

LEQUIA REPORT

2025
YEAR

Water treatment

Gas treatment and carbon dioxide bioconversion

Digitalization and application of artificial intelligence to the water cycle

THE LABORATORY OF CHEMICAL AND ENVIRONMENTAL ENGINEERING

A MULTIDISCIPLINARY RESEARCH GROUP OF THE UNIVERSITY OF
GIRONA FOUNDED IN 1992 AND DEVOTED TO THE DEVELOPMENT
OF ECO-ENVIRONMENTAL SOLUTIONS

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1 - THE TEAM



50 members: 8 permanent professors, 9 senior and post-doctoral researchers, 21 pre-doctoral researchers (including 6 industrial doctorates), 1 promoter, 1 project manager, 1 laboratory technician and 9 research technicians

2 starting research grants funded by Spanish Research Agency AEI (1 "Consolidación Investigadora" + 1 "Ramón y Cajal")

1 ICREA Academia grant (2024-2029)

8 new pre-doctoral grants

HIGHLIGHTS



Alba Cabrera-Codony investigates the application of adsorption and oxidation processes to the treatment of both liquid and gaseous effluents. She works on projects within the energy (biogas) and water (potable water treatment and regeneration of purified water) fields; often, in multidisciplinary research teams that apply chemical engineering, analytical chemistry and mathematical modeling.

Her appointment as Lecturer at the Department of Chemical, Agricultural and Agro-Food Engineering (EQATA) in 2025 is an important step in her academic career.

 **ALBA CABRERA-CODONY**
Lecturer

2. PROJECTS

RELEVANT DATA

21 RDI projects under development (8 international, 13 National/Regional)

1 as coordinating entity, 7 as sole beneficiary, 12 as partner, 1 as implementing partner

Funding entities: Spanish Research Agency AEI (10 projects). European Commission – Horizon Europe (5). PRIMA partnership (1). European Commission – LIFE+ (1). European Commission – Erasmus+ (1). Fundación Biodiversidad (1). Catalan Agency for Enterprise Competitiveness ACCIÓ (1). Catalan Department of Agriculture DARP (1).

NEW PROJECTS



Role: partner

PI: Sebastià Puig

Duration: 2025-2028

Funding entity: European Commission (MSC doctoral network)

TRAMPOLINE - A training programme to promote the industrial adoption of microbial electrochemical technologies

Microbial technologies (METs) harness the metabolic activities of microorganisms to drive electrochemical reactions. With the support of the Marie Skłodowska-Curie Actions programme, the TRAMPOLINE consortium will train young researchers on cutting-edge MET-based technologies for water bioremediation, desalination and resource recovery. LEQUIA hosts one PhD fellow, José Daniel Izquierdo Moreno.



Role: sole beneficiary

PIs: Hèctor Monclús and Maria Martín

Duration: 2025-2028

Funding entity: Spanish Research Agency AEI ("Generación de Conocimiento")

MORIARTY - Bridging the Water Gap: A Step Forward in Multifaceted Risk Evaluation in Supply Scenarios with Regenerated Water

By combining cutting-edge technology with a social perspective, MORIARTY seeks to make potable water reuse a technically, environmentally, and socially feasible option. A key element of the project is its holistic approach to risk evaluation, which considers the chemical, microbial, and social challenges associated with the reuse of reclaimed water. The project hypothesizes that integrating advanced monitoring techniques with optimized treatment processes will significantly enhance water safety while also improving public perception and acceptance. MORIARTY will undertake an extensive assessment of disinfection by-product formation.



Role: *implementing partner*

PI: Hèctor Monclús and Jesús Colprim

Duration: 2024-2027

Funding entity: European Commission (MSC COFUND Post-doctoral network)

RAMON-LLULL AIRA - MSC Post-doctoral programme on artificial intelligence

The ever-expanding horizons of AI create a need for professionals with interdisciplinary and innovative thinking skills to effectively leverage the emerging opportunities in the field. With the support of the Marie Skłodowska-Curie Actions programme and the Catalan government, the RAMON LLULL AIRA offers 33 three-year fellowships to pave the way for a transformative future in AI. LEQUIA will host one post-doctoral research fellow focused on the development and implementation of EDSSs for a sustainable management of the urban water cycle (starting in 2026).

WATOURISM

Role: partner

PI: Manel Poch

Duration: 2025-2028

Funding entity: Spanish Research Agency AEI (Colaboración público-privada)

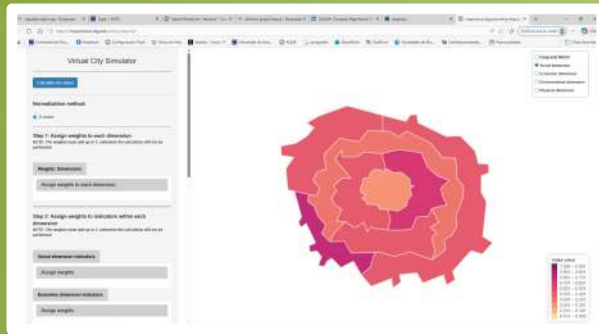
WATOURISM - Smart WATER management contributing to a sustainable TOURISM

This collaborative project between Agbar, Cetaqua, the University of Girona, and the University of Valladolid aims to demonstrate the role of water cycle digitization in promoting sustainable tourism. The project will generate a methodology for detecting anomalous consumption and illegal accommodations, develop an agent-based model methodology to simulate responses to different policies, a toolkit for calculating, reducing, and compensating the water footprint of tourism according to the new Act4water certification, and a roadmap for the industrialization of these solutions.

HIGHLIGHTS



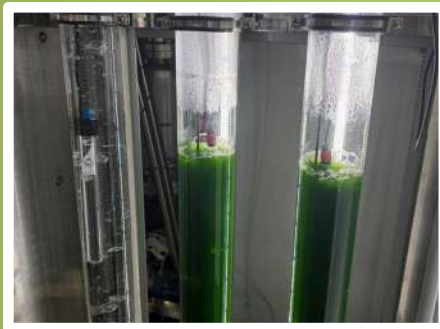
General Assembly meeting of SPORE-MED project coordinated by LEQUIA (Salerno, Italy, November 2025). SPORE-MED (2024-2026, PRIMA) aims at upgrading urban wastewater treatment plants. The consortium integrates 7 universities and 2 large enterprises of 6 EU and North-African Mediterranean countries.



Virtual city simulator developed under CLEPSIDRA project (2023-225, AEI, Generación de Conocimiento). This simulation tool integrates a multidimensional index to assess floods' vulnerability. The tool supports planning and management of water resources in cities.



Pilot plant in Montfullà drinking water treatment (Girona). Experimental results conducted under SHERLOCK project (2021-2025, AEI, Generación de Conocimiento) have demonstrated that the combination of advanced treatments (ozonisation-coagulation-adsorption) can reduce disinfection by-products content in drinking water.



New experimental set-ups for projects DEPURHOB (left) and ALGAESOL (right). ALGAESOL (2024-2027, Horizon Europe) aims at developing new biological platforms to convert carbon dioxide into ship and aviation fuels. LEQUIA is researching the production of microalgae-based biofuels. Project DEPURHOB (2024-2026, DARP, Demonstration Actions) will valorize anaerobic digestion waste into a slow-release fertilizer by using purple phototrophic bacteria and hydrogen oxidizing bacteria.

3 - DOCTORAL THESES

RELEVANT DATA

2 doctoral theses defended (1 industrial doctorate)

21 doctoral theses under development (2 MSCA, 5 industrial doctorates)

Agent-based modelling for user-centered urban water management



This thesis applied agent-based modelling to analyse how users respond to various urban management policies in Barcelona metropolitan area and beyond it. These simulations offer valuable information for urban water managers such as those from Aigües de Barcelona, and open the door to a future where water management is more efficient, sustainable and adapted to social needs.

Industrial doctorate with Aigües de Barcelona

◆ POL VIDAL LAMOLLA

From ageing analysis to second life: a sustainable approach to osmosis membrane recycling



In this doctoral thesis, constraints during operational reverse osmosis membranes life such as drying, industrial use, and chemical exposure were studied to i) better understand their impact on membrane performance and ii) evaluate whether these factors pose limitations for membrane recycling. This approach was also applied to forward osmosis membranes. Bianca Zappulla also explored an alternative oxidative chemical treatment with ozone for membrane recycling, and carried out pilot-scale tests to validate the reuse potential of transformed membranes.

◆ BIANCA ZAPPULLA SABIO

4 - PUBLICATIONS

RELEVANT DATA

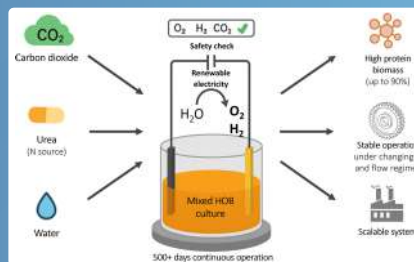
34 indexed peer-reviewed publications (Scopus): 29 articles, 3 reviews, 1 book chapter, 1 data paper

25 open access publications

18 articles published in Q1 JCR journals

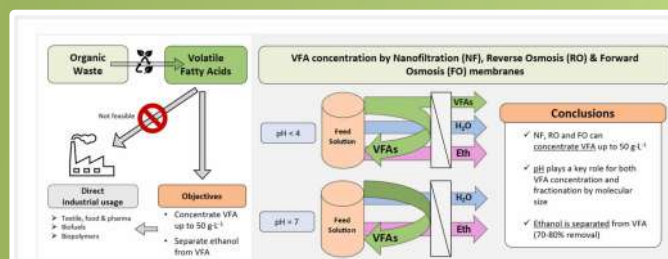
HIGHLIGHTED ARTICLES

Empowering microbial proteins: Continuous electro-fermentation of hydrogen-oxidizing bacteria from water, urea and carbon dioxide, Laura Rovira-Alsina, Narcís Pous, Yifeng Zhang, M. Dolores Balaguer, Elisabet Perona-Vico, Lluís Bañeras, Sebastià Puig, Chemical Engineering Journal, Volume 526, 2025, 171375



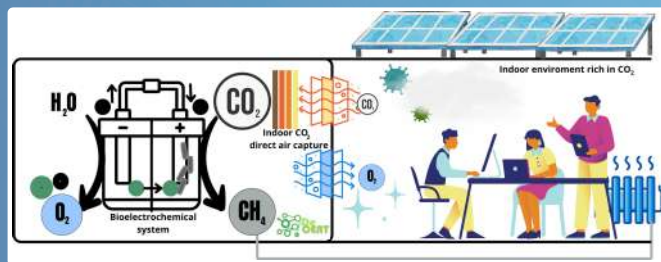
This work provides new insights into the stoichiometric balance of electro-fermentation and its potential for scalable, sustainable microbial protein production. Oxygen and hydrogen were produced in situ through water electrolysis, while carbon dioxide and urea-derived nitrogen were used as the main nutrient sources. Over 500 days of continuous operation, the process maintained stable performance while production was enhanced through targeted adjustments in operating conditions.

Simultaneous high volatile fatty acids concentration and ethanol extraction using nanofiltration, reverse osmosis and forward osmosis, Pere Olives, Carlos Ramos, Ignasi Rodríguez-Roda, Jordi Margarit, Sergi Carbonell, Gaëtan Blandin, Process Safety and Environmental Protection, Volume 197, 2025, 106954, ISSN 0957-5820



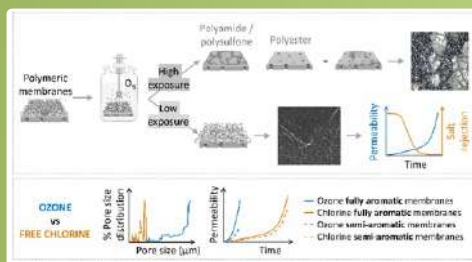
Mixed culture fermentation is a promising approach for producing volatile fatty acids (VFAs), which can replace petrochemical sources for plastics, fuels, and organic acids generation. However, biological VFAs production generates by-products like ethanol and results in dilution within the culture medium, posing challenges for downstream recovery. This article demonstrates the potential of reverse osmosis and forward osmosis membrane technologies for simultaneously concentrating VFAs and separating ethanol. All tested membranes successfully concentrated VFAs up to 50 g·L⁻¹.

Breathe inside the box: optimizing conditions for bioelectrochemical methane production to indoor carbon dioxide valorization and enhance air quality, Silvia Bolognesi, Luis R. López, Elisabet Perona-Vico, Lluís Bañeras, M. Dolors Balaguer, Sebastià Puig, *Chemical Engineering Journal*, Volume 522, 2025, 167426



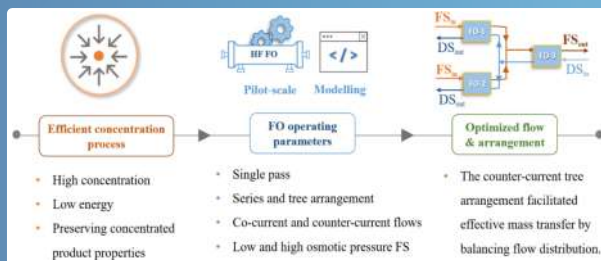
This study evaluated the operation of a novel hybrid platform integrating a direct air capture (DAC) unit for indoor CO₂ capture and concentration with a bioelectrochemical system for methane production. The DAC unit produces a concentrated CO₂ stream and clean indoor air. The indoor captured CO₂ stream (purity 7–17 %) was used to produce grid-standard quality methane (>96 % methane content, higher heating value 39.8 MJ Nm⁻³).

Membrane Recycling: Exploring Ozone as a Viable Alternative to Chlorine for Polymeric Membrane Transformation, Bianca Zappulla-Sabio, Lide Jaurrieta, Wolfgang Gernjak, Harikrishnan Balakrishnan, Ludovic F. Dumée, Hèctor Monclús and Gaëtan Blandin, *ACS EST Engg.* 2025, 5, 11, 3183–3194



This study assesses ozone as an alternative to chlorine oxidation for converting end-of-life reverse osmosis membranes into nanofiltration- and ultrafiltration-like membranes across various new and used reverse osmosis and nanofiltration membranes. These findings address the need to implement circular economy strategies in reverse-osmosis membranes life cycle.

Single-pass forward osmosis for efficient feed concentration: Optimizing multiple modules arrangement and flow distribution, Rajashree Yalamanchili, Pere Olives Cegarra, Albert Galizia, Ignasi Rodríguez-Roda, Gaëtan Blandin, *Desalination*, Volume 615, 2025, 119224



This study presents pilot-scale investigation of forward osmosis (FO) modular arrangements, including series and three configurations operated in single-pass mode under both co-current and counter-current flow orientations, combined with MATLAB-based mass transfer modeling. Understanding FO modular arrangements can contribute to unlock the full potential of forward osmosis for concentration.

5 - KNOWLEDGE AND TECHNOLOGY TRANSFER

RELEVANT DATA

- 9 research projects in collaboration with business organizations
- 1 project to valorize and transfer research outputs
- 6 RDI contracts commissioned by non-academic entities
- 1 patent file
- 1 industrial doctorate completed and 4 under development
- Renewal of TECNIO¹ accreditation for 2025-2028.

HIGHLIGHTS



Drinking water treatment plant of Figueres (Catalonia, Spain, photo: FISERSA). LEQUIA has developed and successfully validated an Environmental Decision Support System to optimize the ozonation process. The work was co-funded by an industrial doctorate project and a contract commissioned by FISERSA.



LEQUIA also developed and validated a digital twin to optimise the operation of La Almunia urban wastewater treatment plant of La Almunia (Zaragoza, Spain, photo: ACCIONA). The work was co-funded by an industrial doctorate and a collaborative project with ACCIONA (HADES, AEI, 2022-2025, Colaboración Público-Privada).

¹ TECNIO is the accreditation granted by the Catalan Government through ACCIÓ to identify and give visibility to technology transfer agents in the Catalan R&D&I system that present differential technological capabilities and have the capacity to transfer them and make the Catalan innovation ecosystem internationally attractive.

6 - AWARDS

2024 Extraordinary PhD award of UdG doctoral programme in water science and technology to Alba Ceballos-Escalera

First place poster award- MEMTECK 2025 (The 8th International Symposium on Membrane Technologies and Applications, November 12-14, 2025 in Izmir, Türkiye): "Combining water reuse and desalination: Optimization of FO-RO hybrid for maximum wastewater recovery, reduced desalination energy through FO module arrangement", by Rajashree Yalamanchili, Pere Olives Cegarra, Albert Galizia, Ignasi Rodriguez-Roda, Gaëtan Blandin

Second Best Poster Prize at ecoSTP2025 conference to Luz Karime Sánchez for her work "Decentralized Urban Water Systems gone wrong? A critical perspective on the Global North and South".

Prize by ATL Chair of Potable Water to Alba Ceballos-Escalera doctoral thesis, Gemma Moncusí's Master research work and Afra Estanyol's Bachelor research work. Girona, 26th May 2025.



Award ceremony of ATL Chair of Potable Water

7 - EVENTS



Training workshop of C-NEWTRAL project (Horizon Europe, MSCA, 2024-2028) held in Girona from 19th to 24th January 2025. C-NEWTRAL Doctoral Network will advance new approaches for integrated planning of climate-neutral cities through citizen engagement and city governance decision-making support.



Workshop on circular management of membranes for water treatment, UdG Research Park, 18th June 2025. More than 70 people attended this event organised by UdG LEQUIA research and spinoff company Ecomemb. The workshop disseminated the results of Osmo4Lives project (AEI, TED2021, 2022-2025).



11th edition of Summer School on degrowth held in Girona from 9th to 15th June 2025 and organized by UdG LEQUIA and Research&Degrowth association.

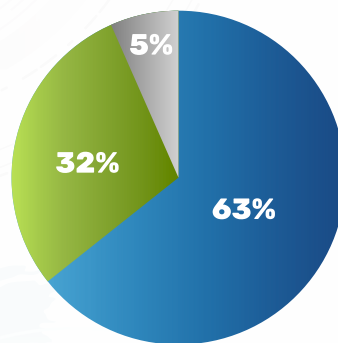
8 - FUNDING

Annual turnover: 2,15M€

38% RDI projects and contracts with business participation

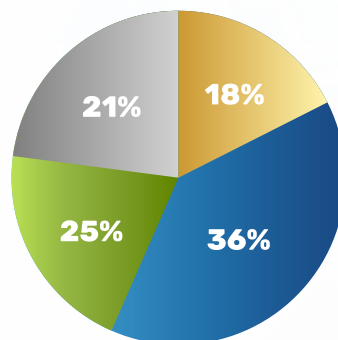
40% of public funds for RDI financed by international entities

TURNOVER DISTRIBUTION



- Public competitive funds without business participation
- Public competitive funds with business participation
- RDI contracts and services

PUBLIC COMPETITIVE FUNDS



- Spain
- Europe
- International (PRIMA)
- Catalonia