

Staff **M**obility to **A**ction **R**esilient, **R**estorative, and **R**egenerative **T**ransitions & **S**ocieties



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I3X – Guiding Principles



SMAR₃TS

- Innovate3X-Igniting Impactful Initiatives, or I3X, should aim to accelerate the understanding/scoping of a challenge (technological, market, societal etc), and the emergence/development of possible solutions. This can be interpreted as e.g. increased technological or societal readiness, once the I3X is completed.
- I3X should have a sufficient scale and scope (i.e. not being too narrowly-defined), and should require multi/cross/inter/trans disciplinary capabilities.
- I3X should align to the core concepts of SMAR3TS – Resilience, Restoration, Regeneration (either R or all Rs).
- I3X should align to (at least) one WP – WPs are the main coordination mechanism of the project, hence I3X should be connected to WPs.
- Any partner can initiate an I3X. Yet, shaping the I3X should be done collectively, and in collaboration with WP leader and SMAR3TS Team.
- At this stage, we are looking for initial I3X, which will be further defined during the Kick Off Meeting – and where engagement across the consortium will be assessed.
- Overall, it is expected that each I3X will lead and enable about 10 person-months of secondment, across the consortium (i.e. not only between the initiator of the I3X and possible contributors), possibly more.
- I3X will serve as guiding instruments for secondments, as well as for events (i.e. hackathons, workshops, showcase)

Innovate3X at UPC BarcelonaTech

Research Center in Multiscale Science and Engineering (CCEM), Spain

Research Group: Resource Recovery and Environmental Management (R2EM)

Presented by: Prof. Jose Luis Cortina Pallás (UPC BarcelonaTech)



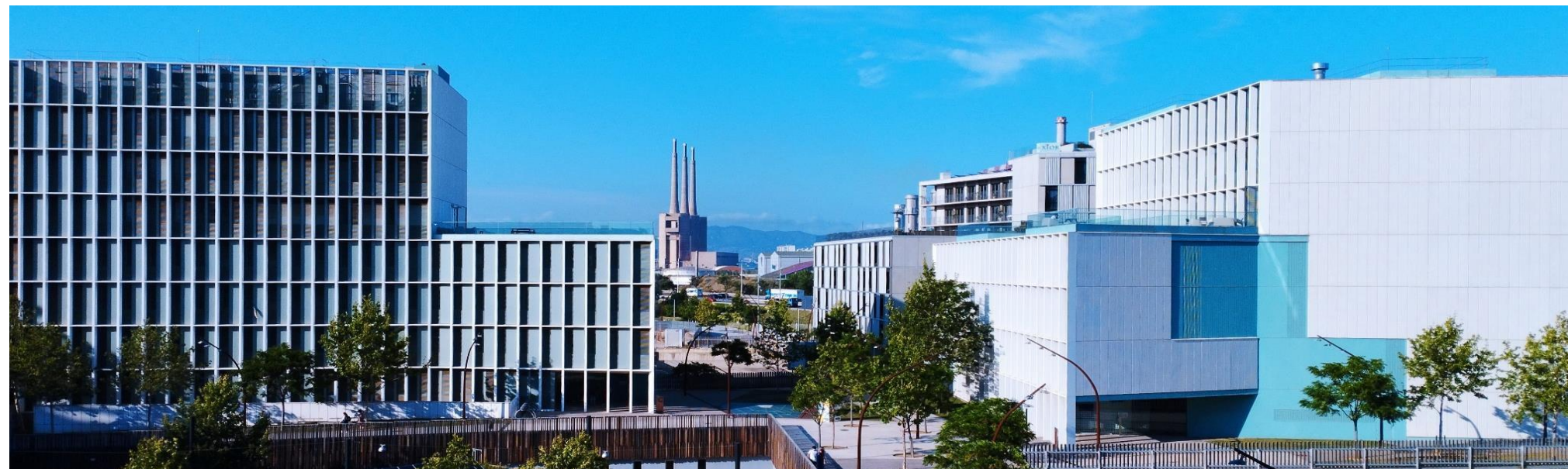
Introduction



- **Leader of R2EM Research Group** at UPC BarcelonaTech
- **Researcher** at the Multiscale Science and Engineering Research Center (MSERC) and the Hydrogen Research Center (CER-H2), and a **professor** in the Department of Chemical Engineering at the Barcelona School of Engineering East (EEBE)
- Scientific career spans the **fields of Chemical, Industrial, and Environmental Engineering**
- **Technical scientific advisor** at the Water Technology Center (Cetaqua) that promotes decarbonization solutions
- Held a **two-year NATO postdoctoral research** position in the field of Fiber Optic Chemical Sensors at the Center for Industrial Process Control (University of Washington, US)
- **Working with waste processing technologies** to ensure a secure, circular, and sustainable supply of critical raw materials (e.g., metals for electric vehicle batteries or electronic components) through urban and industrial mining approaches.
- Supervised around **30 doctoral theses** and has been the **Principal Investigator** on more than 20 national and EU-projects.
- Co-author of more than 300 JCR-indexed publications.



Professor Jose Luis Cortina



Skills and Expertise:

- Remediation
- Water and Wastewater Treatment
- Adsorption, Sorption, Desalination
- Membranes
- Water Purification Technologies
- Wastewater Engineering
- Membrane Technology
- Membrane Separation

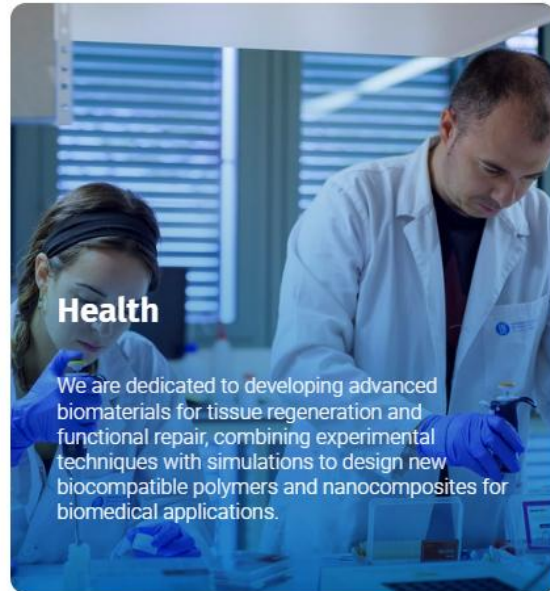


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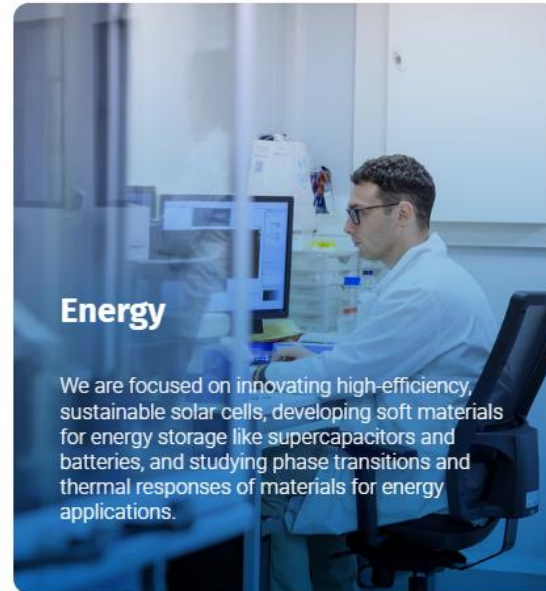
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R2EM Research Group is part of CCEM



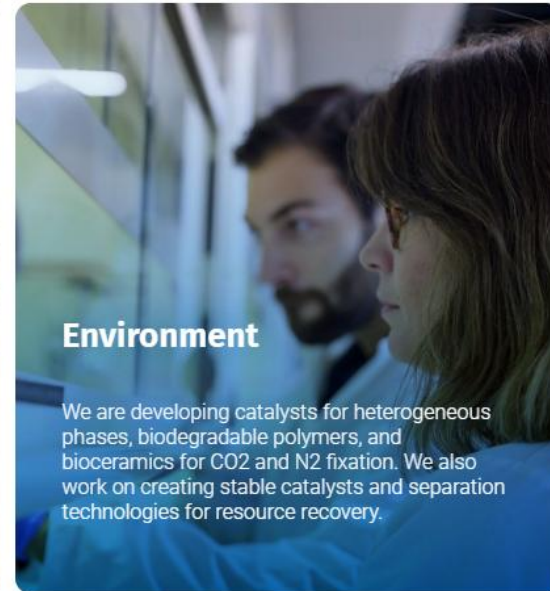
Health

We are dedicated to developing advanced biomaterials for tissue regeneration and functional repair, combining experimental techniques with simulations to design new biocompatible polymers and nanocomposites for biomedical applications.



Energy

We are focused on innovating high-efficiency, sustainable solar cells, developing soft materials for energy storage like supercapacitors and batteries, and studying phase transitions and thermal responses of materials for energy applications.



Environment

We are developing catalysts for heterogeneous phases, biodegradable polymers, and bioceramics for CO₂ and N₂ fixation. We also work on creating stable catalysts and separation technologies for resource recovery.



Barcelona Research Center in Multiscale Science and Engineering (CCEM)

Research Center in Multiscale Science and Engineering (CCEM)



SMAR₃TS

31,5 million €
Of competitive funding

3,3 million €
In tech transfer agreements
With several companies worldwide

+1000
Publications
In the most prestigious journals

19
EU-funded projects
In collaboration with key research centers and universities

4
ERC projects
Granted in recognition
to our cutting-edge
research

250
Scientists
From interdisciplinary
backgrounds

8
Research groups
In the fields of energy, health
and the environment

45%
Of women researchers
Promoting our compromise with equality

Biomaterials,
Biomechanics and Tissue
Engineering (BBT)



Structural Integrity and
Materials Reliability
Centre (CIEFMA)



Group of
Characterization of
Materials (GCM)



Innovation in Materials
and Molecular
Engineering (IMEM)



Micro and
Nanotechnologies -
Photovoltaic laboratory
(MNT-Solar)



Nanoengineering of
Materials Applied to
Energy (NEMEN)



Biodegradable and
Ecologic Polymers and
Composites (eb-
POLICOM)



Resource Recovery and
Environmental
Management (R2EM)

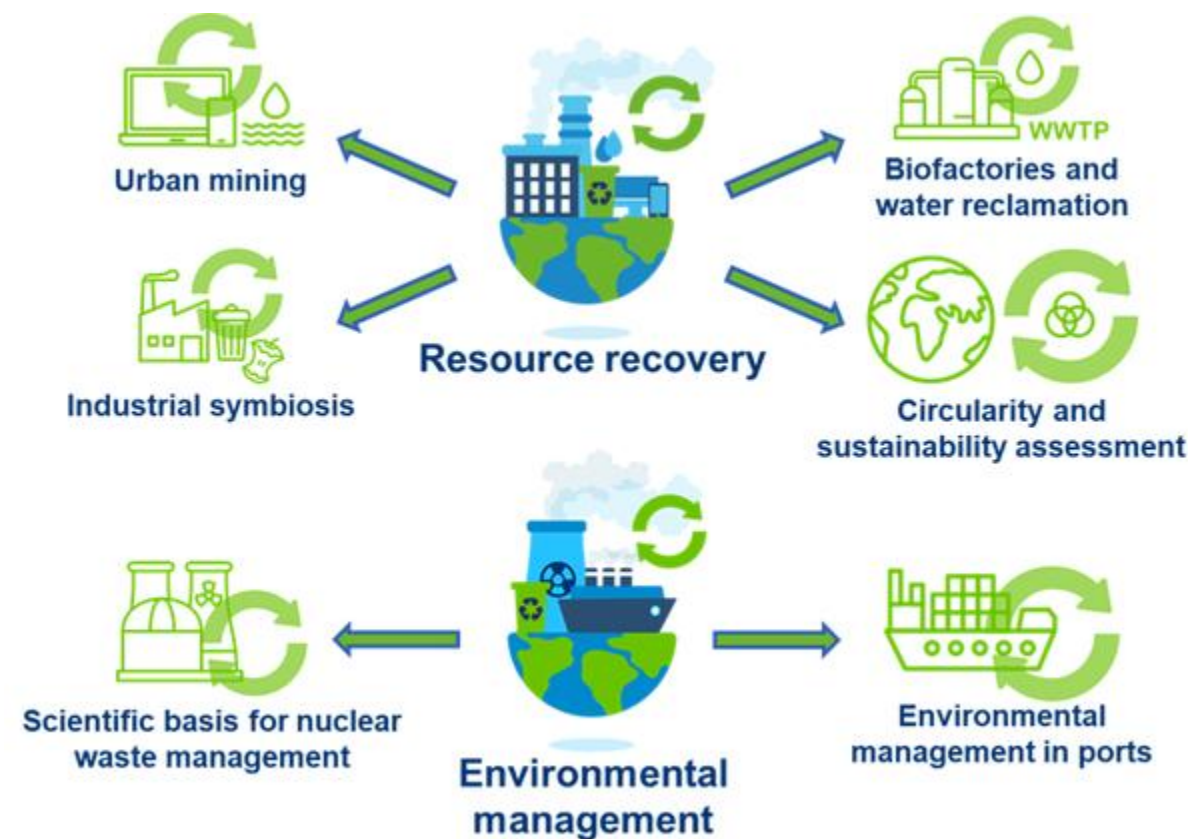


Resource Recovery and Environmental Management (R2EM) Research Group



Research & Development – Key areas:

- **Innovation processes** for metal recovery, pollutant removal, and environmental monitoring
- Work with **separation technologies**
- Development of analytical, waste characterization and treatment methods to **minimize environmental impact**



Research field: Environmental sciences and technologies

- Development of separation processes for metal recovery and pollutant removal using adsorption, biopolymers, reactive resins, and membrane technologies.
- Validation of analytical methods and sensors for monitoring industrial and environmental contaminants, including dissolved organochlorine compounds and volatile organic pollutants.
- Characterization and treatment of industrial and nuclear waste, including pollutant behavior modeling and risk assessment.
- Development of technologies for restoring contaminated soils and aquifers, with a focus on environmental and human health impact.

R&I infrastructure in the lab:

- advanced facilities for adsorption and membrane-based separation processes
- chromatographic and electrophoresis systems
- chemical sensor development technologies

Picture source: R2EM

<https://multiscale.upc.edu/en/research/r2em/laboratory-of-organic-solar-cells>

Research domains



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Resource-factories and water reclamation

Transformation of wastewater treatment plants into resource recovery facilities



Industrial and Urban Mining (Critical Raw Materials)

Recovery of critical raw materials from industrial tailings, e-waste and other urban waste streams



Seawater mining (Blue economy)

Recovery of minerals from seawater/brines/salt works



Bio-based economy

Turn renewable biological resources into products (food, energy, materials...)



Circular Process Engineering and Industrial Symbiosis

Integration of business opportunities for an industrial ecosystem that leverages underutilized resources (energy, water, materials, assets...)



Circularity and Sustainability Assessment

Quantifying sustainability and circularity of proposed technological solutions by integrating a portfolio of methods and tools

Specific services:

- Studies to evaluate risk to human health and ecosystems
- Evaluation of new materials to treat water polluted by metals
- Evaluation of new materials for recovering metals from liquid effluent
- Development of methods for the chemical analysis of pollutants

Relevant equipment:

- Atomic absorption
- HPLC
- UV-Vis spectrometry
- Surface area determination
- Cooperation with the CTM, ICP-MS, GC-MS, TOC, FT-IR
- Laser spectroscopy

Knowledge, skills and capabilities (TRL 3-5)



Separation processes, membrane technologies, technologies integration, circular processing, digital tools for process design and optimization



Membrane Technologies: MF, UF, NF, RO, ED, SED, EDBP, DD, MD, LLMC

Sorption and Ion Exchange Technologies

Digital tools development: process design and integration

Knowledge, skills and capabilities (TRL 3-5)



RDI partnership with Industrial technology partners

The logo for Cetaqua Water Technology Centre, featuring the word "CETAQUA" in a large, bold, sans-serif font and "WATER TECHNOLOGY CENTRE" in a smaller font below it.

Cetaqua,
Water Technology
Centre

VEOLIA
SPANISH RESEARCH NATIONAL COUNCIL
BARCELONA TECH-UPC

We are European leaders in the
application and transfer of scientific
knowledge to the world of water and
the environment.

A map of Europe with a network of lines connecting various points. Numbers are placed at several points: 12, 11, 58, and 11.

A diagram titled "R&D&i development" showing five interconnected areas: Water Resources Management, Biofactory and Resource Recovery, Environmental, Economic and Social Sustainability, Water 4.0, and Critical Infrastructure Management and Resilience. Each area is represented by a circular icon and text.

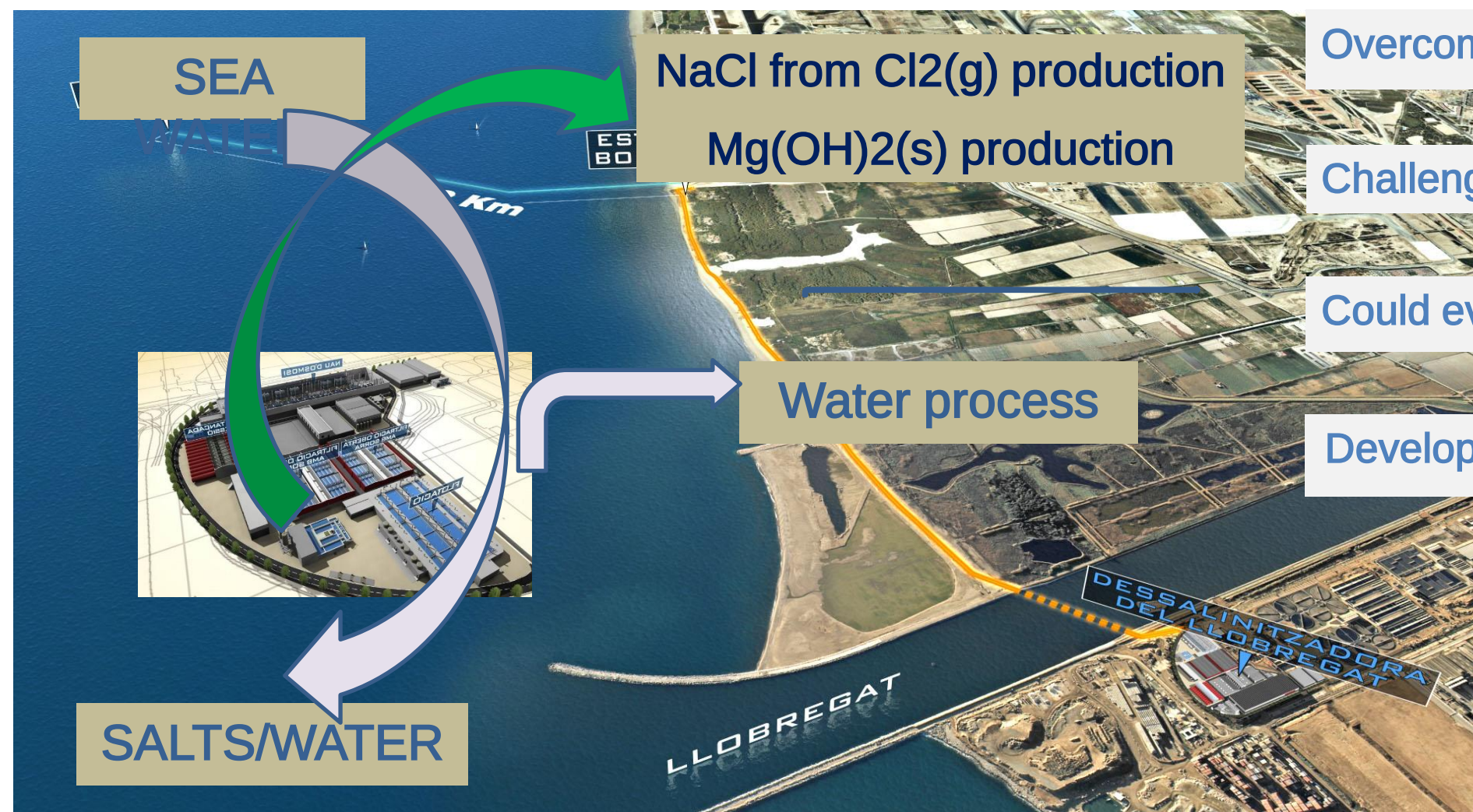
(TRL 7-9)

Examples of current R&I work



Industrial Feasibility of brine mining for $\text{Cl}_2(\text{g})$ and $\text{Mg}(\text{OH})_2(\text{s})$ production

Industrial site (close to sea): water and minerals chemical producer



Overcome the large salt vacuum transport emissions (decarbonization)

Challenge: substitution of vacuum salt by high quality NaCl brine

Could evaporation/crystallization be avoided? (process decarbonization)

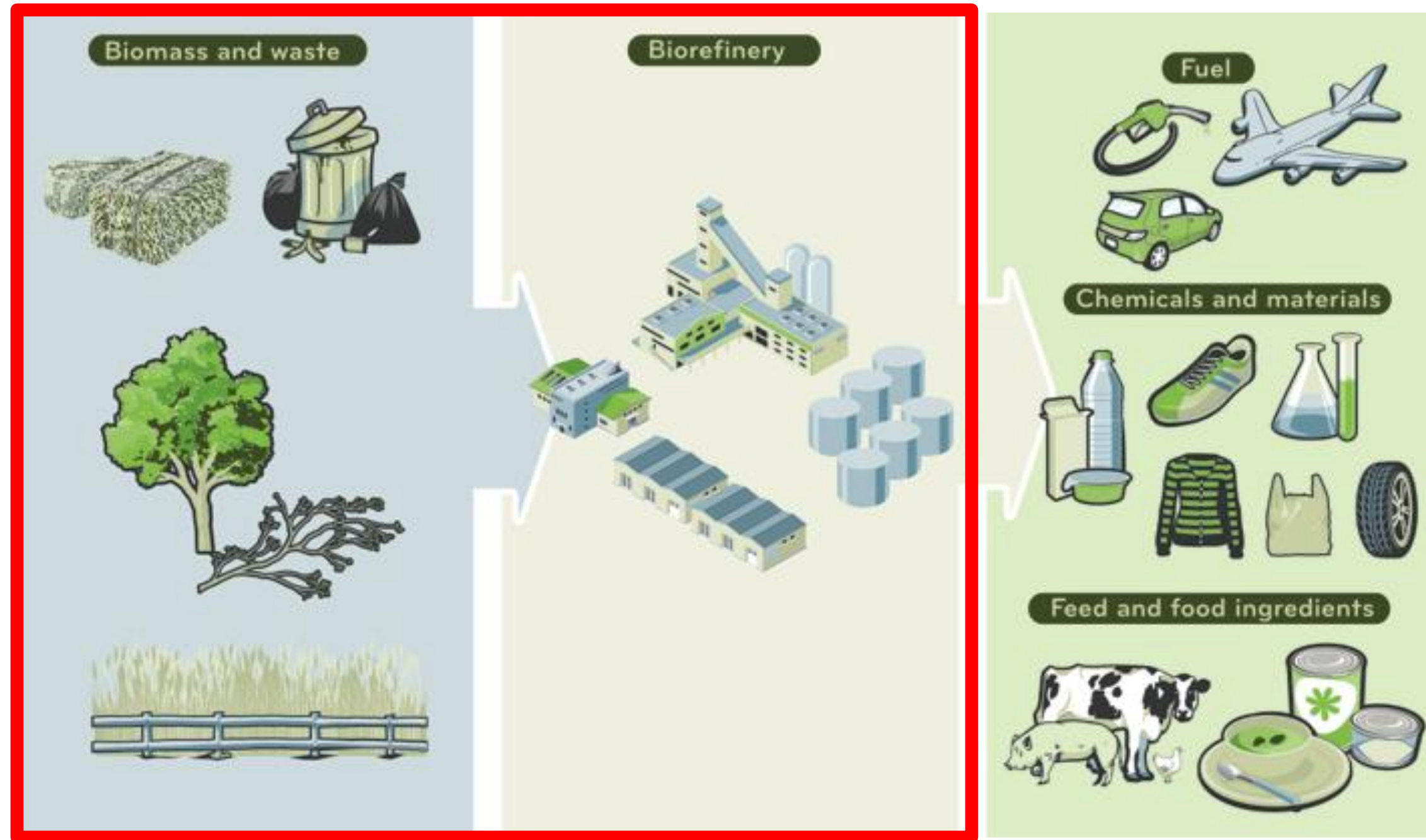
Developing a business case for a chemical company (0.5 Mt/y) in Europe (Spain)

Examples of current R&I work



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Bio-based economy: Upcycling of agri-food waste (Biofactory Concept)

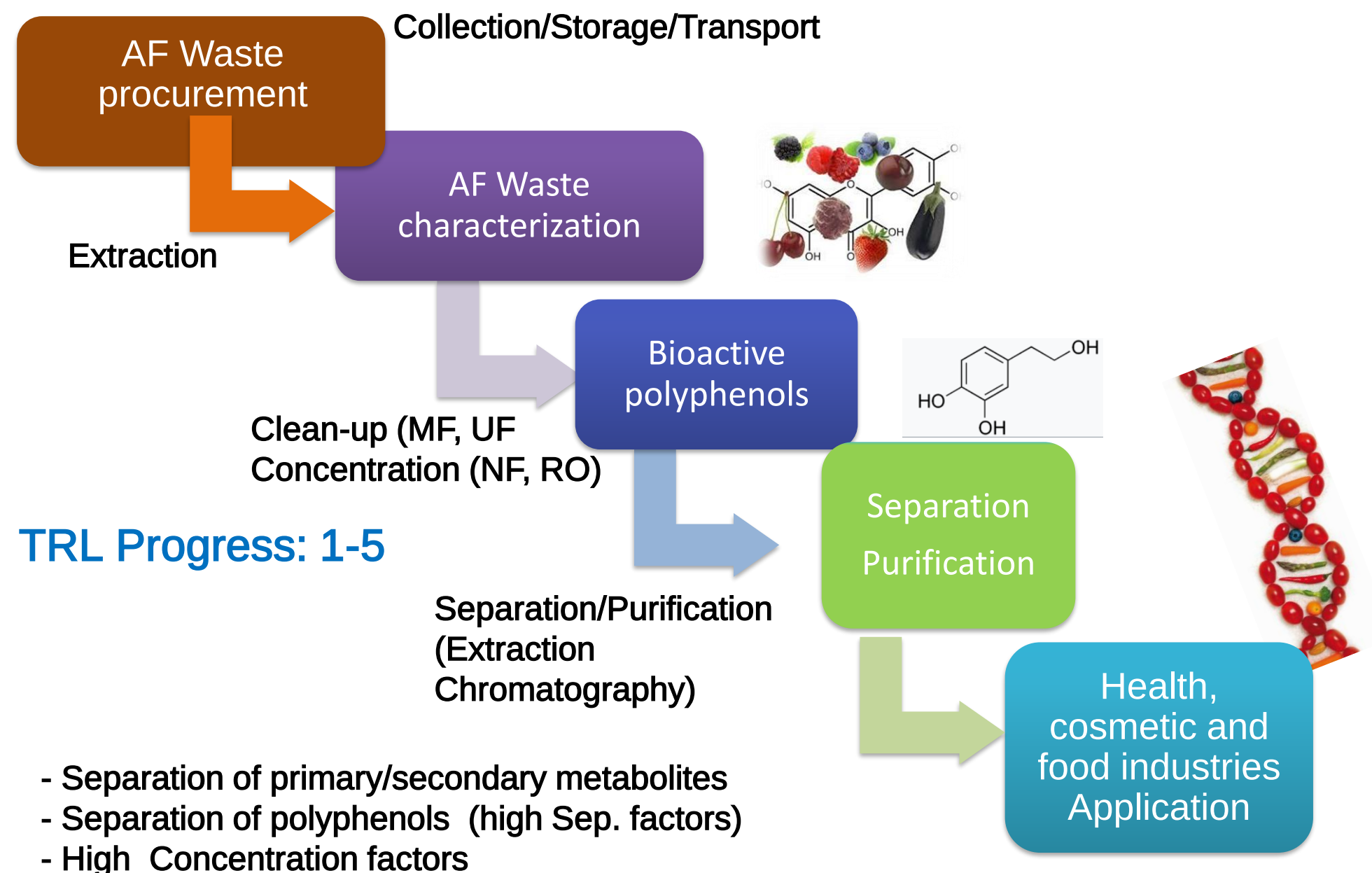
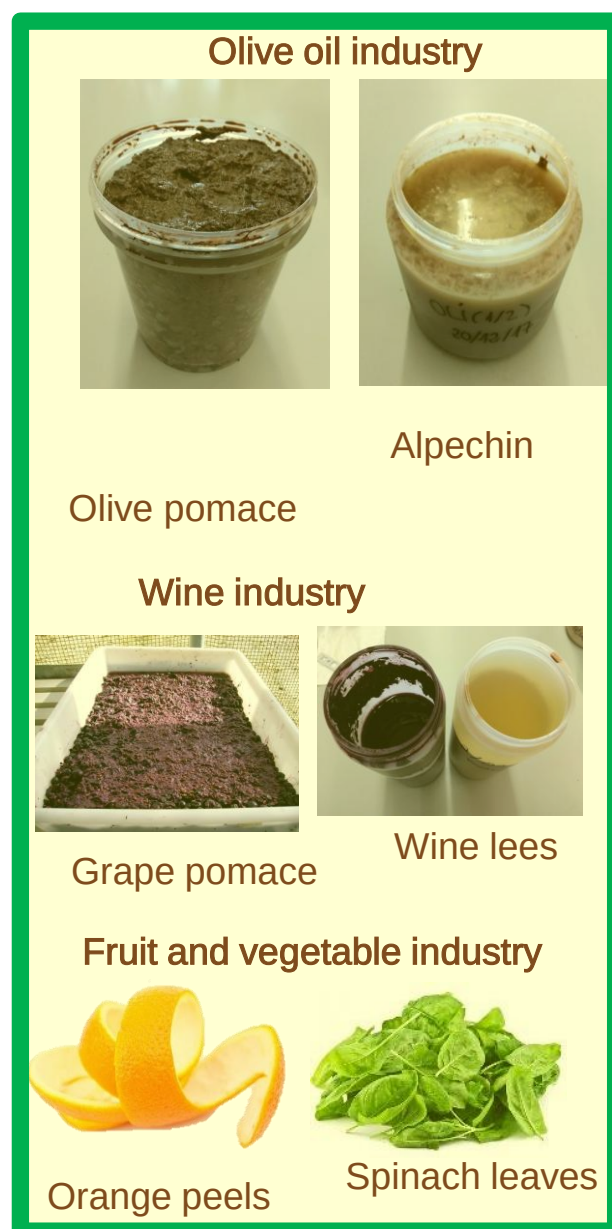


Examples of current R&I work

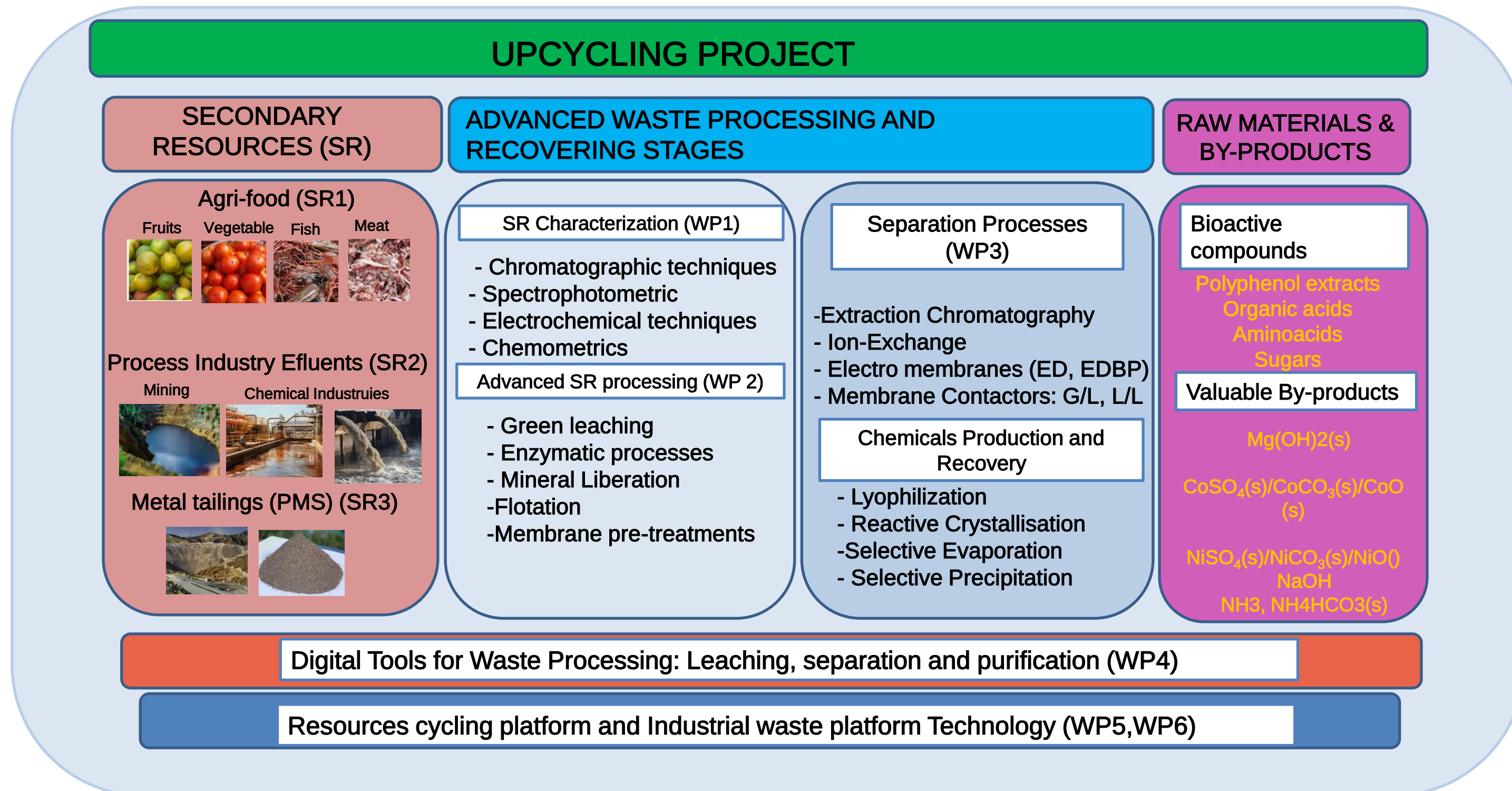


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Domain Bio-based Economy. Building the value chain for antioxidants production



Examples of current R&I work



Inspiration for your secondment to Innovate3X (I3X): for Resilience, Restoration and Regeneration



Snippets of Insights from meeting R2EM research group at UPC BarcelonaTech in July 2025

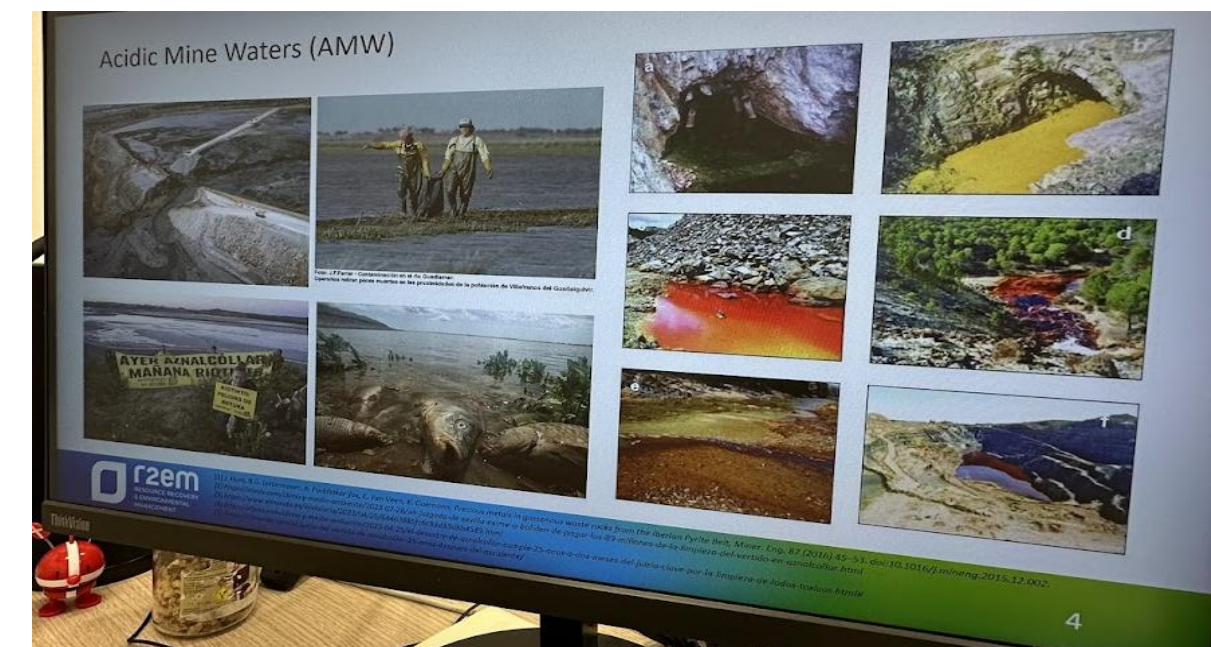
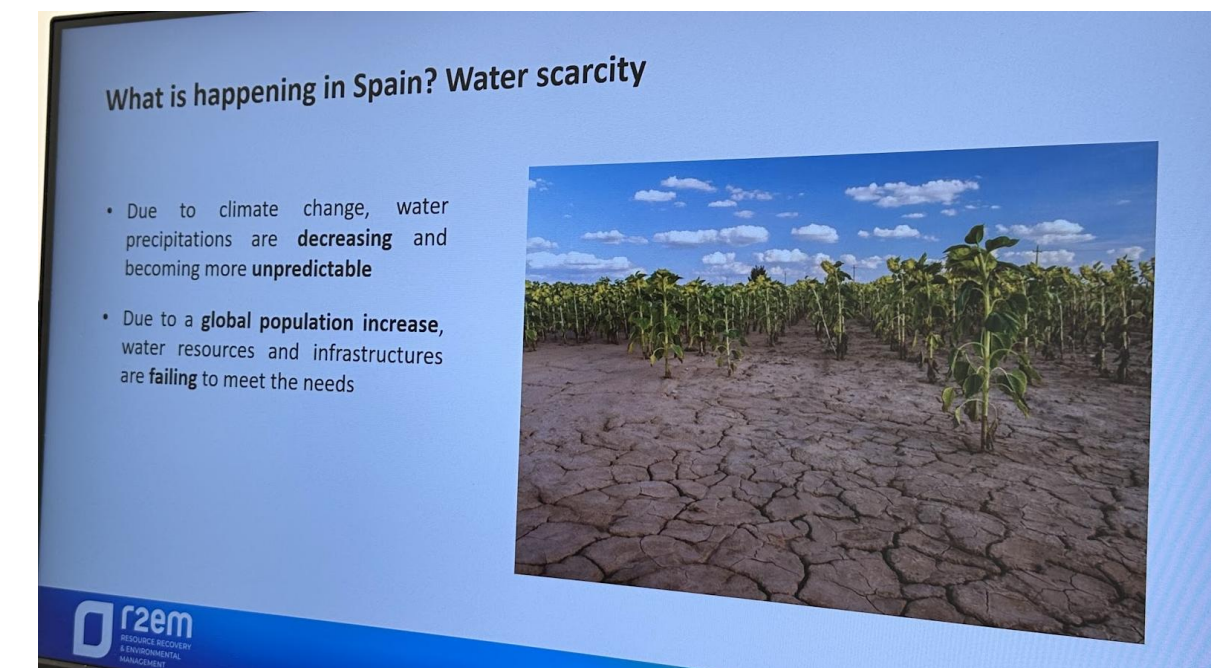
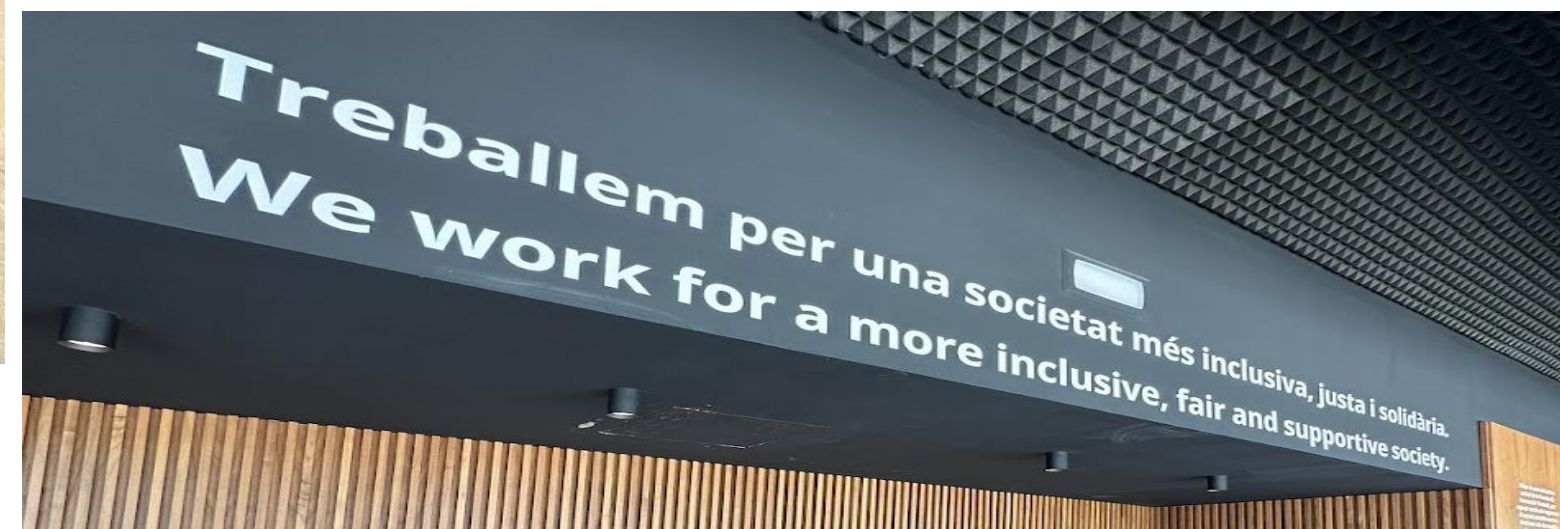


Dr. Kateryna Kryzhanivska
Researcher at LUT University,
Business School, Finland

Tackling real-world problems with I3X

What was insightful?

- Recovery of essential raw materials for industry transition to green and low-carbon economy
- Metal recovery from acid streams
- Processes that can be applied in metalurgy, ceramics, electronics, chemical, optical, medical, agriculture and nuclear technologies
- R&I infrastructure to develop, pilot and scale I3X in agriculture, energy, mobility sectors



I3X at UPC BarcelonaTech – About the initiator



Name of Organization: UPC BarcelonaTech
Research Group/Department: R2EM group
Country: Spain



1. Background info	2. Research Group/Company Department
<p>The Barcelona Research Center in Multiscale Science and Engineering (CCEM Barcelona) is a multidisciplinary hub at the forefront of materials science, in the fields of micro and nanoengineering, nanotechnology and biomaterials.</p>	<p><i>Short description:</i> R2EM group is developing research activity on development of sustainable urban and industrial waste management cycles based on resource recovery approaches promoting circular solutions of waste to product and waste to energy. Research also involves efforts on developing environmental remediation solutions for soils and ground water remediation, process and environmental monitoring and environmental risk assessment on ports.</p> <p><i>Link to the website:</i> https://multiscale.upc.edu/en/research/r2em</p> <p><i>Contact info:</i> Prof. Jose Luis Cortina jose.luis.cortina@upc.edu</p>
3. Expertise and available technologies within SMAR3TS project	4. Examples of strategically relevant Innovate3X (I3X) Initiatives
<ol style="list-style-type: none">1. Development of separation processes, knowledge of membrane technologies, technology integration, circular processing, digital tools for process design & optimization.2. Membrane, sorption, and ion exchange technologies for tests in design, integration, and simulations of industrial processes.3. Processes to recover value-added materials from organic waste (e.g., reusing fiber for functional foods).4. Currently, technologies in waste procurement, leaking, and recovery of concentrates are at laboratory scale and need upscaling.5. TRL status: 3-5. Knowledge, skills, capabilities, and further advancements are needed to reach TRL levels 6-7.	<p><i>Provide a preliminary description of work that needs to be done, which will be further refined and shaped throughout the secondments.</i></p> <p>Examples:</p> <ul style="list-style-type: none">• Extracting high-value bioactive molecules from agri-food waste for pharmaceutical, cosmetics and food industry applications.• Development of symbiotic approaches in the chloralkaline industry, combining seawater desalination, carbon capture and utilization, and on-site chemical production; Status: technologies developed in the lab, but require further industrial and market validation; business model development for industrial demo cases of sustainable production and recovery of (critical) battery metals are needed• Producing critical metals for electric vehicle batteries using urban and mining secondary resources. Status: development of advanced separation processes needed.• Regeneration processes in the pyrometallurgical industry. Status: Industrial and market validation needed• Development of multi-scale approaches for testing, separation, removal and recovery of valuable components, water and energy by developing hybrid processes. <p>Status: recovery of Sb and Bi elements in the lab; ongoing collaboration with Atlantic Copper and Łukasiewicz Research Network - Institute of Non-Ferrous Metals (Ł-IMN) in Poland.</p>

I3X at UPC BarcelonaTech – Alignment to R3 and to WPs



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domains:



1) **Specify here:** one or several **SMAR₃TS domains** that are **relevant to the work of your organization/research and innovation team**.

Nutrition domain: e.g., upcycling process of agri-food waste, sustainable food packaging

Mobility domain: sustainable mobility and digitalization, processes for critical material recovery and reuse in the mobility sector

Energy domain: energy recovery, energy transition, reducing energy consumption

2) **Specify here:** **alignment** of the work of your organization/research and innovation team with one or several SMAR₃TS focus areas on Resilience, Restoration, and Regeneration. Share examples.

- Regenerative food production and recycling
- Regeneration processes in the pyrometallurgical industry
- Restoration: recovery and reuse critical raw materials for the future of mobility
- Restoration: maximizing water reuse and water recovery through smart, circular and integrated solutions for sustainable energy use and production



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I3X at UPC BarcelonaTech: From Lab to Market - Upcycling agri-food waste through upscaling industrial applicability and business case modelling



(1) I3X:



1. Description of Current Stage	2. Necessary skills and capabilities, across disciplines:
<p>Specify here: <i>What is your research group/department currently working on? Which initiatives/projects are underway under I3X? How does this work contribute to resilience, restoration, and regeneration?</i></p> <ul style="list-style-type: none">• working with agri-food waste• refining, separation and purification technologies in the labs <p>Goal: to advance with the development of technologies towards technological and societal readiness and scalability, this I3X needs to focus on the development of industrial pilots.</p>	<p>Specify here: <i>What gaps or barriers need to be addressed to move forward? Which new skills, knowledge, expertise, interdisciplinary approaches or collaborations are required?</i></p> <ul style="list-style-type: none">• Development of industrial pilots with cosmetic, pharma and food industries• Advanced knowledge of separation and purification processes for critical raw material extraction• Business case modelling scenarios• Further development of technologies (e.g., in smart film food packaging)
3. Examples of challenges that need to be addressed	
<p>Specify here: <i>Please outline which challenges remain unresolved. You may answer in bullet points.</i></p> <div><div><div>1) Testing and applicability of technologies in the industry (e.g., testing the upcycling process of agri-food waste for fuel production, chemicals and materials, feed and food ingredients);</div><div>2) Business case modelling and scalability assessment scenarios of upcycling agri-food waste (e.g., on the Spanish market in olive oil; winery; fruits and juices industries);</div><div>3) Regulatory assessment scenarios – EU level</div><div>4) Domain Bio-based Economy: building the value chain for antioxidants production</div><div>5) Testing the recovery processes of polyphenols from agri-food waste including olive oil and wine industries through a circular economy</div></div><div><div>6) Validation of extraction, clean-up and concentration of polyphenol extracts from olive and wine waste (in connection with LIFE CYCLOPS project)</div><div>7) Market and Life Cycle Assessment (LCA)</div><div>8) Test of bioactive polyphenols in the industry</div><div>9) Collaboration in wastewater valorization and material recovery</div><div>10) Soil quality and waste recycling processes</div><div>11) Digital technologies for food waste reduction and improvement of food logistics</div><div>12) Development of food systems</div><div>13) Open Innovation and business model innovation – role of technologies (e.g., AI) in agrifood systems</div></div></div> <div></div>	



I3X at UPC BarcelonaTech: Processes for market assessment – LCA and regulatory assessment



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(2) I3X:

<div>1. Description of Current Stage</div> <div><p><i>Specify here: What is your research group/department currently working on? Which initiatives/projects are underway under I3X? How does this work contribute to resilience, restoration, and regeneration?</i></p><ul style="list-style-type: none">Technologies are currently on TRL 3-4 levels and can be further developed to TRL 5-6Interest in further validation of bioactive polyphenols for smart filmed food packaging, purification processes, life-cycle assessment (LCA), techno-economic assessment (TEA), as well as seawater desalination, carbon capture and utilization, and on-site chemical production.</div>	<div>2. Necessary skills and capabilities, across disciplines:</div> <div><p><i>Specify here: What gaps or barriers need to be addressed to move forward? Which new skills, knowledge, expertise, interdisciplinary approaches or collaborations are required?</i></p><ul style="list-style-type: none">Business model evaluation analysisResearch on food supplementary materials, animal feed application, sustainable food packaging, food materials</div>
<div>3. Examples of challenges that need to be addressed</div> <div><p><i>Specify here: Please outline which challenges remain unresolved. You may answer in bullet points.</i></p><ol style="list-style-type: none">Recovery of polyphenols, fivers, sugars’ valorizationAssessment of biomedical applications in pharma industryDevelopment of digital tools (e.g., digital passport for electric vehicles’ (EV) batteries in the EU) – how can it be applied for the waste that is vaporized?Regulatory assessment for waste material treatmentWater treatmentBusiness case analysis and scalability assessment; techno-economic analysis</div>	



I3X at UPC BarcelonaTech: Assessment of scalability processes for industrial decarbonization



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(3) I3X:

1. Description of Current Stage

Specify here: *What is your research group/department currently working on? Which initiatives/projects are underway under I3X? How does this work contribute to resilience, restoration, and regeneration?*

- The research group is working on Industrial Feasibility of brine mining for Cl₂(g) and Mg (OH)₂(s) production in collaboration with Spanish chemical producers.
- Need to **assess the scalability** of industrial decarbonization processes.
- Also, **pure separation** of metals from mine tailings and industrial waste from metallurgical industries and urban e-waste remains a **big problem**, as the recovery process contains often a mixture of raw materials.

2. Necessary skills and capabilities, across disciplines:

Specify here: *What gaps or barriers need to be addressed to move forward? Which new skills, knowledge, expertise, interdisciplinary approaches or collaborations are required?*

- Economic feasibility assessment, TEA and LCA for industrial decarbonization
- Development of green tax/eco tax scenarios
- Understanding of industrial maturity of technologies
- Knowledge on recovery of critical raw materials
- Knowledge of hydrogen production processes
- Skills on analysis of the circular approaches to recovery of critical raw materials
- Knowledge about ion exchange
- Techno-economic analysis in industrial scale (currently only lab scale assessments are available)
- Collaboration with the government and companies needed
- Knowledge of the impact of battery waste (need for further impact assessment)



3. Examples of challenges that need to be addressed

Specify here: *Please outline which challenges remain unresolved. You may answer in bullet points.*

- Major challenge: **high costs and high energy consumption for industry** in membrane distillation and nanofiltration.
- **Development of green tax/eco tax scenarios**
- **Assess market and conditions for industrial pilots** (currently an ongoing collaboration on a first pilot with an automotive batteries manufacturing company within EU R&I Actions - [METALLICO](#))
- **Techno-economic analysis** in industrial scale (currently only lab-scale assessments are available)
- Substitution of vacuum salt by high-quality NaCl brine in **desalination processes** (from seawater to clean water)
- **Development of decarbonization processes** to avoid evaporation/crystallization of critical raw materials
- **Business case** for a chemical company e.g., on e-waste battery recovery processes
- **Reduction of acidic mining or acidic mines' treatment processes**
- **Recovery of materials as fertilizes for soils** (developing further collaboration with the University of Palermo in Italy)
- Economic evaluation of critical and strategic raw materials recovery
- Developing scenarios for upscaling of industrial decarbonization processes (e.g., with [Veolia](#) company (France), mining companies in Australia (e.g., [BHP](#)), energy companies (with expertise on heating and cooling in Finland); and water purification processes (e.g., with industry partners in USA – e.g., [RIOTINTO](#))
- Reducing energy consumption in nanofiltration processes
- Lithium recovery from battery waste (currently, **only experiments were done on the lab scale, but not tested with the industry.**)
- Potential collaboration with companies such as industrial projects with [RIOTINTO](#) in Serbia, [Lithium-Iberia](#) in Spain, and [Savannah](#) in Portugal)



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I3X at UPC BarcelonaTech: Scaling industrial processes of critical raw materials recovery and application



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(4) I3X:

<div>1. Description of Current Stage</div> <div><p><i>Specify here: What is your research group/department currently working on? Which initiatives/projects are underway under I3X? How does this work contribute to resilience, restoration, and regeneration?</i></p><ul style="list-style-type: none">Recovery of materials such as brine to be reused in industry, e.g., rare earth elements (REE) recovery, and managing industrial waste.Example of successful nano-filtration pilot (removing materials and allowing pure filtration tests – technology that has been commercialized – high pressure NF for separation of NaCl and CaCl₂).</div>	<div>2. Necessary skills and capabilities, across disciplines:</div> <div><p><i>Specify here: What gaps or barriers need to be addressed to move forward? Which new skills, knowledge, expertise, interdisciplinary approaches or collaborations are required?</i></p><ul style="list-style-type: none">Knowledge of industrial critical raw material recovery processesAbility to perform economic analysisExperience of developing techno-economic evaluation scenariosEngagement of mining technology companies and research centers (e.g., RMIT and mineral processing companies in Australia, e.g., BHP)</div>
<div>3. Examples of challenges that need to be addressed</div> <div><p><i>Specify here: Please outline which challenges remain unresolved. You may answer in bullet points.</i></p><ul style="list-style-type: none">Managing metal waste (e.g., in the pyrometallurgical industry)Interaction of hazardous metal waste with the soil</div>	



I3X at UPC BarcelonaTech: Development of multi-scale approaches for testing, separation, removal, and recovery of valuable components, water, and energy through hybrid processes



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(5) I3X:

1. Description of Current Stage

Specify here: What is your research group/department currently working on? Which initiatives/projects are underway under I3X? How does this work contribute to resilience, restoration, and regeneration?

- Engagement in [R3Volution project](#) (HORIZON-RIA - HORIZON Research and Innovation Actions) using revolutionary approaches for maximizing water reuse and water recovery through smart, circular and integrated solutions (e.g., integration of MF, UF, NF, RO, EDBP-MD).

2. Necessary skills and capabilities, across disciplines:

Specify here: What gaps or barriers need to be addressed to move forward? Which new skills, knowledge, expertise, interdisciplinary approaches or collaborations are required?

- Development of technologies** related to process optimization for water reuse, energy recovery in industry, bio-based economy, circularity and sustainability assessment.
- Commercial analysis** of technologies for separation, removal and recovery material.

3. Examples of challenges that need to be addressed

Specify here: Please outline which challenges remain unresolved. You may answer in bullet points.

1) **Development of digital tools** for modelling and control optimization of testing processes, integration of AI into testing, separation, removal and recovery of valuable components, water and energy.

2) **Piloting separation, removal and recovery processes in industrial sites.**



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Welcome to Innovate3X Secondments at UPC BarcelonaTech

Research Center in Multiscale Science and Engineering, Spain



Contact:

Prof. Jose Luis Cortina
jose.luis.cortina@upc.edu



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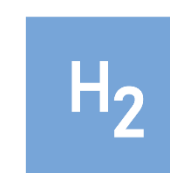


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RESOURCE RECOVERY
& ENVIRONMENTAL
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