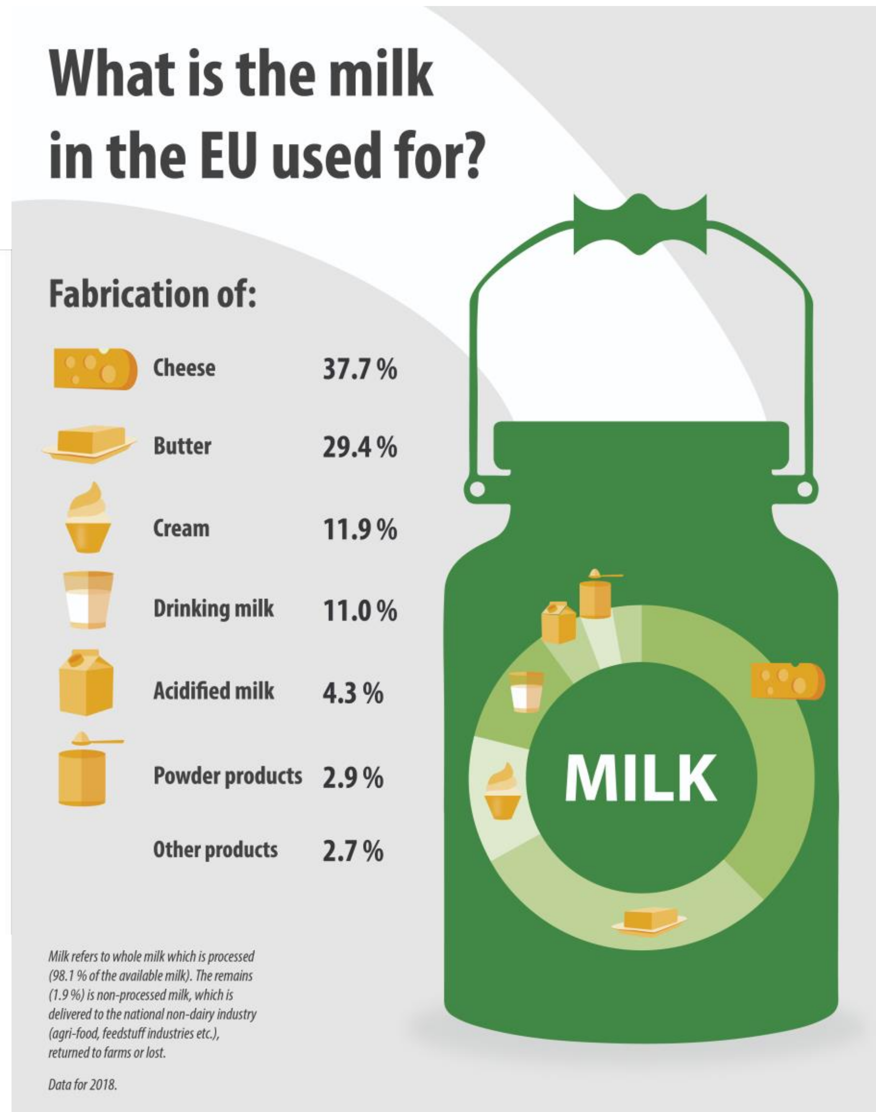


Country's share in 2018



Dairy industry in EU

Horizon 2020
European Union Funding
for Research & Innovation



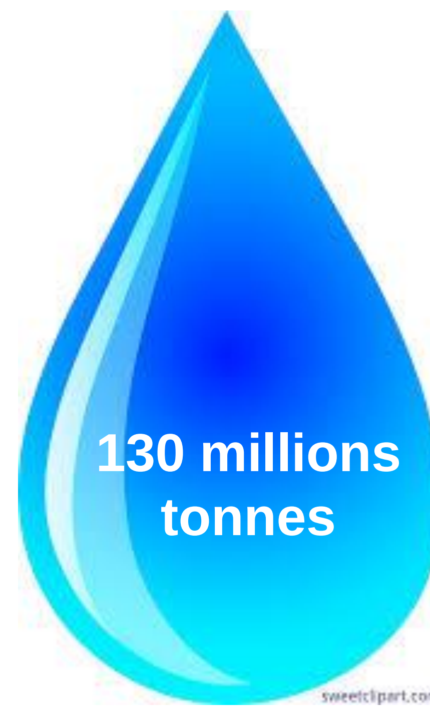
ec.europa.eu/eurostat

Water consumption in EU dairy industry

Horizon 2020
European Union Funding
for Research & Innovation

Annual milk production		Specific water consumption		Annual water consumption
158 millions tonnes	X	4 m^3/ton	=	630 millions tonnes

SpotView Target:
25% reduction



Separation Capabilities of Membranes

Microfiltration, MF

- Suspended solids
- Colloidal matter
- Microorganisms

Ultrafiltration, UF

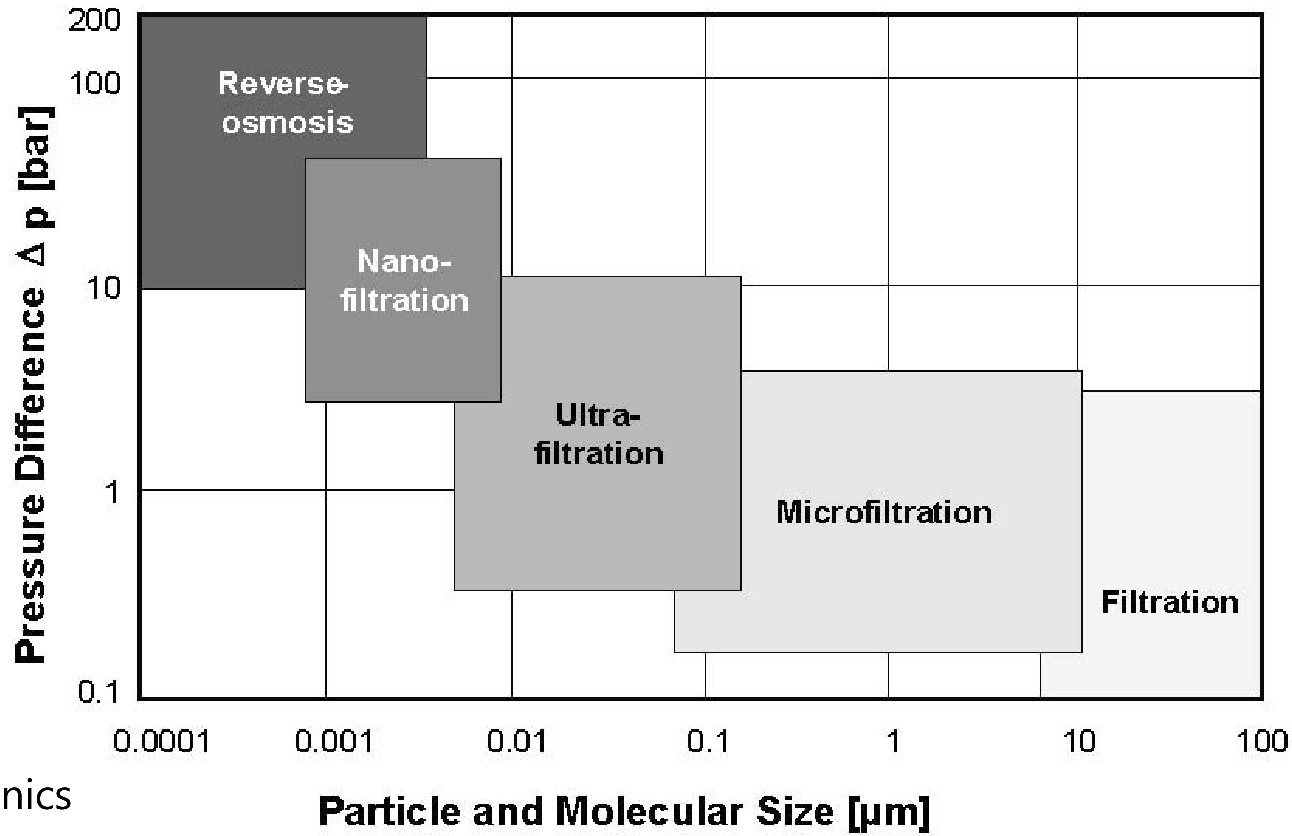
- Organic macromolecules
- Pathogens

Nanofiltration, NF

- Multivalent ions
- Hardness removal
- Low molecular weight organic compounds

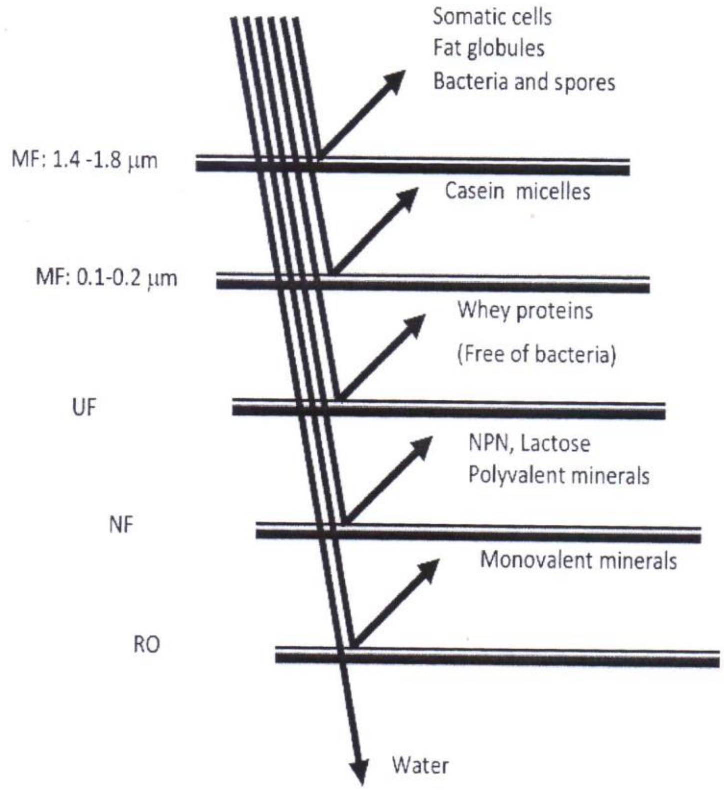
Reverse Osmosis, RO

- Dissolved salts
- Low molecular weight organics

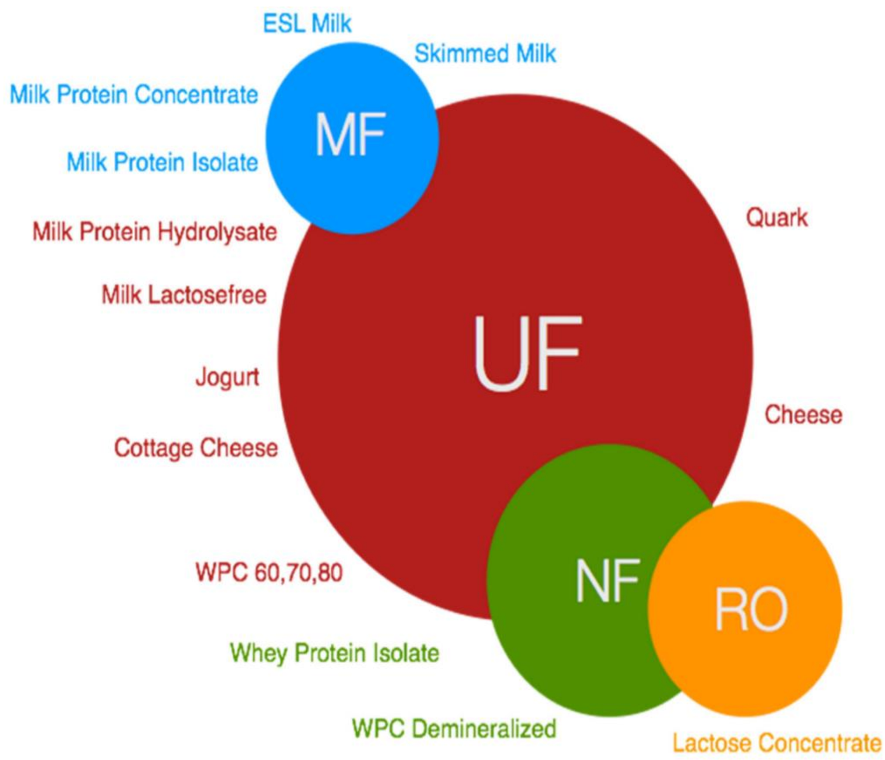


Membranes in dairy industry

Rejection of milk components



Membrane usage

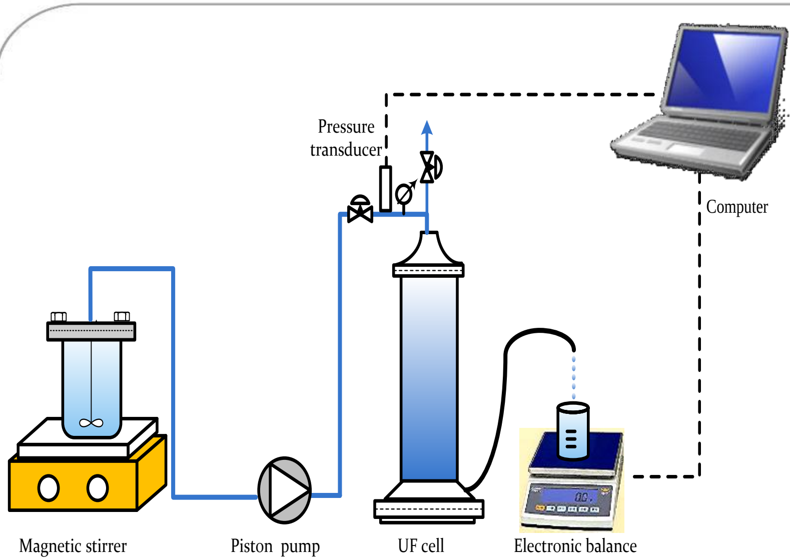


Separation technologies for the recovery of valuable compounds - Lab tests

Pressurized membrane cell

UF/NF membrane Lab pilot

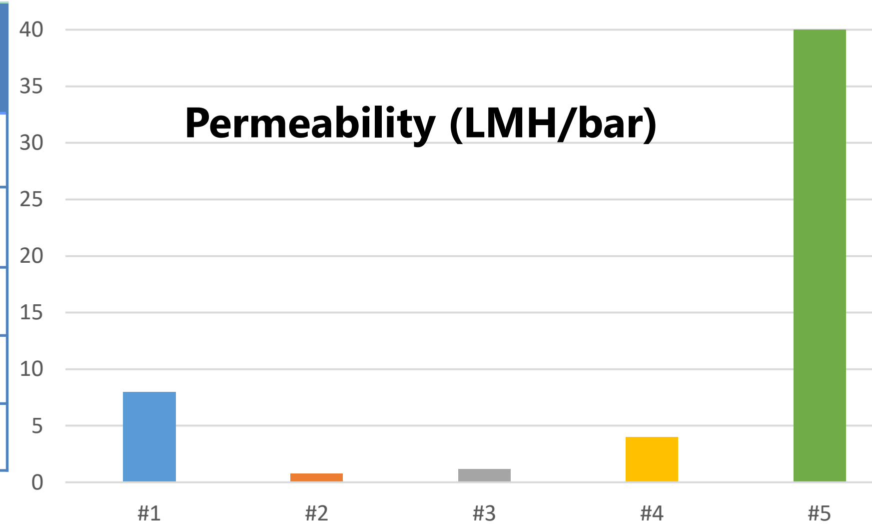
Experimental set-up and conditions

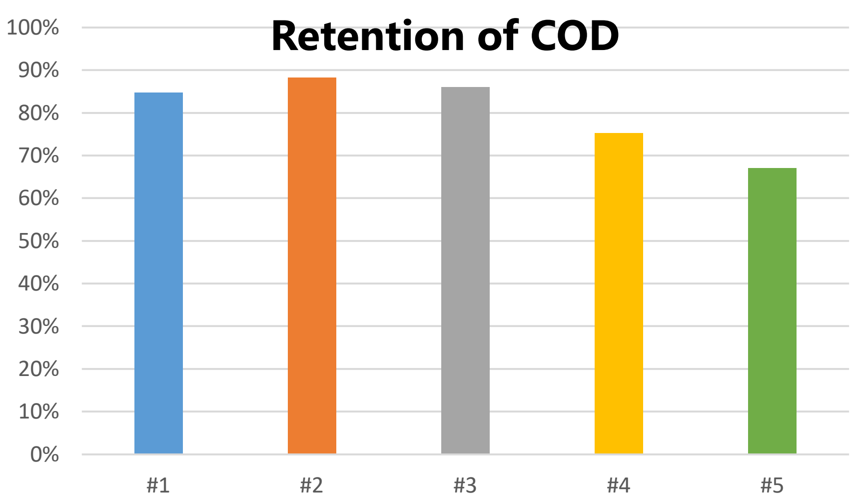


- **Treated sample**
  1. Flushing yogurt
  2. Flushing milk
- **Membrane type**
  1. UF PAN 20 kDa (AMI®)
  2. UF PES 20 kDa (ALVA LAVAL)
  3. MF 0.20 μm (MILLIPORE)
  4. NF NF-270 (FILMTEC)

Experimental results

#	Feedwater	Membrane	Applied pressure	Permeability Clean water (LMH/bar)	Permeability (LMH/bar)
1	Flushing milk	UF PAN 20 kDa	0.5 bar	550	8
2	Flushing milk	UF PES 20 kDa	3.0 bar	60	0.8
3	Flushing milk	UF PES 20 kDa	5.1 bar	80	1.2
4	Flushing yogurt	UF PES 20 kDa	3.0 bar	40	4
5	Flushing yogurt	MF 0.20 µm	0.14 bar	12,000	40





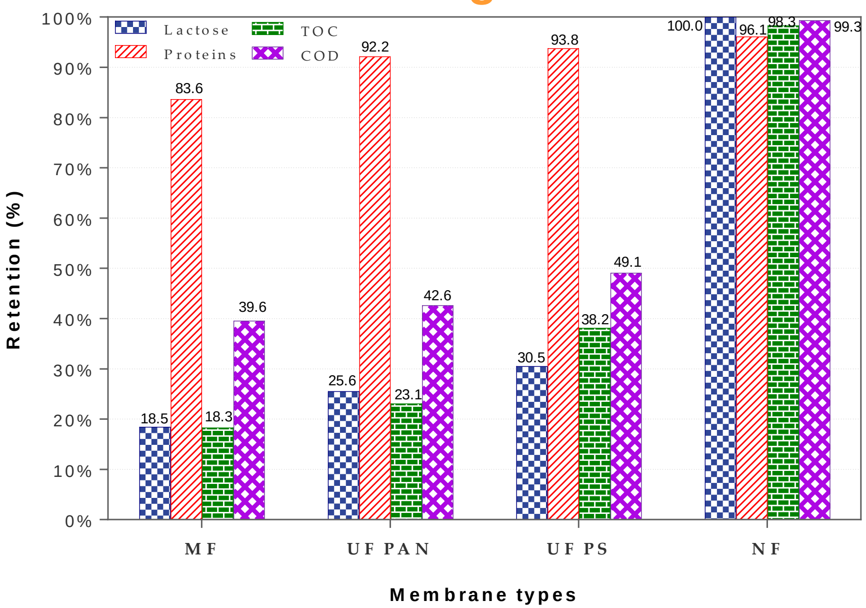
UF membranes exhibit high COD retention (80%-90%)

UF PAN (#1) membrane has less fouling tendency compared to UF PES (#2)

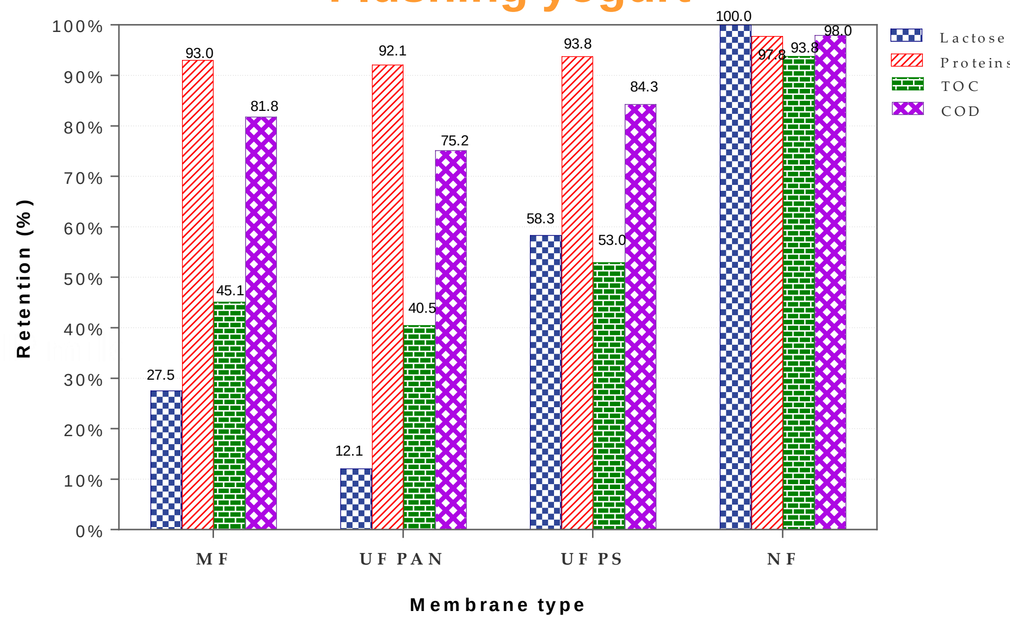
MF membrane has poor COD retention

Retention characteristics

Flushing milk



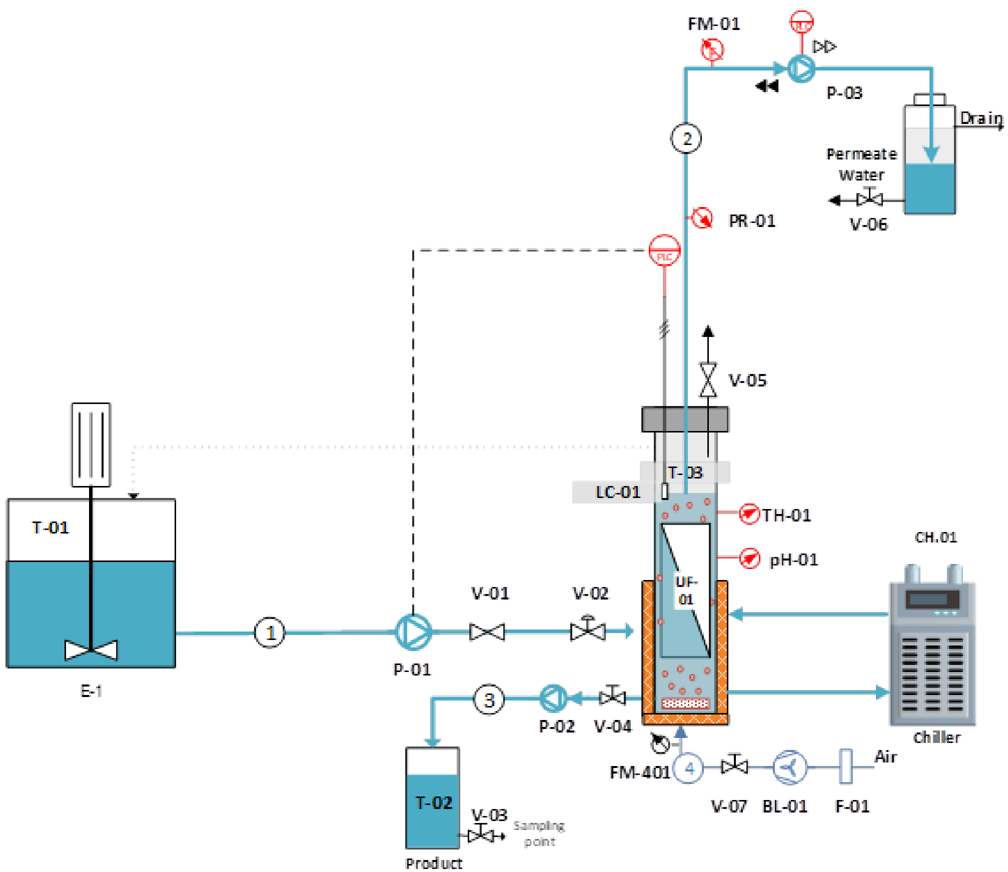
Flushing yogurt



- ✓ Valuable compounds (proteins, fat) are effectively retained by UF membranes
- ✓ Lactose is totally rejected by NF, whereas UF membranes retain appr.10%-20% of lactose
- ✓ In general, higher recovery of valuable compounds using flushing yogurt compared to flushing milk

Separation technologies for the recovery of valuable compounds – Pilot unit tests

Submerged UF pilot



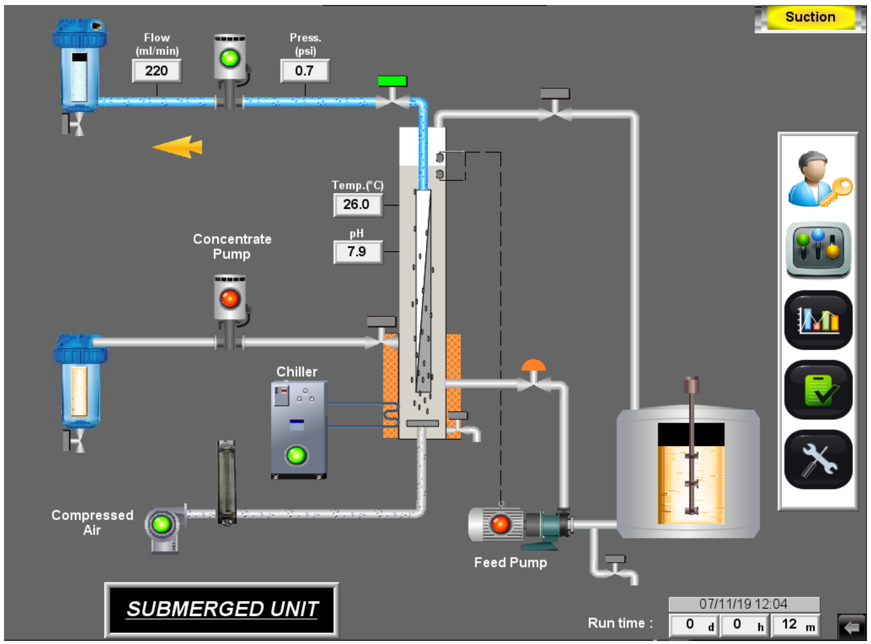
Design parameters

Feed Tank Volume: Membrane	**500 L**
Module membrane area	**3.4 m^2**
Membrane module volume	**12 L**
Feedwater Concentrating factor :	**up to 10**
Hydraulic Retention Time (HRT)	**35 min**
Membrane Flux-Forward	**4-10 LMH**
Membrane material	**PVDF**
Membrane pore size	**0.04 µm**
Mean Volumetric Rate	**20 L/h**
Effective Membrane Flux	**6.0 LMH**

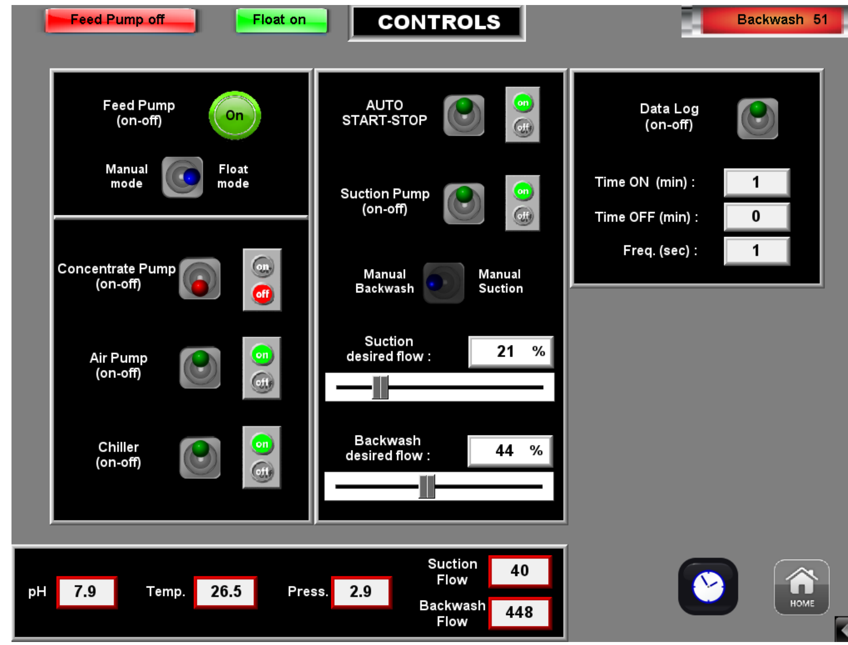
Horizon 2020 European Union Funding for Research & Innovation

Separation technologies for the recovery of valuable compounds – Pilot unit

PLC flow diagram



PLC main display



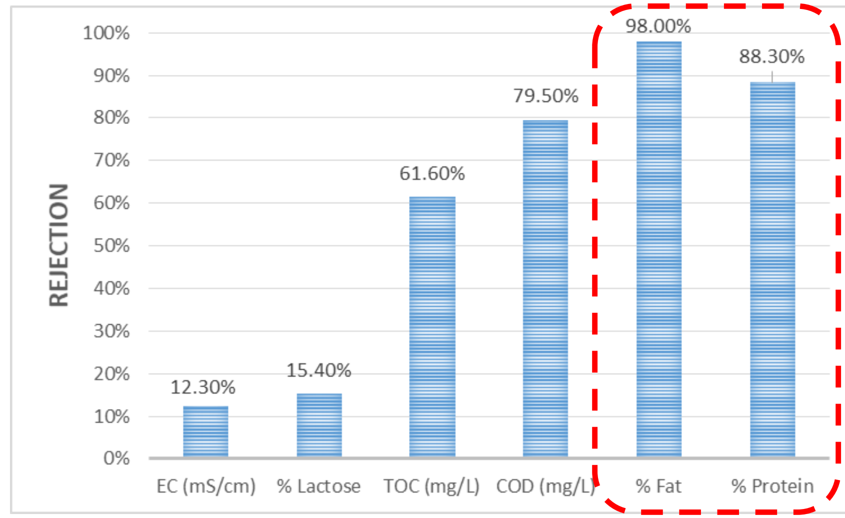
- Fully automatic, remotely controlled pilot unit through a PC, tablet, or smartphone
- Allows the operator to monitor - in real time - the trends of the most important system operating parameter (i.e suction pressure, backwash pressure, permeation rate, pH, temperature, etc)
- Warning alarms and safety alerts in case of increased pressure for pilot unit protection

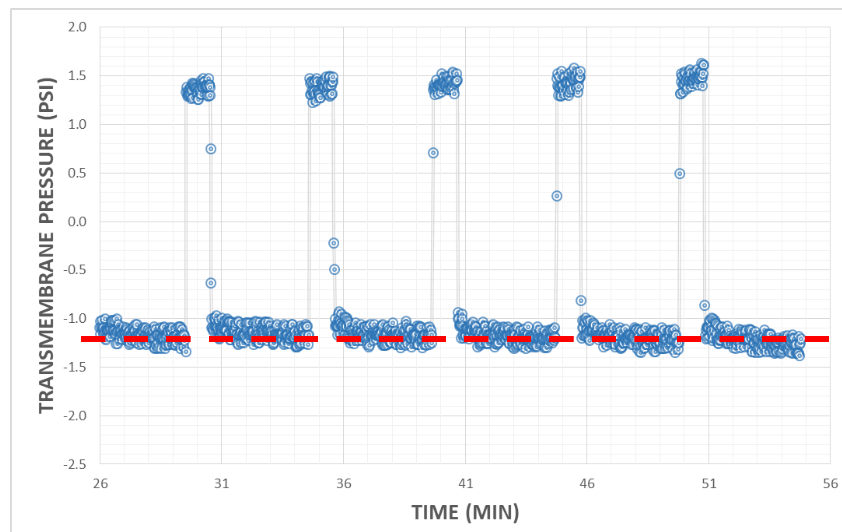
Separation technologies for the recovery of valuable compounds – Pilot unit tests

SpotView

Horizon 2020
European Union Funding
for Research & Innovation

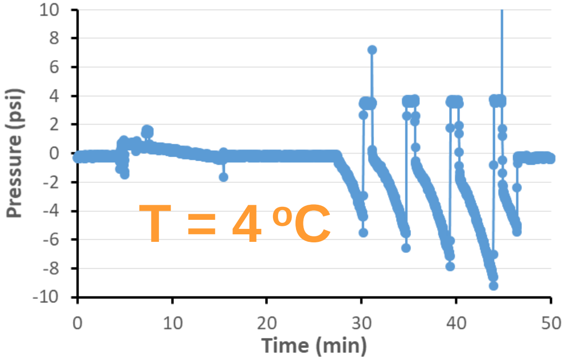
SPIRE PROJECT



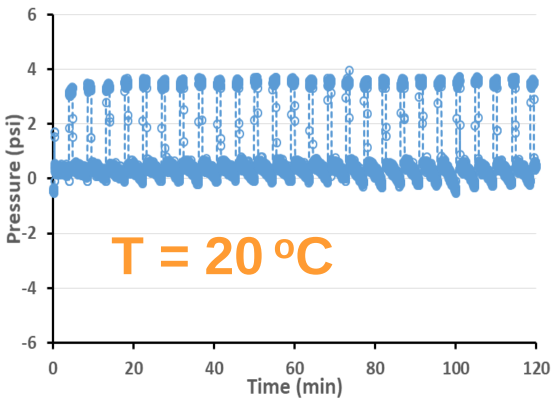


Separation technologies for the recovery of valuable compounds – Pilot unit tests

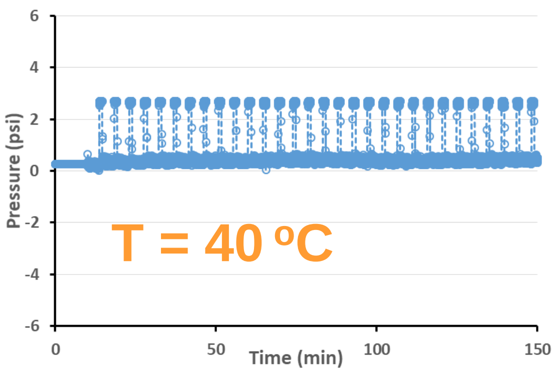
Temperature effect



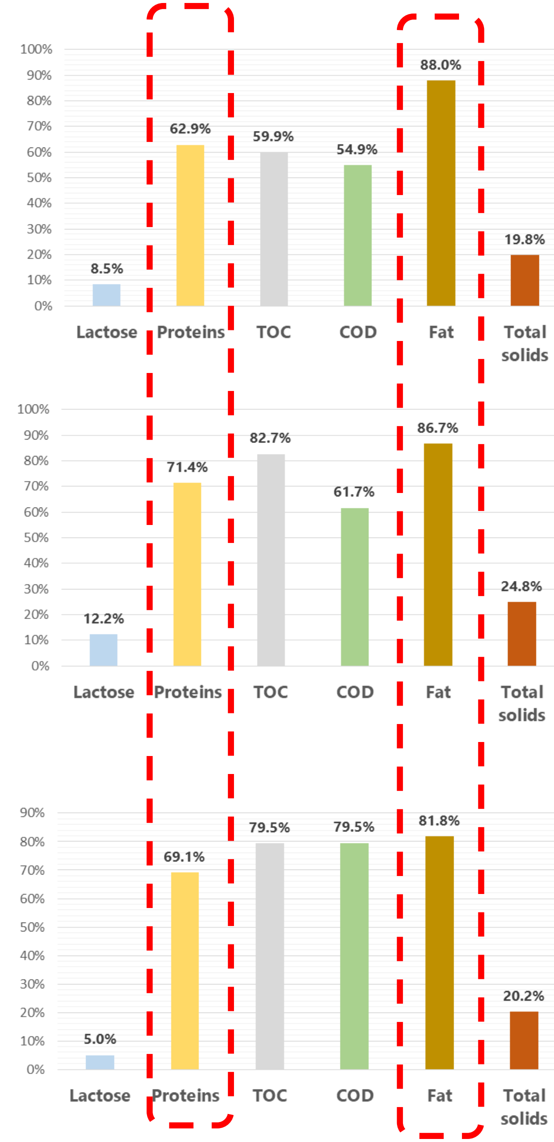
Severe fouling



Moderate fouling



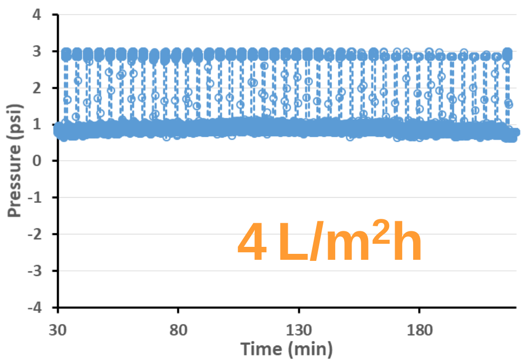
Low fouling



Separation technologies for the recovery of valuable compounds – Pilot unit tests

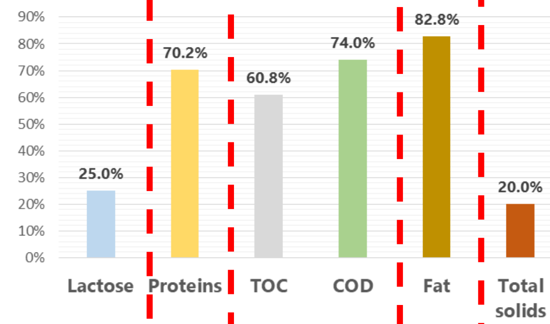
SpotView
Horizon 2020 European Union Funding for Research & Innovation
SPIRE PROJECT

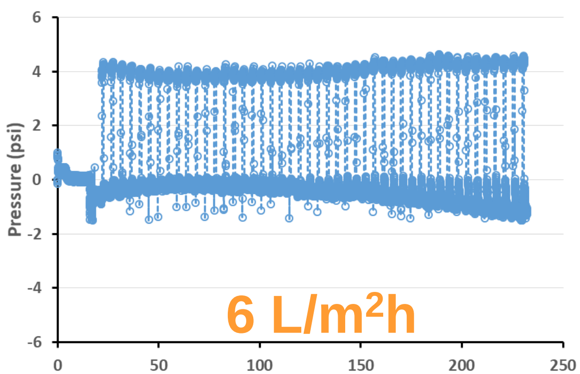
Permeation rate effect



Low fouling

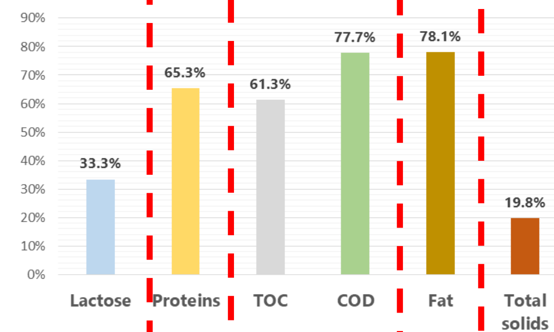
Low permeability

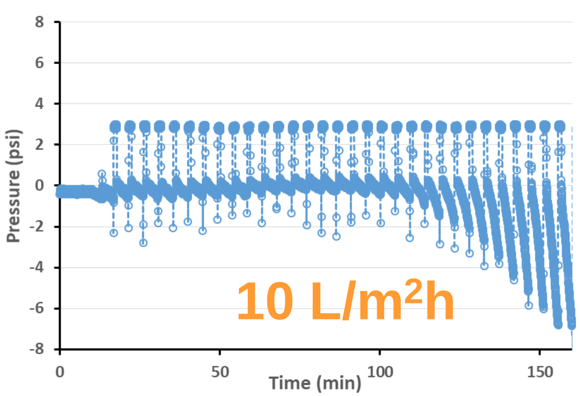




Moderate fouling

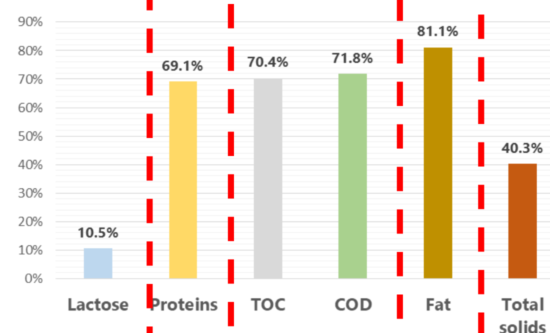
Moderate permeabilty





Severe fouling

High permeability



General conclusions

- ✓ Microfiltration due to large pore size exhibits poor useful compounds retention, whereas, nanofitration is characterized by the best retention/selectivity; however, due to increased feed-pressure requirements, energy consumption is significant.
- ✓ Ultrafiltration (UF) exhibits satisfactory selectivity and modest energy consumption.
- ✓ The implementation of a submerged Ultrafiltration (UF) system was selected as the best option for further pilot testing.
- ✓ The results of Submerged Ultrafiltration (sUF) pilot unit confirm that sUF is characterized by low fouling tendency, high selectivity and low energy consumption
- ✓ The effect of temperature in the filtration process is crucial. In particular, it is observed that higher temperature (in the range of 40ºC) results in lower fouling and higher concentration factors
- ✓ Permeation flux values smaller than 8 L/m^{2}h, severe fouling phenomena could be avoided, thus ensuring smooth operation of the pilot unit

RECOVERY OF ACIDS AND METALS FROM PICKLING SOLUTIONS OF THE METAL PROCESSING INDUSTRY

D. Winter et. al

23.03.2020, Freiburg

InspireWater Webinar

Fraunhofer Institute for Solar Energy Systems ISE

www.ise.fraunhofer.de

European Commission

Fraunhofer ISE

AGENDA

- ReWaCEM – Consortium and Objective
- Demonstration Cases
- Results of Selected Show Case
- Summary

Introduction

Consortium – 14 Project Partners

R&D Institutes and Univeristies	SMEs	Industry
Fraunhofer ISE	SolarSpring membrane solutions	TecnoZinco zincatura a caldo centro lavorazione acciaio
BFI Excellence in Applied Research VDEh-Betriebsforschungsinstitut GmbH	DEUKUM	ELECTRONIQUEL
Gobierno de España, Ministerio de Economía, Industria y Competitividad, Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	PSE Powering Scientific Exchange	DEUTSCHE EDELSTAHLWERKE
University of Stuttgart Chair of Building Physics (LBP) Life Cycle Engineering (GaBi)	aIz	AT&S
Università degli Studi di Palermo		
AEE INTEC		

Introduction

Objective

The overall objective of the project is to reduce the :

- fresh water demand
- demand for make-up acids
- ammount of disposed waste water
- amount of disposed valuable metals

in metal plating industry by a combiantion of innovative membrane separation technologies as Diffusion Dialysis (DD), Membrane Distillation (MD) and advanced filtration systems for pre treatment

Source: DEW

Demonstration Cases

<u>Show-Case A:</u> TecnoZinco zincatura a caldo centro lavorazione acciaio **(Carini, Italy)** *Commissioning 3/2019*

*Recovery of **HCl** and **Iron** from hot dip galvanizing pickling solutions*

Demonstration Cases

Show-Case A: (Carini, Italy) *Commissioning 3/2019*

*Recovery of **HCl** and **Iron** from hot dip galvanizing pickling solutions*

Show-Case B: (Gijon, Spain) *Commissioning 4/2019*

*Recovery of **H_2SO_4** and **Copper** from electroplating pickling solutions*

Demonstration Cases

Show-Case A: TecnoZinco zincatura a caldo centro lavorazione acciaio (Carini, Italy) *Commissioning 3/2019*

*Recovery of **HCl** and **Iron** from hot dip galvanizing pickling solutions*

Show-Case B: ELECTRONIQUEL (Gijon, Spain) *Commissioning 4/2019*

*Recovery of $\boldsymbol{H_2SO_4}$ and **Copper** from electroplating pickling solutions*

Show-Case C: DEUTSCHE EDELSTAHLWERKE (Hagen, Germany) *Commissioning 2/2019*

*Recovery of **HF** and $\boldsymbol{HNO_3}$ from mixed acid pickling solutions from stainless steel wire rod production*

Demonstration Cases

Show-Case A: TecnoZinco (Carini, Italy) *Commissioning 3/2019*

*Recovery of **HCl** and **Iron** from hot dip galvanizing pickling solutions*

Show-Case B: ELECTRONIQUEL (Gijon, Spain) *Commissioning 4/2019*

Recovery of H_2SO_4 *and **Copper** from electroplating pickling solutions*

Show-Case C: DEUTSCHE EDELSTAHLWERKE (Hagen, Germany) *Commissioning 2/2019*

*Recovery of **HF** and* HNO_3 *from mixed acid pickling solutions from stainless steel wire rod production*

Show-Case D: AT&S (Fehring, Austria) *Commissioning 3/2019*

*Recovery of rinsing **water** and **gold** in printed circuit board production*

Demonstration Cases

<u>Show-Case A:</u> (Carini, Italy) *Commissioning 3/2019*

*Recovery of **HCl** and **Iron** from hot dip galvanizing pickling solutions*

<u>Show-Case B:</u> (Gijon, Spain) *Commissioning 4/2019*

*Recovery of **H_2SO_4** and **Copper** from electroplating pickling solutions*

<u>Show-Case C:</u> (Hagen, Germany) *Commissioning 2/2019*

*Recovery of **HF** and **HNO_3** from mixed acid pickling solutions from stainless steel wire rod production*

<u>Show-Case D:</u> (Fehring, Austria) *Commissioning 3/2019*

*Recovery of rinsing **water** and **gold** in printed circuit board production*

Selected Show Case A – Hot Dip Galvanization

Problem Statement

- Pickling – Surface (pre-)treatment by reactive chemical etching for
  - removal of oxide layers
  - formation of surface textures

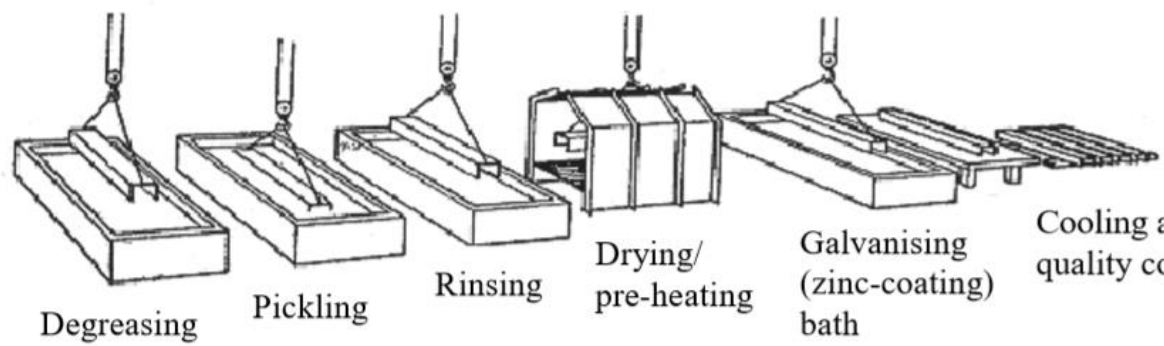
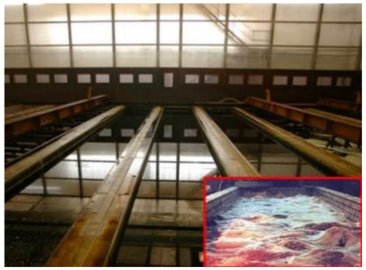


Illustration of the total process chain for hot dip galvanizing



Quelle: TecnoZinco

- Similar pickling processes in

electro galvanization, stainless steel production, silicon wafer production

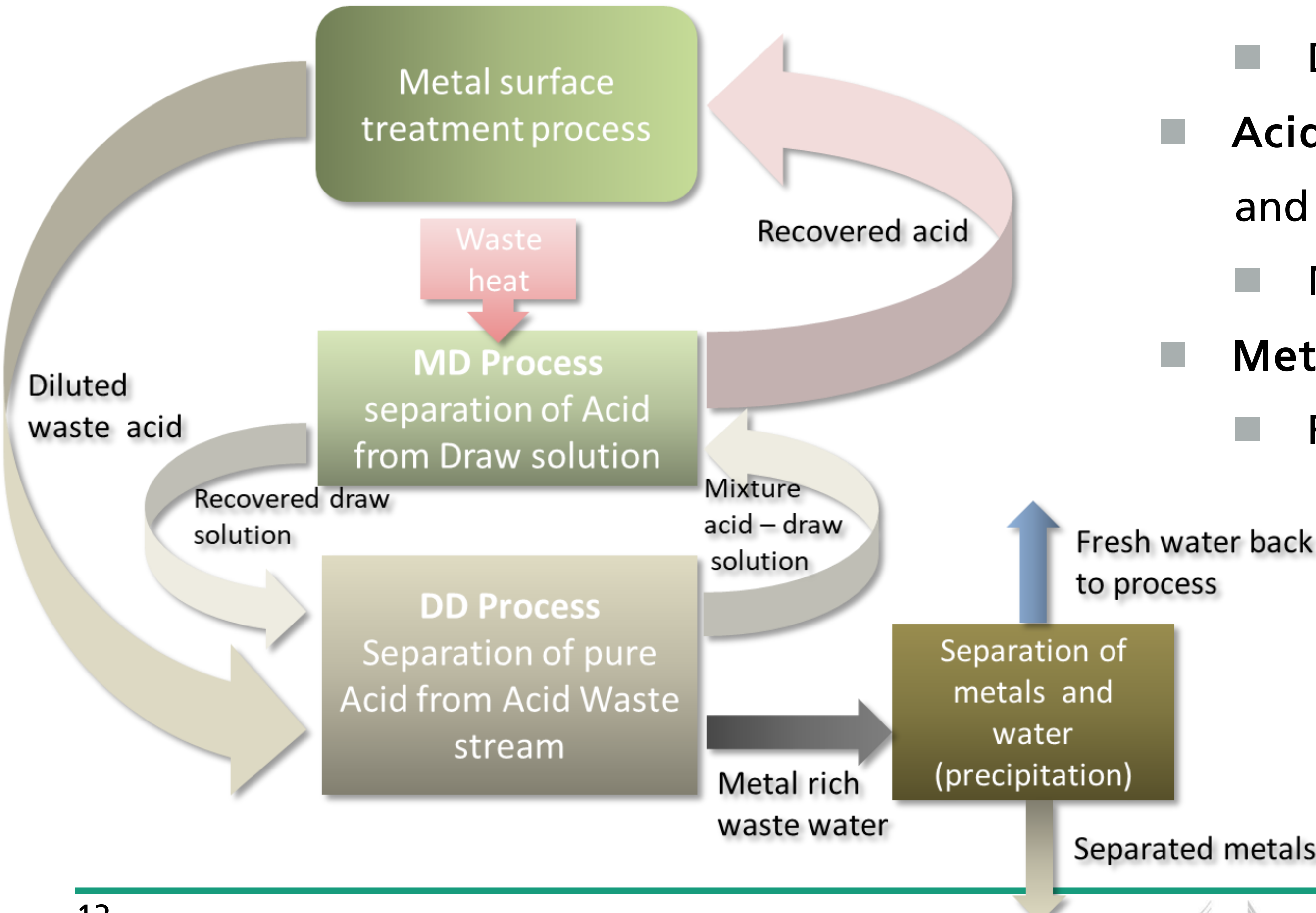
Selected Show Case A – Hot Dip Galvanization

Problem Statement

- **Pickling baths**
  - Acids are consumed, introduction of reaction products and particles into the pickling bath
  - Continuous or batch-wise recovery of pickling bath necessary
  - Disposed pickling solutions still contain free acid next to reaction products (metal salts) and particles
  - Economic and ecologic benefits possible through recycling of spent pickling solutions
    - Reduced demand on make-up acid
    - Reduced disposal quantities
    - Process intensification and advanced process control possible

Selected Show Case A – Hot Dip Galvanization

Recycling of Acids and Metals in a ZLD Approach



- **Acid Recovery**
  - Diffusion Dialysis (DD)
- **Acid Recovery** and **Water Recovery**
  - Membrane Distillation (MD)
- **Metal Recovery**
  - Reactive Precipitation (RP)

European Commission

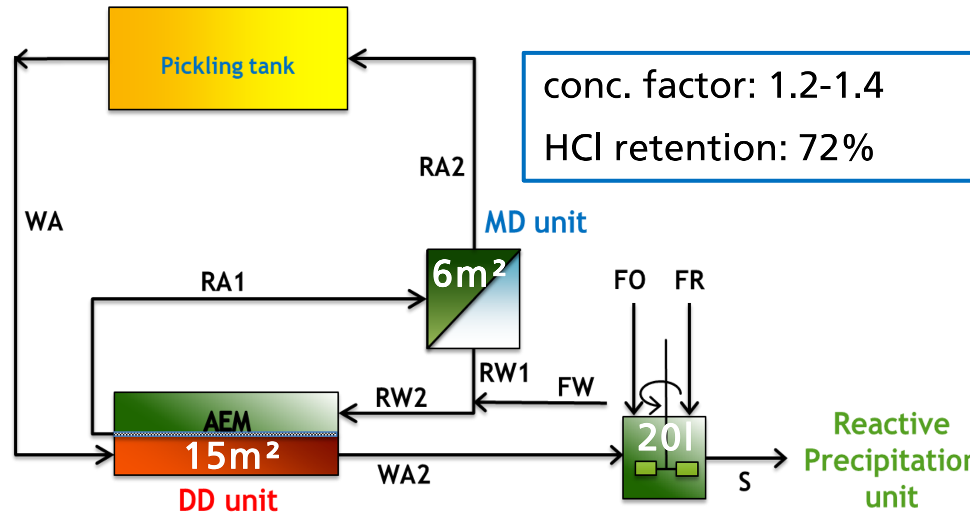
Fraunhofer ISE

Selected Show Case A – Hot Dip Galvanization

Selected Results

pickling solution:

~100g/l free HCl / ~265g/l $FeCl_2$ (consumed HCl)



conc. factor: 1.2-1.4

HCl retention: 72%

recovery of free HCl: ~80%

retention on $FeCl_2$: ~65%

oxidation and precipitation

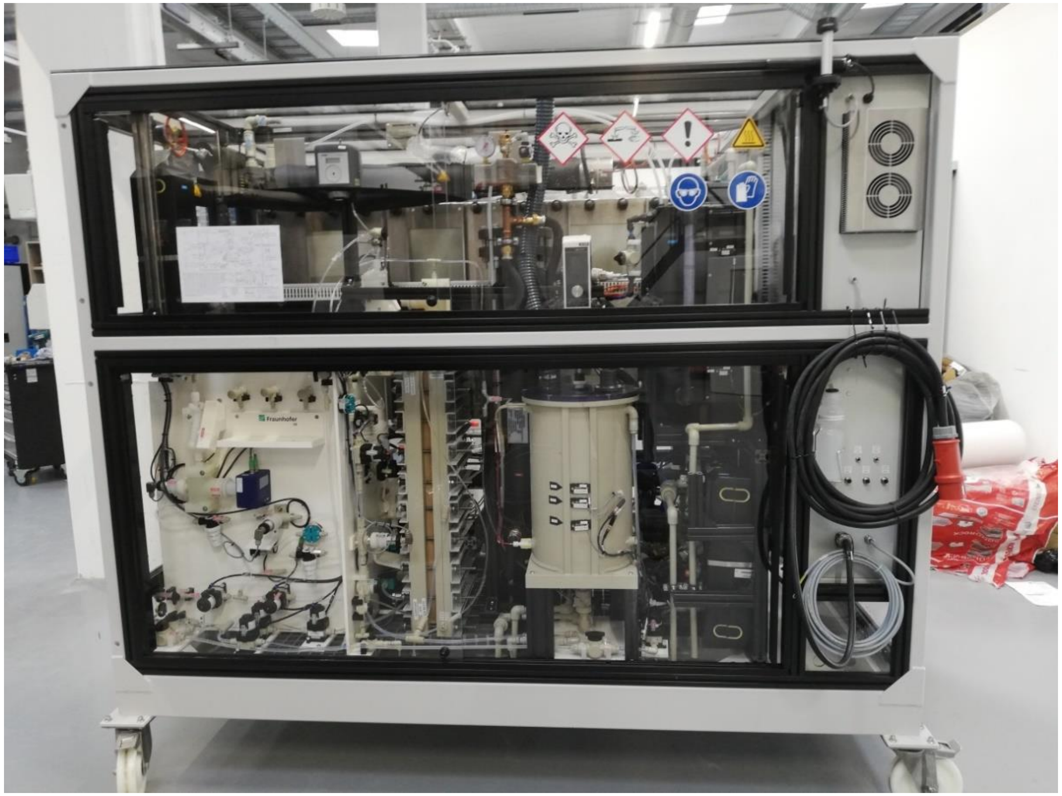
$Fe(OH)_3$: ~99%

ReWaCEM plant Demo A, arrival at industrial site in Carini, IT

Summary

Four industrial scale Demonstrators for waste acid, metal and rinsing water recovery were successfully designed, built and operated

- **Capacity**
  - 10-100l/h
- **DD Membrane**
  - 10-70m²
- **MD Membrane**
  - 6.5-25m²
- **RP Reactor**
  - 20l



Summary

Four industrial scale Demonstrators for waste acid, metal and rinsing water recovery were successfully designed, built and operated

Results were rated by applying LCA and water footprint methods and showed positive ecologic impact on various impact categories

Diffusion Dialysis (DD)

- Very high acid recovery rates in DD (80-90%) for all tested acid systems

  -> *Future challenge: Additional* recovery of consumed/bound acid ($FeCl_2$) - substitution thermal pyrolysis with advanced membrane approaches (CO_2 efficient and not only for huge capacities)

- Slight metal passage in DD modules observed

  -> *Future challenge: Minimization of metal passage through DD membranes*

Summary

Membrane Distillation (MD)

- New MD concept for hazardous media was developed
- Waste heat is (and should be) applied to achieve economic feasibility
- acid concentration and rinsing water recovery works fine, but volatile acid compounds pass the membrane

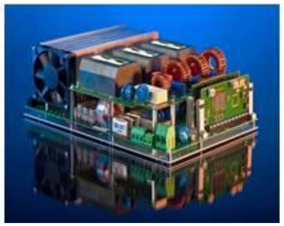
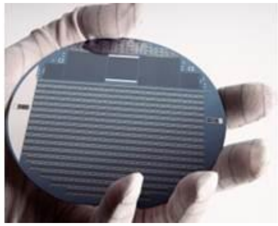
  -> Future Challenge: Optimization of concentration concept specifically for volatile acids

Reactive Precipitation (RP)

- CSTR process control works well, high metal recovery (~90%) and purity achieved

Thank you for your attention!




Fraunhofer Institute for Solar Energy Systems ISE

Daniel Winter

www.ise.fraunhofer.de

daniel.winter@ise.fraunhofer.de

INSPIRE WATER   SpotView

WEDNESDAY, 25 MARCH 2020

09:30 Web conference room is open

10:30 Start of the conference program
Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)

10:30 Welcome
DECHEMA and CTP

10:40 Welcome and introduction from SPIRE
Angels Orduna (SPIRE)

10:45 Introduction of INSPIREWATER and SPOTVIEW
Staffan Filipsson (IVL), Eric Fourest (CTP)

11:00 KEYNOTE: Challenges for the chemical industry – creating the next level of sustainable water usage
Niels Groot (Dow Benelux B.V.)

11:10 KEYNOTE: Water and Resource efficiency in the Steel Industry: current challenges and new solutions under an ecosystem perspective
Sophie Carler (Jerncontoret)

11:20 KEYNOTE: Water and Resource efficiency in the Pulp and Paper Industry: situation and new challenges with digitalisation
Jori Ringman (Confederation of European Paper Industries)

11:30 KEYNOTE: Recent development in EU Water Policy
Bettina Doeser, Head of Clean Water Unit, European Commission

11:40 PANEL DISCUSSION: Challenges for Water Management in Industry
Moderator: Brian Maguire (EBX MEDIA)
Participants: Niels Groot (Dow Benelux B.V.), Sophie Carler (Jerncontoret), Jori Ringman (CEPI), Bettina Doeser (EC), Angels Orduna (SPIRE)

12:15 Lunch break

13:15 Innovative and sustainable solutions in the steel industry – new developments in water management (INSPIREWATER/SPOTVIEW)
Martin Hubrich, VDEh-Betriebsforschungsinstitut (BFI), Elena Piedra Fernández, Beatriz Padilla Vivas (ArcelorMittal)

13:30 Innovative and sustainable solutions in the steel industry – recovery of acids (INSPIREWATER)
Andreas Rosberg (Sandvik), Fredrik Hedman (IVL)

13:45 New strategies and technologies for process water recycling in tissue paper industry (SPOTVIEW)
Antti Grönroos (VTT), Jenni Vaino (Essity), Pasi Nurminen (Valmet), Lotta Sorsamäki (VTT)

14:00 New strategies for effluent reuse in packaging paper industry (SPOTVIEW)
Stéphanie Prasse (Centre Technique du Papier), Serge Andres (Saica EL)

14:15 Coffee break

14:45 Improved technology solutions in the chemical industry (INSPIREWATER)
Jozef Kochan, Friedhelm Zorn (Clariant)

15:00 Innovative and sustainable solutions in the dairy industry (SPOTVIEW)
Anastasios Karabelas, Dimitris Sioutopoulos (CERTH), Konstantinos Georgakidis (MEVGAL)

15:15 Resource recovery from industrial waste water by cutting edge membrane technologies – Outcomes of the ReWaCEM project
Daniel Winter (Fraunhofer Institute for Solar Energy Systems ISE)

15:30 End of the first day

THURSDAY, 26 MARCH 2020

08:30 Web conference room is open

09:00 Wrap-up Day 1
Moderation: DECHEMA (Dennis Becker), CTP (Eric Fourest)

09:10 KEYNOTE: The Energy Footprint of Water Treatment
Joachim Koschikowski (Fraunhofer Institute for Solar Energy Systems ISE)

09:20 KEYNOTE: Water Footprint, financing industrial water through Blue Bonds
Jaap Feil (iWater – Water Footprint Implementation)

09:30 KEYNOTE: The Value of Water
Thomas Track (DECHEMA e.V.)

09:40 PANEL DISCUSSION: How to save costs with water in industry?
Moderator: Brian Maguire (EBX MEDIA)
Participants: Joachim Koschikowski (Fraunhofer ISE), Jaap Feil (iWater), Thomas Track (DECHEMA e.V.)

10:15 Coffee break

10:45 Holistic water management (INSPIREWATER)
Agata Andersson, Henrik Kloo (IVL)

11:00 Environmental impacts of water optimization strategies developed within SPOTVIEW
Elorri Igos (LIST)

11:15 Environmental and economic assessment of INSPIREWATER solutions for resource recovery in process industries
Fredy Dinkel (FHNW)

11:30 Next steps towards creating sustainable impact through business exploitation (INSPIREWATER/SPOTVIEW)
Presentation of the exploitation opportunities of both projects by PDC and IMCG

11:45 Opportunities and challenges to implement new innovative technologies into existing industrial environments (INSPIREWATER/SPOTVIEW)
Panel discussion moderated by PDC/IMCG. Interactive session with technology providers and end users from both projects

12:15 Wrap-up and some closing words

12:30 End of the conference

www.inspirewater.eu / www.spotview.eu