UNIVERSIDAD DE BURGOS | ICCRAM

INTERNATIONAL RESEARCH CENTER IN CRITICAL RAW MATERIALS FOR ADVANCED INDUSTRIAL TECHNOLOGIES

ICCRAM

UNIVERSIDAD DE BURGOS

International Research **C**enter in **C**ritical **RA**w **M**aterials
for Advanced Industrial Technologies

ICCRAM Scientific Presentation

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ICCRAM — UNIVERSIDAD DE BURGOS

ABOUT

ICCRAM

International Research Center in Critical RAw Materials for Advanced Industrial Technologies

This center, **inaugurated in 2014** and affiliated with the University of Burgos, **has the following objectives:**

THE THREE MAIN OBJECTIVES OF ICCRAM

OBJECTIVE 1

Position the University of Burgos as a European leader in the areas of **biotechnology research, sustainability, toxicology, electrochemistry, and computer simulation.**

OBJECTIVE 2

Collaborate with **other University Departments** to achieve greater success in international projects.

OBJECTIVE 3

Promote innovation in society by driving **industrial**, **institutional**, and **social** engagement.

ABOUT

ICCRAM

THE FOUR MAIN STRENGTHS OF ICCRAM

STRENGTH 1

ICCRAM is located inside the **R+D+i / CIBA / Scientific Technological Park** of the University of Burgos.

STRENGTH 2

ICCRAM is a specialist in forefront technologies in the **fields of:**

Biomedicine, Environment, Soil Health, Sustainability, Circular Economy, Materials, Energy Storage and SSbD.

STRENGTH 3

ICCRAM promotes **different activities** to motivate young people to be future researchers.

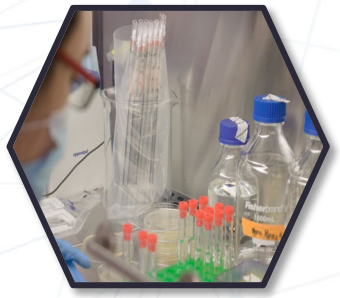
STRENGTH 4

ICCRAM has a **interdisciplinary** and **multidisciplinary** team of **over 40 people** specialized in the **different research fields and project management.**

ABOUT

ICCRAM

THE SIX MAIN RESEARCH LINES OF ICCRAM



Research Line 2

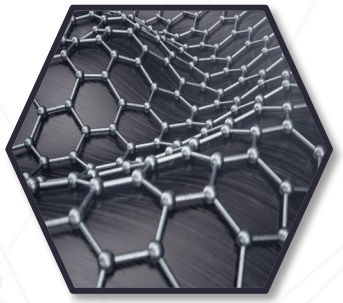
Sustainability | Circular economy

Research Line 5

Multi-scale materials modelling

Research Line 1

Environment | Soil Health



Research Lines 3, 4

Toxicology and Biomedicine

Research Line 6

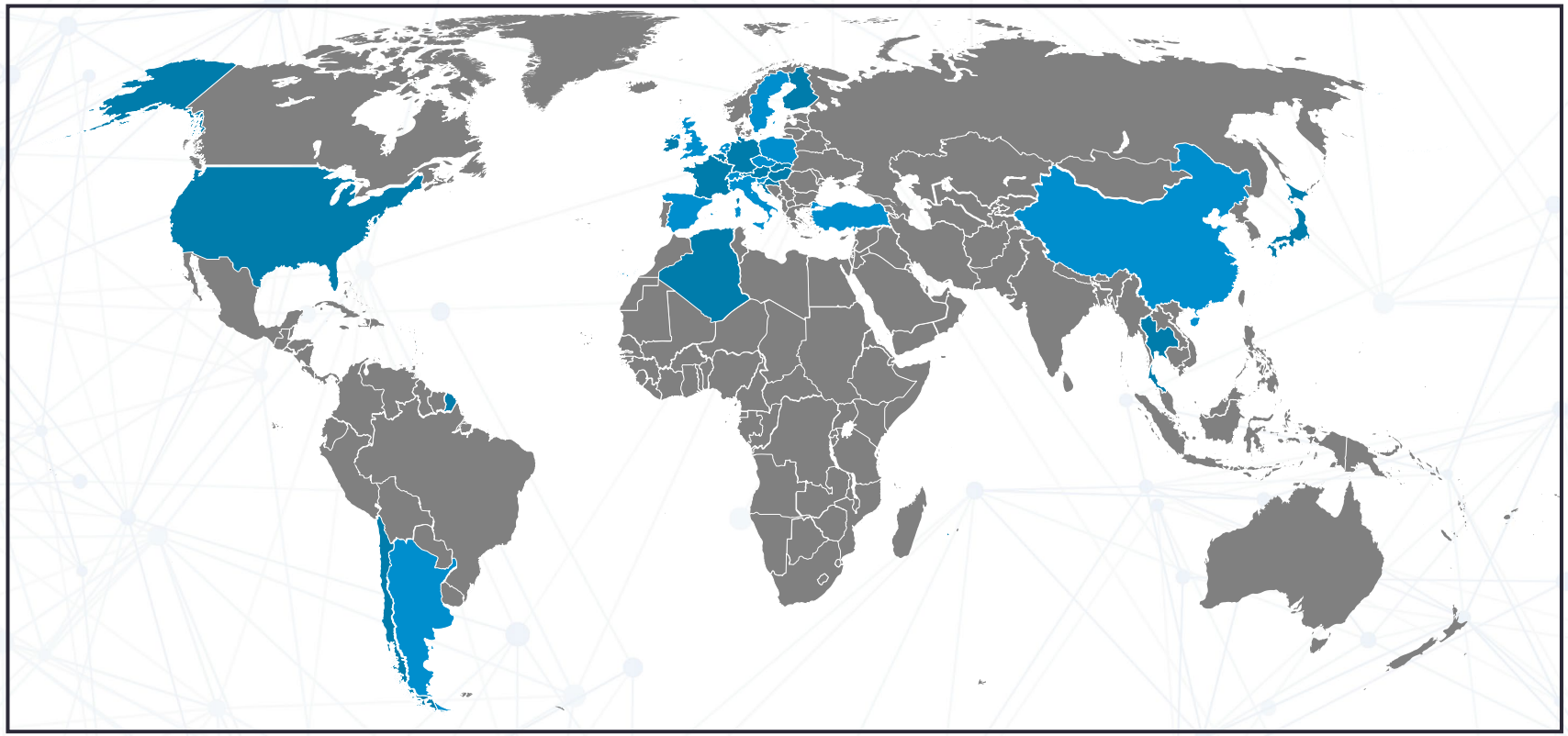
Electrochemistry and Energy storage

ABOUT

ICCRAM

NATIONAL, EUROPEAN AND INTERNATIONAL COLLABORATION

University / Research Centers / non-profit associations / private institutions



Collaboration in Spain

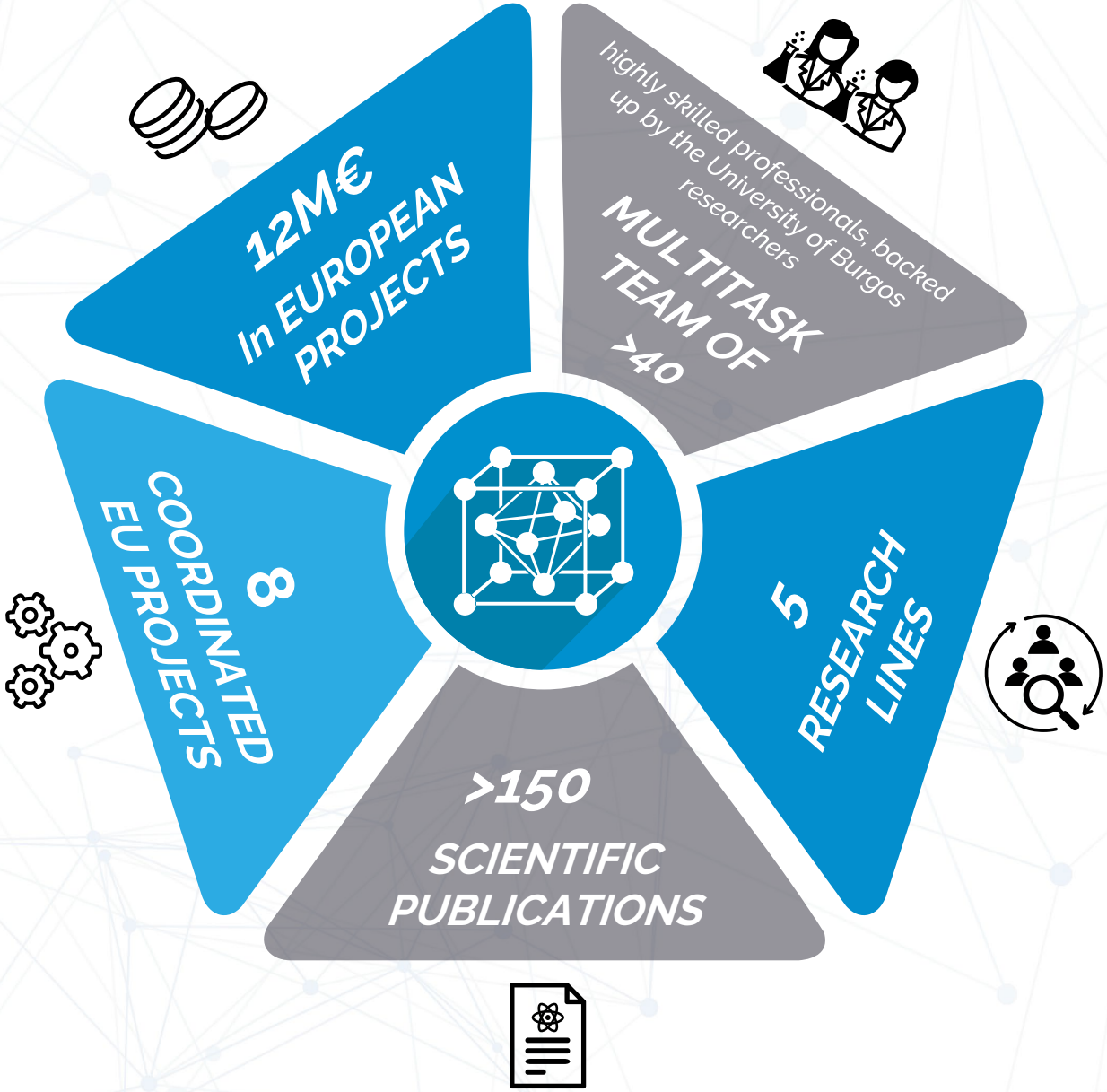
Collaboration in Europe

ABOUT

ICCRAM

International Research Center in Critical RAw Materials for Advanced Industrial Technologies

This center, **inaugurated in 2014** and affiliated with the University of Burgos, **has five main features:**



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ICCRAM

Environment, Sustainability and Toxicology Research Group (ICCRAM-EST)

Rocío Barros García
Head of Environmental biotechnology

ICCRAM

Environmental biotechonolgy

ENVIRONMENT
and Soil Health

01. BIOREMEDIATION

- **Design and optimize ad-hoc bioremediation strategies** for different targeted pollutants.
- **Scaling-up:** From microcosm experiments to pilot scale.

02. MICROORGANISM OPTIMIZATION

- **Isolation and characterization of microorganisms** using advanced techniques. **Synthetic microbial consortia** to degrade pollutants.
- **Enhancing plant growth** through bacteria/fungi interaction.

03. NATURE-BASED SOLUTIONS

- **Strategies to reduce agrochemicals use** and promote sustainability in agricultural systems.
- **Plant based solutions for environmental restoration**: wetland systems and phytomanagement.

04. SOIL HEALTH AND SUSTAINABLE AGRICULTURE

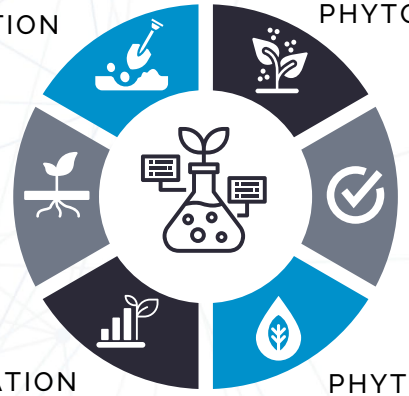
- **Comprehensive evaluation** of soil function and ecosystem services.
- **Sustainable agricultural practices** to promote soil resilience.

ENVIRONMENT RESTORATION

Soil and Water Matrix: Inorganic and Organic Pollutants

COLLABORATION WITH OTHER GROUPS: **UBUCOMP, BBT, ADMIRABLE, LEH**

BIOREMEDIATION TECHNOLOGIES



- ENZYME – ASSISTED BIOREMEDIATION
- MICROBIAL – ASSISTED PHYTOREMEDIATION
- PLANT-GROWTH PROMOTING MICROORGANISM
- ORGANIC AND INORGANIC AMENDMENTS
- BIOAUGMENTATION AND BIOSTIMULATION
- PHYTOREMEDIATION

APPLICATIONS

- WETLANDS SYSTEMS
- INTEGRATED SYSTEMS
- PHYTOMANAGMENT
- BIOPILES

CAPABILITIES

- MOLECULAR BIOLOGY APPROACHES
- -OMICS
- STABLE ISOTOPE PROVING
- MODELLING AND MACHINE LEARNING
- AGREEMENTS WITH POLLUTED OWNERS

SCALING-UP

Microcosm → Pilot Scale → Field Scale

SOIL HEALTH

and Sustainable Agriculture

PROJECTS | TRIBIOME | pHYBi

— SUSTAINABLE PRACTICES —

*"Evaluation of **sustainable strategies for crop production and soil protection**"*

01/ Biostimulants	**02/** Biopesticides	**03/** Cover Crops
04/ Floral Margins	**05/** Plant Growth promoting microorganism	

COLLABORATION WITH OTHER UBU GROUPS: **GICAP, UBUCOMP and BBT.**

RESEARCH AND CAPABILITIES

Soil Monitoring

- **Physicochemical and biochemical** properties
- Computerised **tomography**
- **Microbiome**
- **Biodiversity**
- **Soil nutrient** dynamics

Ecosystem services

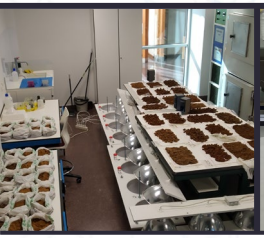
- Soil Function.
- **Collaboration Agreements / Stakeholders engagement:**
  - **Farmers Associations**
  - **Vineyards**

Digital Tools

- **Digital innovation** in farming
- **Remote** servers
- **Drones** and **scanners**
- **Machine learning** models

Plant Phenotyping

- Salinity.
- Drought



SCALING-UP → Growing → Greenhouse → Field Scale

SOIL ANALYSIS

Capabilities

Soil Pollution

1. **Total and available trace elements:** microwave assisted acid digestion in **ETHOS ONE** (**Millestone**) and quantification using **ICP-OES** (**Spectro Arcos, AMETEK**) or **ICP-QQQ** (**Agilent**)
2. **TPHs** microwave assisted extraction in **ETHOS-X (Millestone)** and quantification using **GC-MS/MS**
3. **Pesticides extraction and quantification** (lindane and atrazine).

Soil physicochemical analysis

1. **Texture and Bulk** soil and particle density
2. **Water retention capacity** and **SOM content by LoI**
3. **Total Carbon and Nitrogen** by combustion (**TruSpec LECO**)
4. Cation exchange capacity (**CEC**) by **ICP-OES** (**Spectro Genesis, AMETEK**)
5. **Available nutrients: NO3-N, NH4-N, PO4-P** by segmented flow analysis (**SKALAR**)
6. **Lime content and OM** fractionation: **PAOM** and **MAOM**.

Soil Sampling

1. **Geological sampling**
2. **Soil sampling with auge**r for physical chemical analysis
3. **Rhizosphere sampling** for microbiome analysis
4. **Biodiversity studies.**

Soil Biochemistry

1. **Basal soil respiration** with alkaline trap.
2. **Microbial biomass** (C, N and P) by fumigation-extraction method and **DOC or DON quantification by TOC TC/TN** (Shimadzu).
3. **Soil enzymatic profiling** (AcPA, bGA, aGA, bXyl, bNAG, SA, AlkPA, LeuAMP) with **fluorogenic substrates** in microtiter plates.
4. **Biomarkers**: PLFA with FAMES quantification by GC-MS.
5. **Physiological profiling CLPP** with EcoPlates.

ENVIRONMENT

Projects and Team

National and European Projects

Bioremediation Phytoremediation greener	Bioremediation Phytoremediation BIOSYSMO	Phytomanagement Plant Growth Promoting Microorganisms pHYBi
Bioremediation and Phytix BIOREM	Soil microbiome and biostimulants TRIBIOME	Microbial assisted PHY2SHINE (NATIONAL)
Erasmus mundus IM4SOILHEALTH Erasmus Mundus biocolloid ERASMUS MUNDUS MASTER	Sustainable Agriculture Practices NOVATERRA	Biocontrol and enzyme based technologies POMATO ECOSEEDS+

ENVIRONMENT TEAM


NEW YORK STATE

Sonia Martel Martín
Head of Sustainability

ICCRAM

Sustainability

SUSTAINABILITY

And Circular Economy

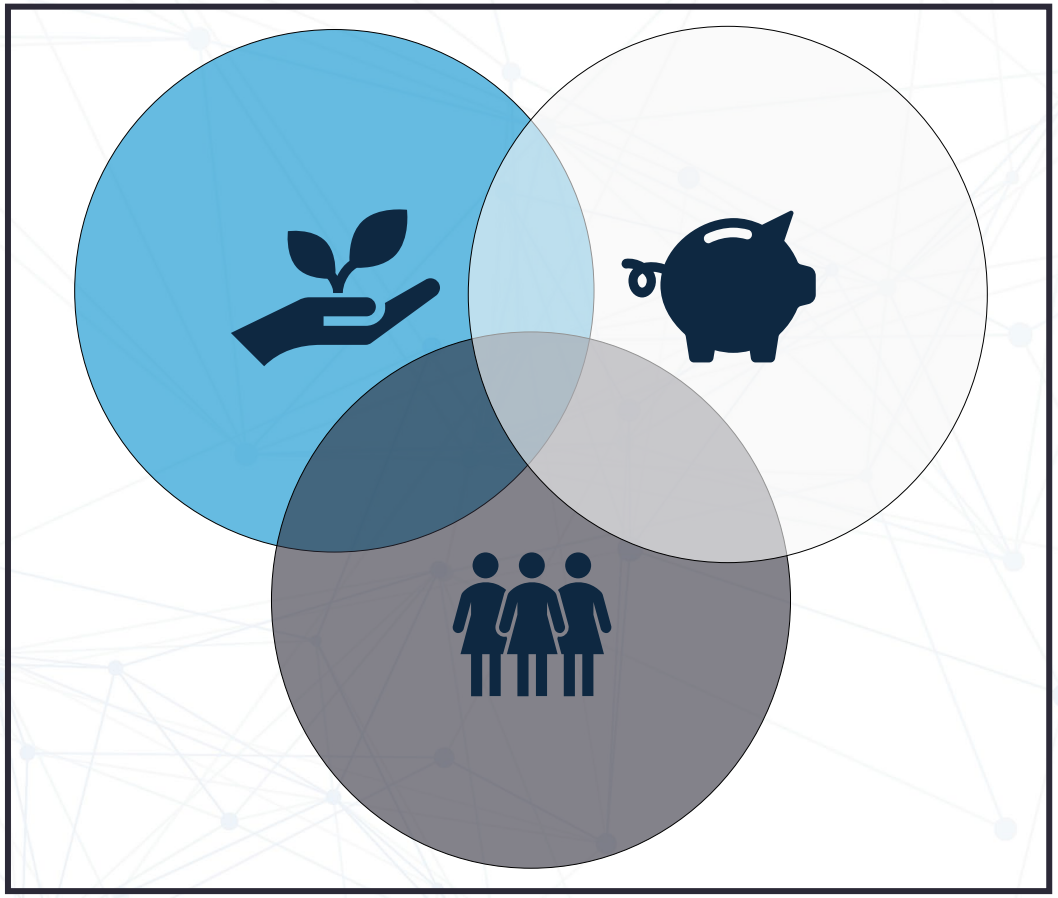
WHAT SUSTAINABILITY ASSESSMENT EVALUATES?

Sustainability Assessment evaluating environmental, economic and social aspects of innovative technologies towards **Circular Economy.**

THE THREE MAIN ASPECTS IN CIRCULAR ECONOMY

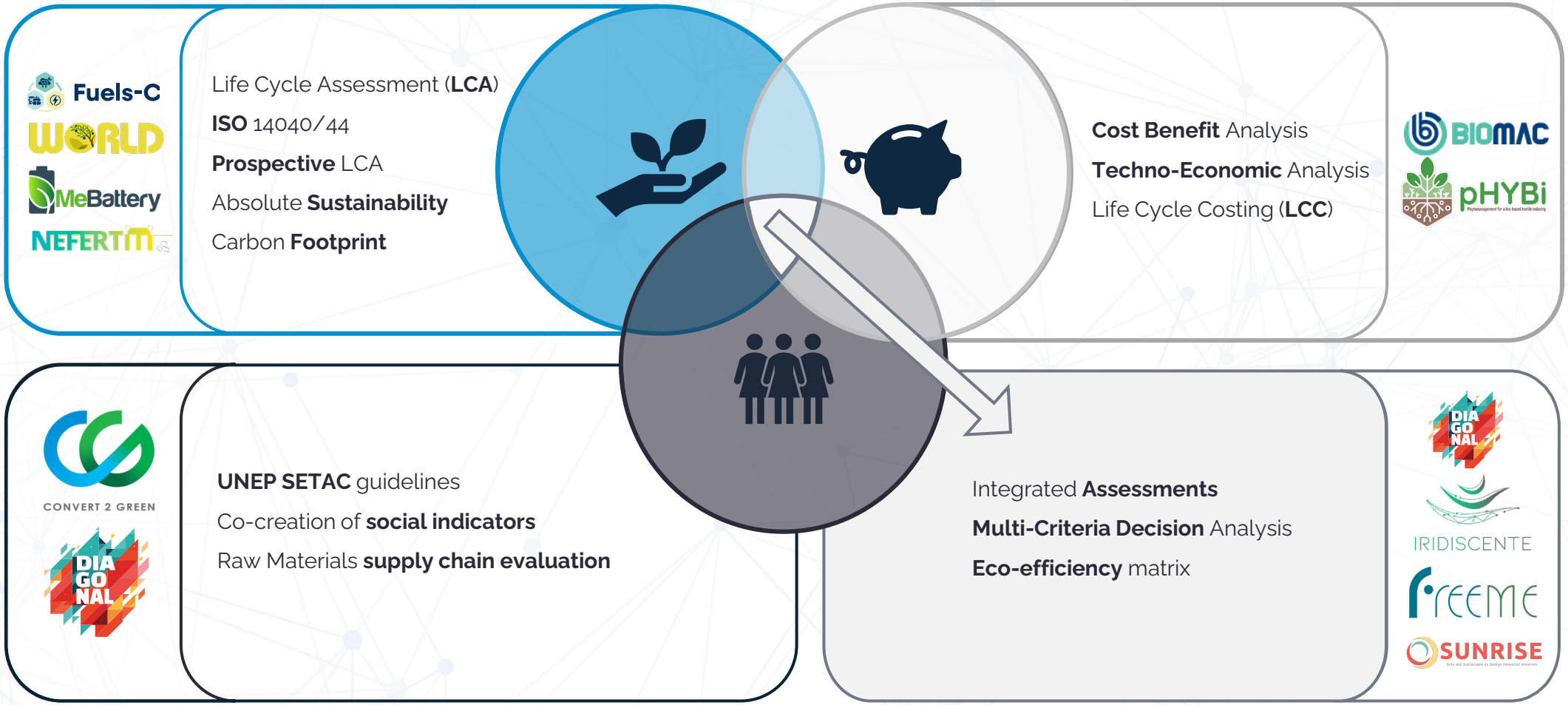
- ECONOMIC ASPECTS
- ENVIRONMENTAL ASPECTS
- SOCIAL ASPECTS

CIRCULAR ECONOMY INFOGRAPHIC



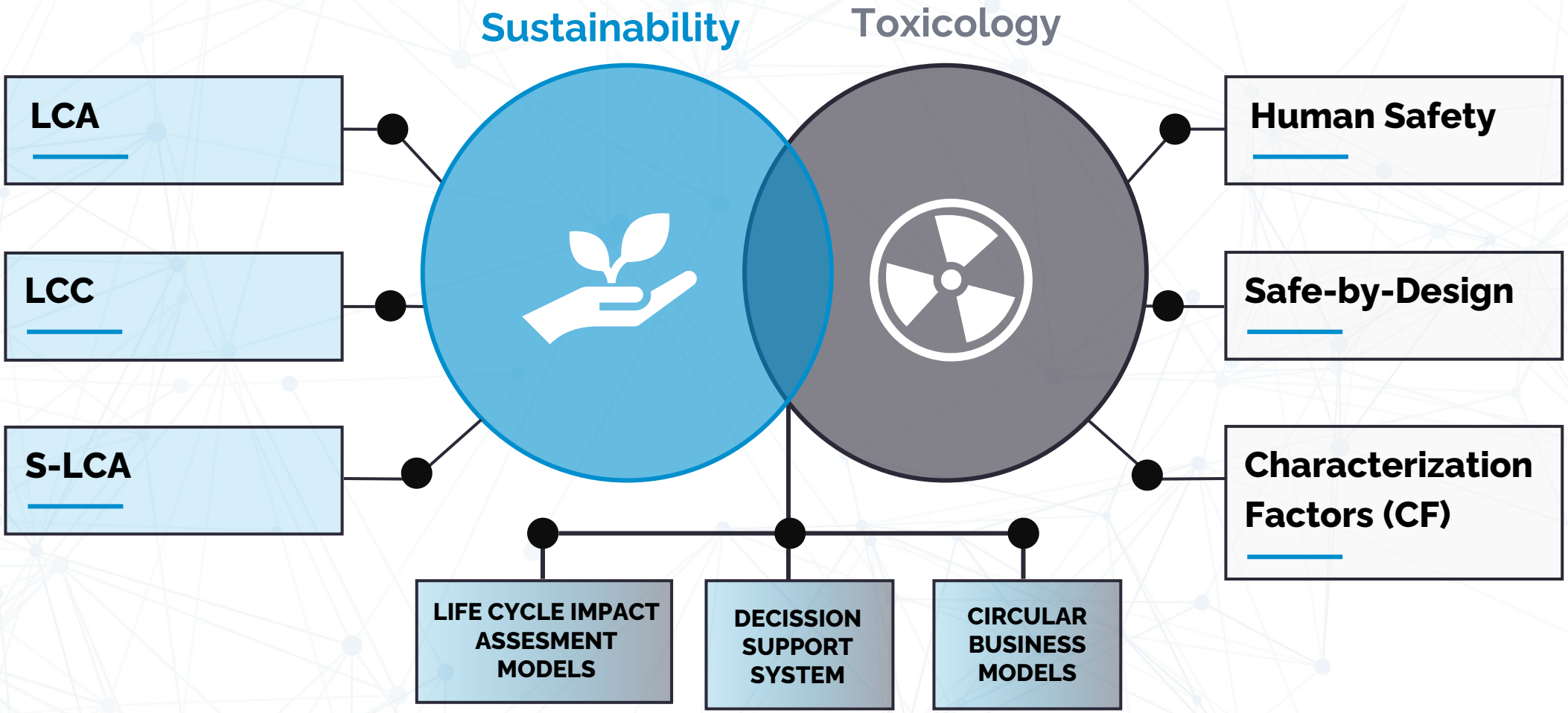
SUSTAINABILITY

And Circular Economy

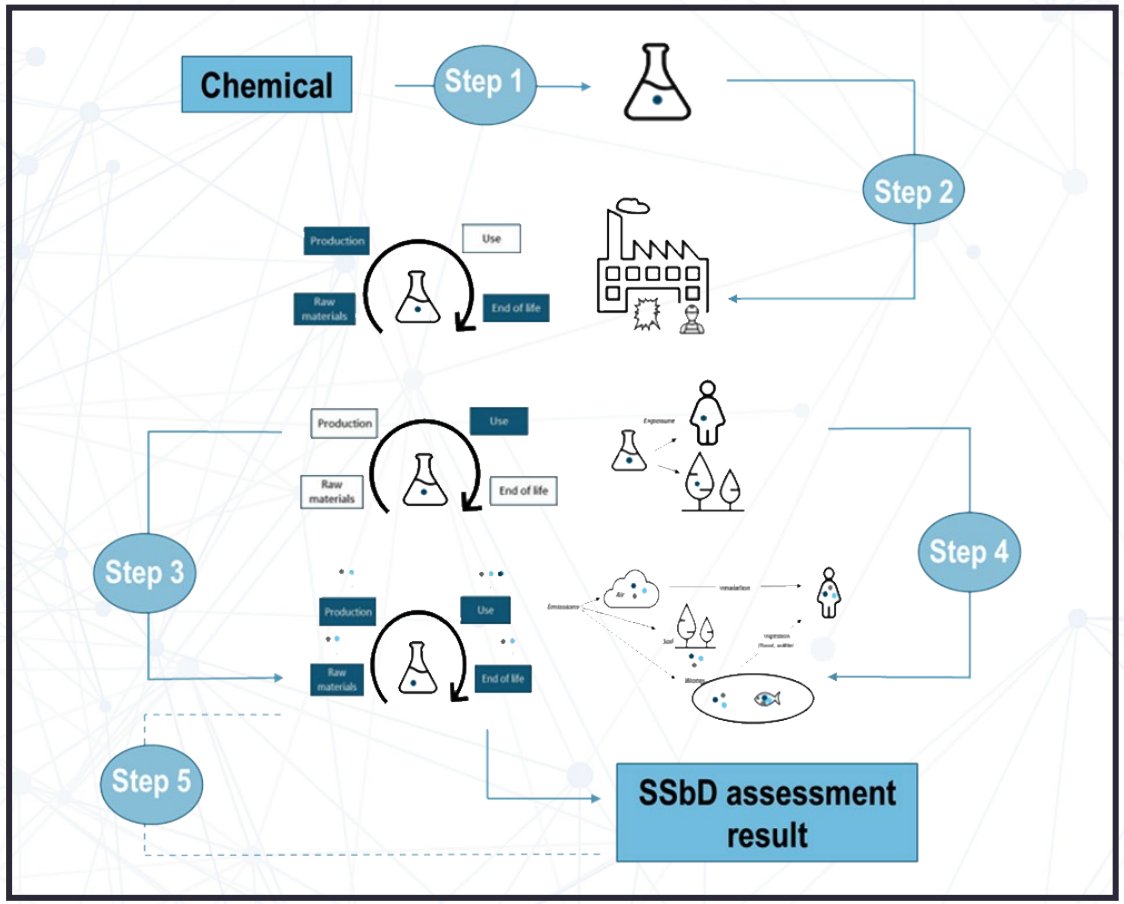


TOXICOLOGY

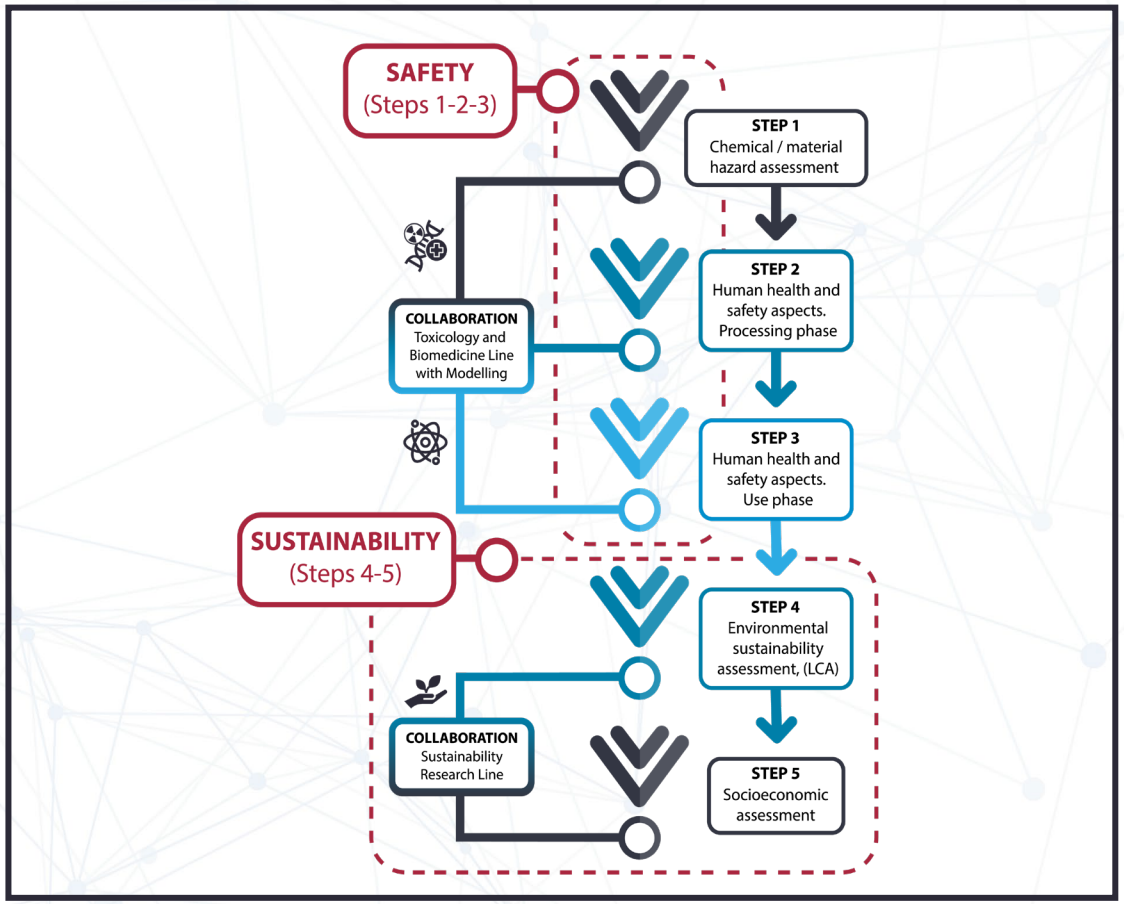
And Sustainability interaction



CHEMICAL PROCESS INFOGRAPHIC



SAFETY AND SUSTAINABILITY PROCESS INFOGRAPHIC



SUSTAINABILITY

Projects and Team

National and European Projects

Life Cycle Assessment (LCA) MeBattery DESIDERATA	Life Cycle Sustainability Assessment Fuels-C IRIDISCENTE	Absolute Sustainability Assessment NEFERTITI
Circular Business models WORLD	Safe and Sustainable-by-Design SUNRISE FREEME	Carbon footprint UNIVERSIDAD DE BURGOS
Life Cycle Costing BIOMAC pHYBi	Multi-Criteria Decision Analysis DIAGONAL	Social LCA CONVERT 2 GREEN

SUSTAINABILITY TEAM

Carlos Rumbo Lorenzo,
Head of Toxicology and Microbiology

ICCRAM

Toxicology and Microbiology

Environmental and human hazard assessment for novel (nano)materials and chemicals in line with the European Safe and Sustainable by Design (SSbD) Strategy.

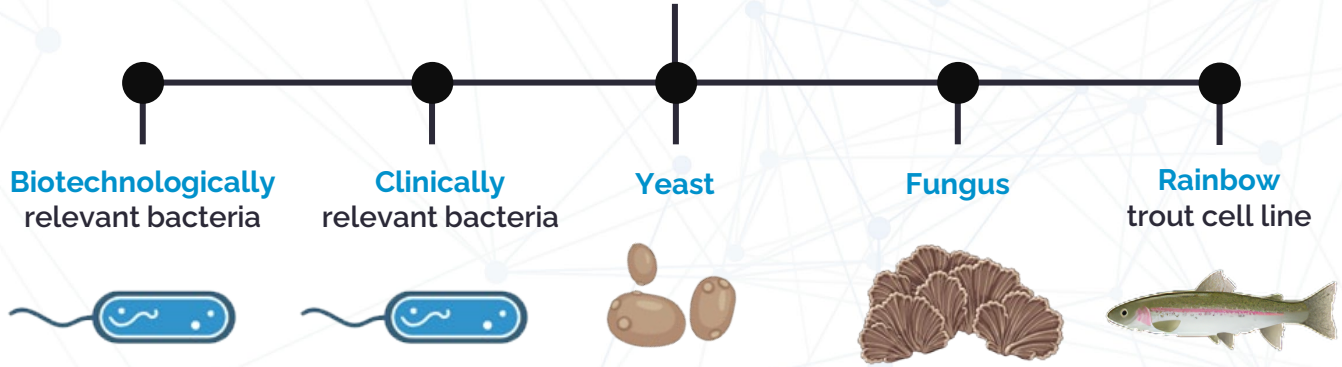
TOXICOLOGY

Microbiology

Determination of antimicrobial potential and environmental toxicity of new compounds and nanoparticles from a safety perspective:

- **Viability**
- **Minimal Inhibitory** Concentration
- **Growth curve** assays
- **Surface** attachment
- **Biofilm** formation/disassembly assays

Environmental Models Used



TOXICOLOGY

Microbiology (biomedical field)

Antimicrobial properties of new compounds and molecules	Clinical Relevant Strains	
Evaluation of the **bacterial growth inhibitory properties**	**MICs/MBC**	**Growth Curves**
Effects on **biofilm formation**	**Inhibition**	**Disassembly**
Anti-infective properties	In vitro infection	

OBJECTIVES

01 **Evaluate** the **antimicrobial potential of new compounds and nanoparticles** at different levels.

02 **Understanding** of **antimicrobial mechanisms** using molecular biology approaches and –omics.

03 **Analyse the safety** of promising antimicrobial compounds/nanoparticles for **human health**

TOXICOLOGY AND BIOMEDICINE

Projects and Team

National and European Projects

SSbD Human & Environmental tox DIAGONAL	Upgrading toxicology facility CONVERT 2 GREEN	SSbD, Human toxicology SAFARI
SSbD, Human & Environmental tox NEFERTITI	Human & Environmental tox BIOMAC	Human & Environmental tox BIOSYSMO
SSbD, Human & Environmental tox FREEME	SSbD, Human & Environmental tox IRIDISCENTE	SSbD, Human & Environmental tox DESIDERATA

BIOMEDICINE & TOXICOLOGY TEAM

Laura Gómez Cuadrado,
Head of Biomedicine and Cellular Toxicology

ICCRAM

Biomedicine and Cellular Toxicology

- *Human and environmental hazard assessment for novel (nano)materials and chemicals in line with the European Safe and Sustainable by Design (SSbD) Strategy.*
- *Understanding mechanisms of toxicity in human models.*
- *Biomedical studies related to human health.*

BIOMEDICINE

and cellular toxicology

THE THREE MAIN OBJECTIVES

01 "**Toxicology services**": Advanced ***In-vitro*** **assays** for human and ecotoxicity assessment.

02 **Understanding of toxicity mechanisms** using cell and molecular biology approaches.

03 Application of **cell and molecular biology techniques** for **biomedical studies** related to human health.

CELL & MOLECULAR BIOLOGY TECHNIQUES:

CURRENTLY AVAILABLE 01 02

- **2D, 3D and 3DD** cell culture models
- **Xenobiotic exposure assessments**: dose-response
- **Viability** assays, **Oxidative** stress, **Membrane** integrity, **Metabolic** activity
- Transcriptomic analyses (**qPCR, RNAseq**)
- **Immunofluorescence**
- Flow **cytometry** & **cell sorting**
- **Skin irritation test OECD 439** for chemicals & Medical Devices
- **Acute toxicity test OECD 249** - ecotoxicity

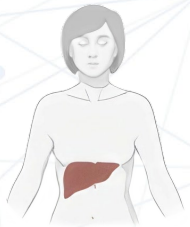
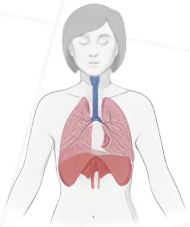
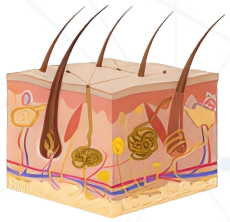
POTENTIAL FUTURE IMPLEMENTATIONS 03

- **Gene delivery assays** using both viral (**transduction**) and non-viral (**transfections**) vectors in cellular models
- **Viral Gene Delivery Systems:** Lentivirus production
- **Cell Line Engineering:** CRISPR/Cas9 genome engineering, shRNA-mediated gene knockdown
- Primary **Human-Derived** Cell culture, **2D and 3D** Co-culture **Models**
- **Tumour** microenvironment, migration, invasion and metastasis
- **Analytical Techniques:** ELISAs, Immunohistochemistry, Western Blotting.

BIOMEDICINE

and cellular toxicology

Models/exposure routes

Oral	Respiratory	Dermal
		
Hepatotoxicity	*Pulmonary toxicity*	*Dermal toxicity*
		
Neurotoxicity	*Neurotoxicity*	

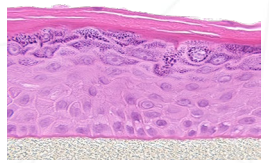
Environmental Model

Rainbow trout cell line

Techniques

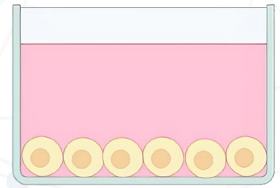
Tissues

In Vitro *EpiDerm Skin Irritation Test (**EPI-200-SIT**)*



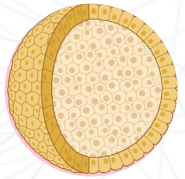
2D

Applicated example *of 2D technique*



3D Static

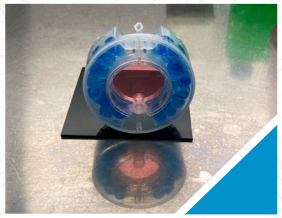
Applicated example *of 3D static*

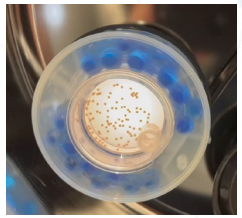


3D Dynamic

Applicated examples *of 3D dynamic*

3D Dynamic applications





TOXICOLOGY AND BIOMEDICINE

Projects and Team

National and European Projects

SSbD Human & Environmental tox DIAGONAL	Upgrading toxicology facility CONVERT 2 GREEN	SSbD, Human toxicology SAFARI
SSbD, Human & Environmental tox NEFERTITI	Human & Environmental tox BIOMAC	Human & Environmental tox BIOSYSMO
SSbD, Human & Environmental tox FREEME	SSbD, Human & Environmental tox IRIDISCENTE	SSbD, Human & Environmental tox DESIDERATA

BIOMEDICINE & TOXICOLOGY TEAM

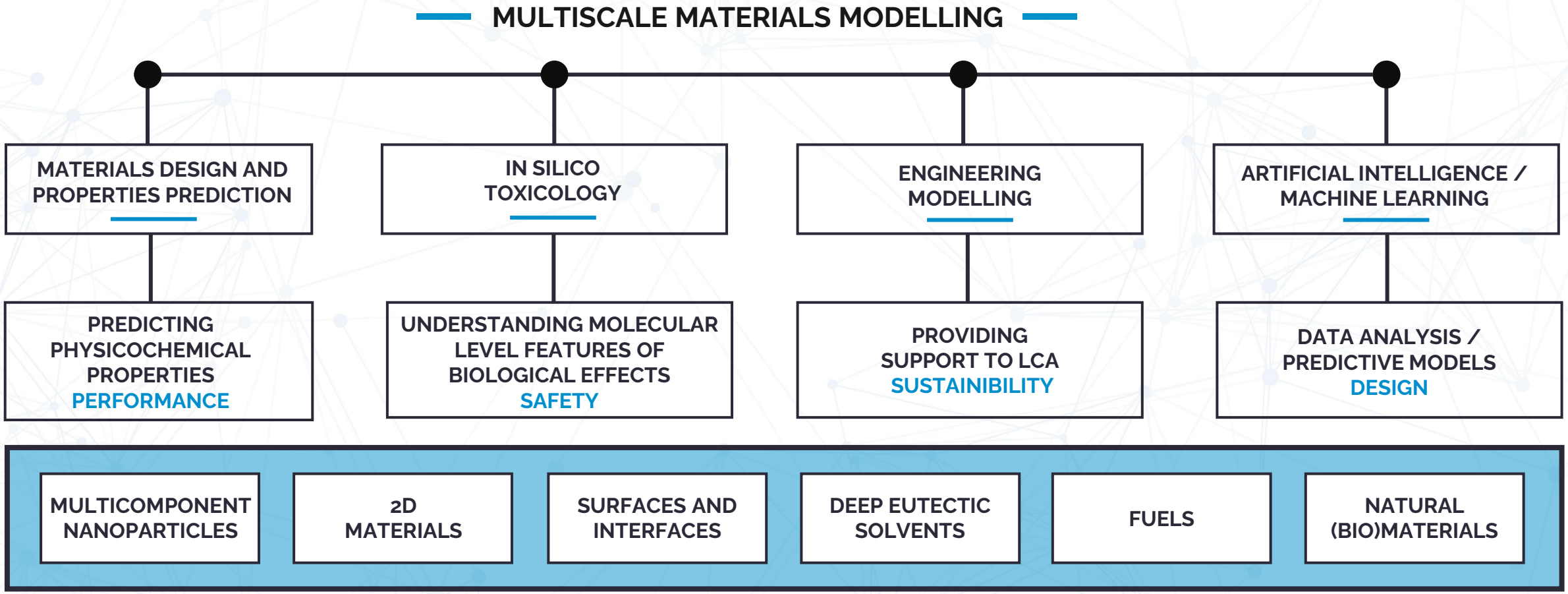
Santiago Aparicio.
Head of AdF group

ICCRAM

Design and Materials Modelling Research Group

IN-SILICO DESIGN AND TESTING

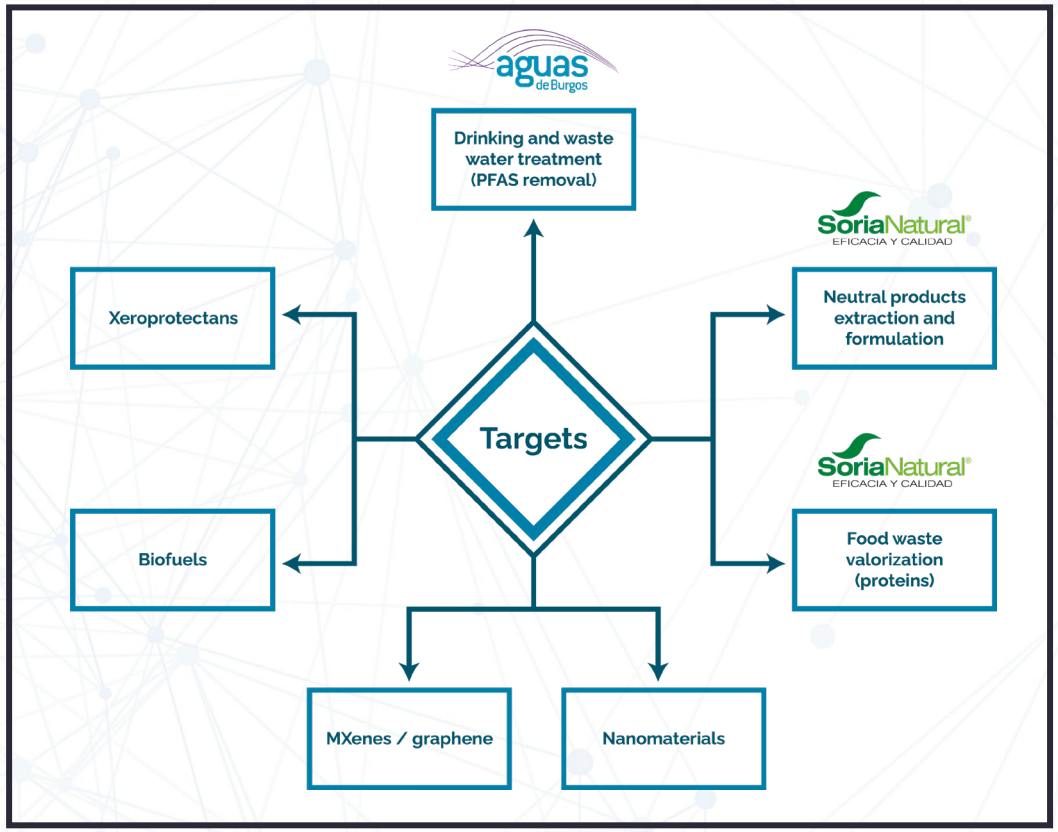
Safe, Sustainable and Functional Materials



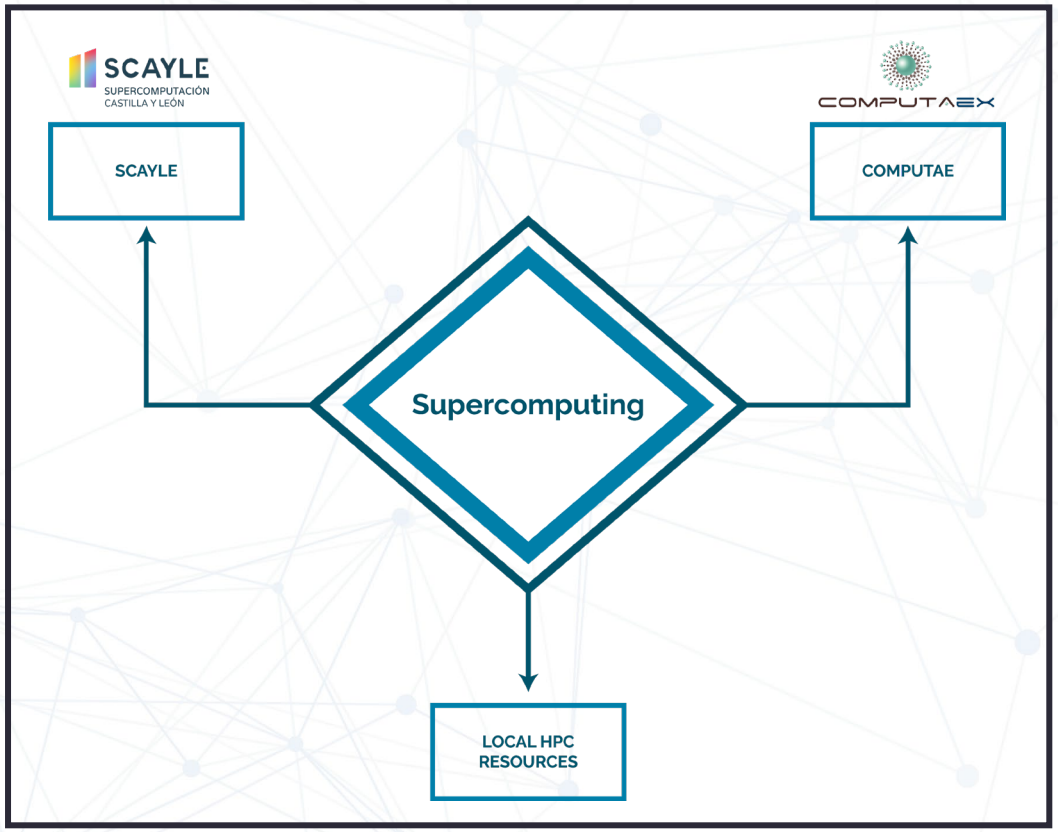
IN-SILICO DESIGN AND TESTING

Safe, Sustainable and Functional Materials

IN-SILICO TARGETS OF SSbD



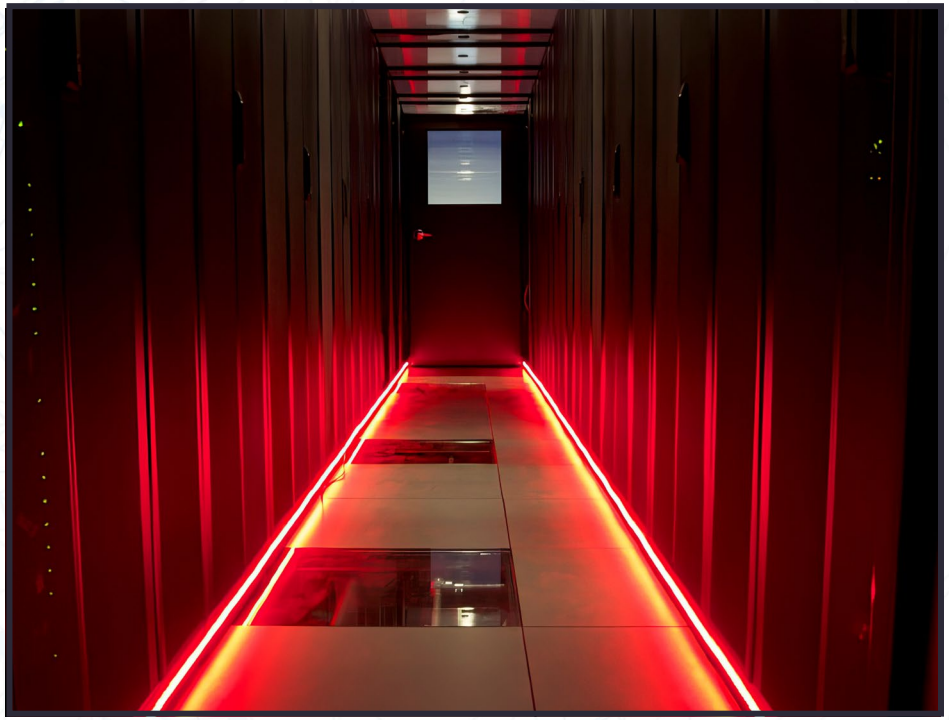
SUPERCOMPUTING OF SSbD



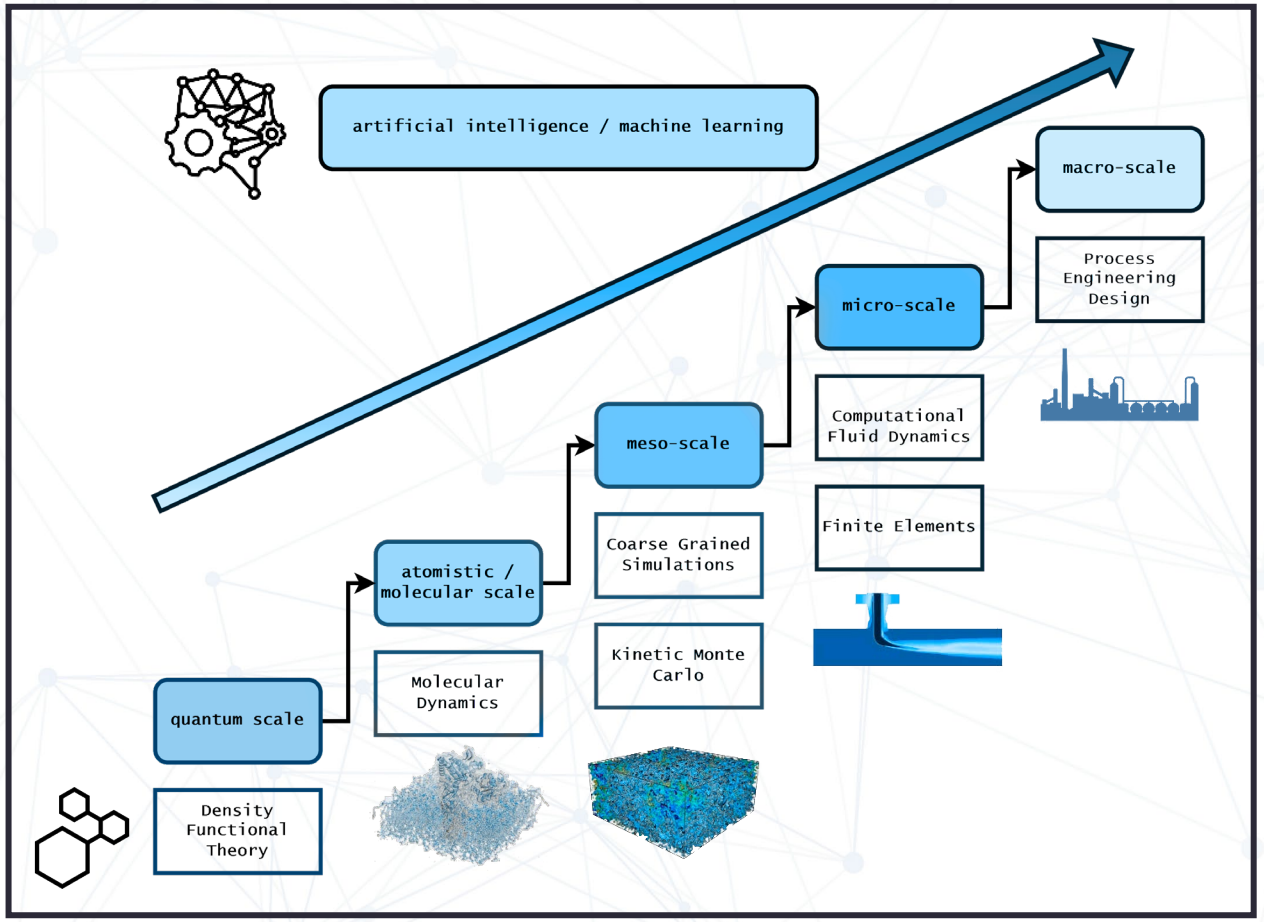
IN-SILICO DESIGN AND TESTING

Methods and Tools

SCAYLE DPC Corridor



Methodologies & Tools



IN-SILICO DESIGN AND TESTING

Projects and Team

National and European Projects

PFAS replacement DESIDERATA	Proteins extraction from waste CONVERT 2 GREEN	Graphene – Mxenes composites SAFARI
Photocatalysts for solar fuels from CO_2 NEFERTITI	In silico methods for SSbD SUNRISE Safe and Sustainable by Design Advanced Materials	In Silico methods for SSbD BIOREM
Digital Twins for biofuels production Fuels-C	Deep Eutectic Solvents from waste oils WORLD	Xeroprotectants for biopreservation WhyNotDry

MODELLING TEAM

Edgar Ventosa Arbaizar
Head of PROELECTRO group

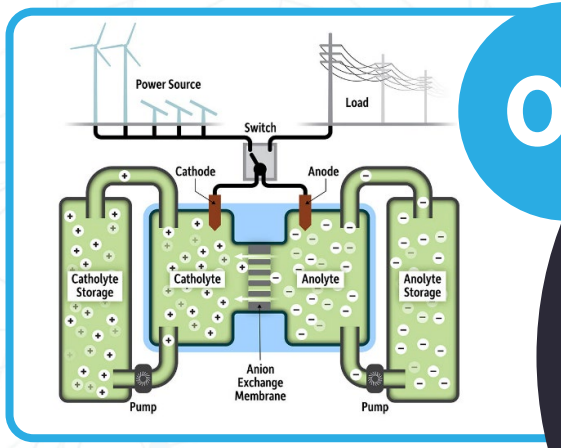
ICCRAM

Electrochemical Processes and Energy Storage Research Group (PROELECTRO)

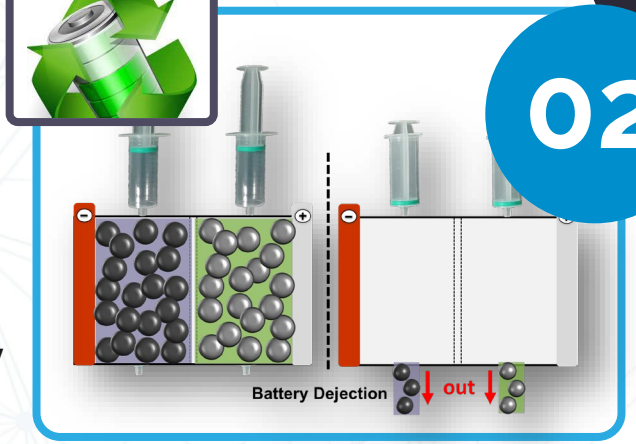
ELECTROCHEMICAL PROCESSES

Research Lines

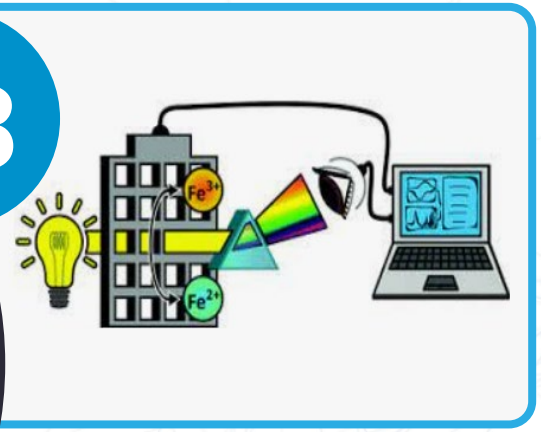
Redox Flow Batteries



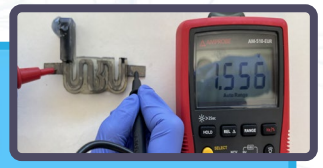
Recycling Strategies & Injectable battery



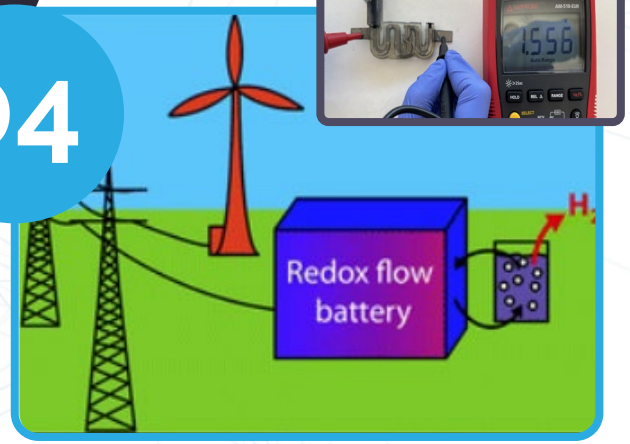
Battery Sustainability



Operando & In-situ techniques for batteries



Shape-conformable battery & Battery-Electrolyzer



Innovative Battery Concepts

ELECTROCHEMICAL PROCESSES

Capabilities

CAPABILITIES OF PROELECTRO

CAPABILITY 1 Flow and non-flow battery assembling (e.g. Ar-filled glovebox).	**CAPABILITY 2** Electrochemical characterization (e.g. EIS, cyclers).
CAPABILITY 3 Advanced electrochemical and spectroelectrochemical techniques.	**CAPABILITY 4** Fast prototyping (e.g. 3-D printing): TRL 4

ELECTROCHEMICAL PROCESSES

Projects and Team

National and European Projects

High-Energy Redox Flow Batteries MeBattery	Battery Recycling CONVERT 2 GREEN	Sustainable Redox Flow Batteries OMBAT
Advanced Materials for Energy Storage MAT2TEC	New Shape-conformable Battery Concept INGELBAT	Long-duration Redox Flow Batteries MEDIABATT
Operando techniques for battery characterization BU036P23	Nanomaterials-enhanced Redox Flow Batteries QUANTUMBAT	

PROELECTRO TEAM

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Communication and dissemination

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LEADING DISSEMINATION AND COMMUNICATION WORK PACKAGES WITHIN EUROPEAN RESEARCH PROJECTS
+ A GREAT TEAM CARRIES OUT DIFFERENT ACTIVITIES TO BRING SCIENCE CLOSER TO SOCIETY


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BIOMAC
Unveiling Cell Responses to Nanolignin Particles Contributing to New Insights on Nanosafety


SSbD application: widening Step 1 to environmental, economic and social considerations for early-stage decision-making
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Task 4.2: Upgrades Timeline
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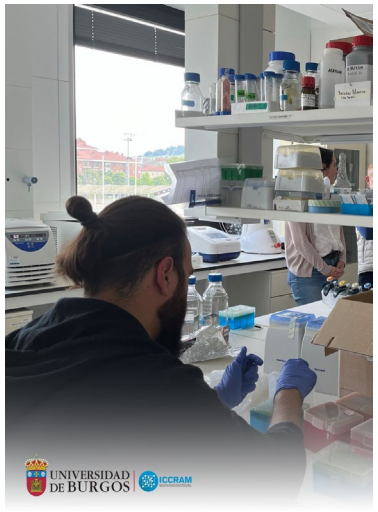
WEEK OF
MICROBIAL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INTERNATIONAL RESEARCH CENTER IN CRITICAL RAW MATERIALS FOR ADVANCED INDUSTRIAL TECHNOLOGIES

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