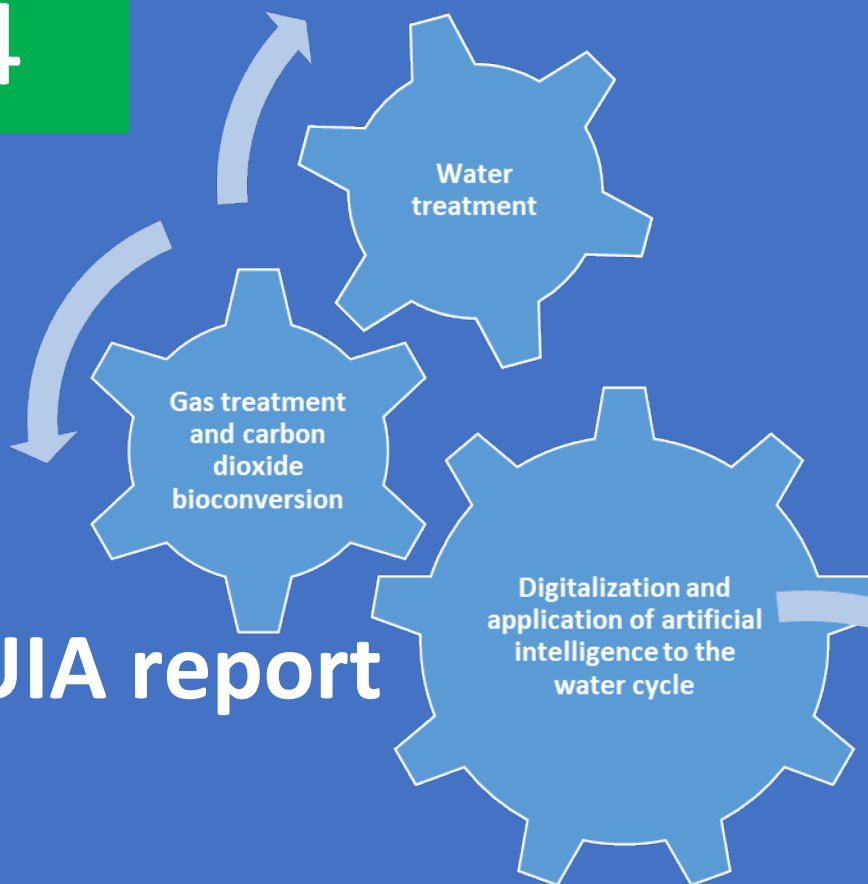


Year

2024

LEQUIA report



THE LABORATORY OF CHEMICAL AND ENVIRONMENTAL ENGINEERING

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

WWW.LEQUIA-UDG.EDU

1. THE TEAM

Relevant data

- 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
- 8 pre-doctoral grants

Highlights

Gaëtan Blandin's work focuses on **water processes associated with membrane technologies** within the context of circular economy applications (desalination, water reuse, nutrients recovery). Technical challenges addressed are process validation and control, fouling and cleaning, module design /process modelling, and optimization and fundamentals of mass transfer.

→ *Ramón y Cajal program allows starting a career as independent researcher*

Gaëtan Blandin

Ramón y Cajal (2024-2029)



Hèctor Monclús applies **artificial intelligence techniques, such as Environmental Decision Support Systems and control algorithms, to improve the urban water cycle**. [WATERCLUE](#) project will contribute to understand how drinking water treatment systems could be enhanced by leveraging real-time data analysis, predictive modeling, and intelligent optimization. Main challenge is identifying dissolved organic matter proxies related with its reactivity with disinfectants and its relationship with the formation of disinfection by-products during water treatment.

→ *Consolidación Investigadora program boosts the establishment of permanent research posts in universities*

Hèctor Monclús

Consolidación Investigadora (2024-2026)



Sebastià Puig's research in biotechnology has applications in: i) wastewater and groundwater treatment, and ii) the conversion of carbon dioxide into biofuels and other valuable compounds. One of his most valuable contributions is the study and development of **bioelectrochemical systems**, an emerging technology based on the capacity of certain microorganisms to facilitate reduction and oxidation reactions of chemical compounds. In 2024, he was included in the Stanford Elsevier list of the best 2% of scientists worldwide within their field for four consecutive years.

→ *ICREA Academia award allows expanding consolidated research careers*

Sebastià Puig

ICREA Acadèmia (2024-2029)



2. PROJECTS

Relevant data

- 19 RDI projects under development (6 international, 13 National/Regional)
- 1 as coordinating entity, 9 as sole beneficiary, 9 as partner

Funding entities:

- Spanish Research Agency AEI: 9
- European Commission – Horizon Europe: 4
- PRIMA partnership: 1
- European Commission – LIFE+: 1
- Fundación Biodiversidad: 1
- Catalan Agency for Management of University and Research Grants AGAUR: 1
- Catalan Agency for Enterprise Competitiveness ACCIÓ: 1
- Catalan Departament of Agriculture DARP: 1

Highlighted projects

 Role: coordinating entity PI: Jesús Colprim Duration: 2024-2027 Funding entity: PRIMA Foundation (Section 1) and the European Union	<u>SPORE-MED</u> - Sustainable upgraded WWTPs for resource recovery, water reuse and health surveillance in the Mediterranean region. Coordinated by LEQUIA research group, SPORE-MED aims to upgrade urban wastewater treatment plants by making them more efficient, more environmentally/economically/societally sustainable, and capable of providing eco-systems services within the water-energy-food-health nexus. To this end, SPORE-MED will scale-up a set of innovative physicochemical and biological water treatment technologies, ITC tools and protocols at TRL 6-8. This will be done at lab scale and in pilot plants located in urban wastewater treatment plants in Spain, Italy, Greece, Tunis and Cyprus.
 Role: partner PIs: Alexandra Popartan and Joaquim Comas Duration: 2024-2027 Funding entity: European Commission (MSC doctoral network)	<u>C-NEWTRAL</u> - Smart comprehensive training to mainstream new approaches for climate-neutral cities through citizen engagement and decision-making support for innovative governance and integrated planning. The aim of C-NEWTRAL Doctoral Network is to advance new approaches for integrated planning of climate-neutral cities through citizen engagement and city governance decision-making support. We will approach climate-neutral cities from multiple dimensions of Urban Nature, Urban Mobility, Built Form, Energy and Circularity. LEQUIA hosts two pre-doctoral fellows focused on the application of social sciences and decision support systems in urban water management.
 Role: partner PI: Sebastià Puig Duration: 2024-2027 Funding entity: European Commission (Horizon Europe, Cluster 5)	<u>FUELS-C</u> - An integrated platform of novel cost and energy-efficient conversion technologies producing liquid and gaseous bioFUELS from sustainable biogenic residues validated for direct use in fuel Cells. Fuels-C will develop an integrated platform of innovative energy-efficient conversion technologies validated at TRL5, including bioelectrochemically assisted methane production, bioelectrochemical ammonia production, gasification, microbial electrosynthesis, and electroreduction. To this end, various biogenic residues (biodegradable and non-biodegradable) will be converted into drop-in biofuels.
 Role: partner PI: Sebastià Puig Duration: 2024-2027 Funding entity: European Commission, Horizon Europe, Cluster 5)	<u>ALGAESOL</u> - Sustainable aviation and shipping fuels from microalgae and direct solar BES technologies. ALGAESOL will reduce production costs by 25% and improve efficiency of converting solar energy, carbon dioxide and organic wastes into renewable methanol, methane and biooils, forming the basis for aviation and shipping fuels. Various systems (biologic, photoelectrochemical, electrochemical and bioelectrochemical) will be evaluated and smart reactor design will be combined with process improvements.
 Role: sole beneficiary PI: Manel Poch Duration: 2024-2027 Funding entity: Agencia Estatal de Investigación	<u>D-PATTERN</u> - Interdisciplinary approach to evaluate decentralisation in urban water management: two case studies in Spain. This project will evaluate water systems decentralization in two distinct urban case studies in Spain: Girona and Santiago de Compostela. D-PATTERN involves analyzing spatial and social variables of the case studies, implementing a pilot study for decentralized water treatment to evaluate its feasibility, scalability and potential urban impact, and using advanced modeling tools, including Agent-based Modelling, to simulate various decentralization scenarios. The research effort will culminate in creating a Decision Support System that extrapolates case study results into practical planning tools for widespread application of decentralization strategies.



[SPORE-MED](#) Kick Off Meeting (June 2024, UdG Research Park). Funded by PRIMA Foundation and the European Union, SPORE-MED project has a global budget of 3,63M€ and a consortium made up of seven universities and two large enterprises from Spain, Italy, Greece, Cyprus, Morocco and Tunis.



Project [LIFE4Zoo](#) will develop and validate circular solutions for water management in zoos. A pilot plant to treat water with natural filters (plants, microorganisms) will be installed in Barcelona zoo in 2025.



After three years of research, [GAIA](#) project gathered relevant results to advance towards production of sustainable biofuels (biomethane, bioethanol) from renewable resources as carbon dioxide and wastewater. Consortium integrated technological center Leitatz, LEQUIA research group of UdG, and water utility FACSA.

3. DOCTORAL THESES

Relevant data

- 6 doctoral theses completed
- 2 industrial doctorate projects
- 1 thesis awarded

Greywater reuse: decentralized treatment with forward osmosis and hydroponic systems

This thesis evaluates the feasibility of forward osmosis and hydroponics as decentralized systems for greywater treatment and reuse.

Esther Mendoza Perdiguero



Operation and control of high rate activated sludge process in urban wastewater treatment plants

This doctoral thesis focuses on the High Rate Activated Sludge (HRAS) process, which emerges as an alternative to the primary clarifier in activated sludge systems (CAS) to reduce energy consumption, analysing its effects on the removal of organic matter and nutrients compared to CAS.

Industrial doctorate with GS INIMA

Joan Canals Tuca



Electro bioremediation of nitrate contaminated groundwater: from laboratory to on site pilot plant

This thesis describes the development of electro-bioremediation from laboratory experiments to constructing an on-site pilot plant. In addition, it explored the full potential of this technology to address other contaminants, such as arsenic and pathogens.

Alba Ceballos-Escalera López



Bio-electro CO₂ recycling into added value compounds: insights, routes, strategies and performance improvements

This research demonstrates the viability of microbial electrosynthesis and anaerobic fermentation for transforming waste CO₂ into valuable chemicals.

Meritxell Romans Casas



Towards energy neutral WWTPs: piloting mainstream partial nitrification AGS and anammox

This thesis addresses a new configuration in the mainstream line of the WWTP aiming to maximize the energy recovery with biogas while minimizing the energy consumption of the process. Such configuration is based on a first high-rate activated sludge (HRAS) reactor followed by a two-stage autotrophic nitrogen (N) removal.

Industrial doctorate with GS INIMA

Oriol Carbó Monmany



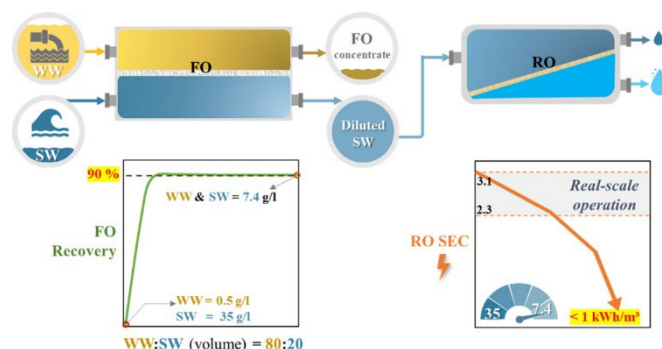
Formation of disinfection by-products in drinking waters: a combination of advanced analytical techniques and modelization

This thesis evaluates the application of different advanced characterization techniques such as size exclusion chromatography, fluorescence, and high-resolution mass spectrometry to deepen the understanding of the properties of this highly complex matrix with the aim to understand how it is removed by the various treatment processes involved in potabilization and to propose different parameters

Meritxell Valentí Quiroga

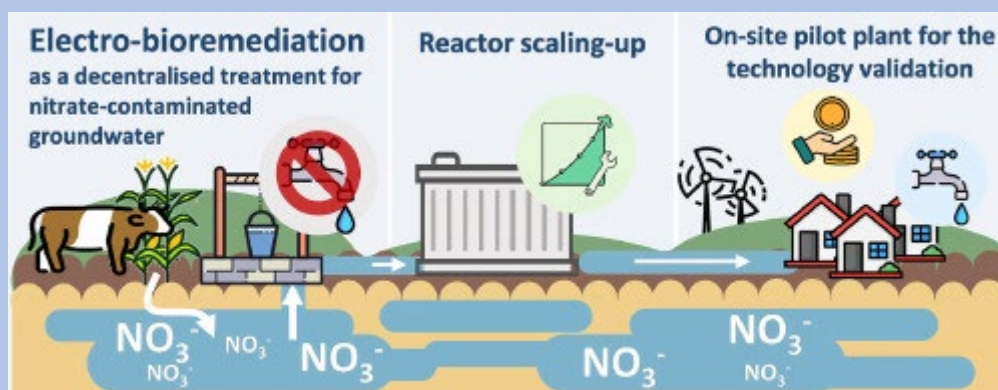


[Can a forward osmosis-reverse osmosis hybrid system achieve 90 % wastewater recovery and desalination energy below 1 kWh/m³? A design and simulation study.](#) Rajashree Yalamanchili, Ignasi Rodriguez-Roda, Albert Galizia, Gaëtan Blandin, Desalination, Volume 585, 2024, 117767



This study explores the feasibility of achieving enhanced forward osmosis recovery from wastewater.

[Advancing towards electro-bioremediation scaling-up: On-site pilot plant for successful nitrate-contaminated groundwater treatment.](#) Alba Ceballos-Escalera, Narcís Pous, Lluís Bañeras, M. Dolors Balaguer, Sebastià Puig, Water Research, Volume 256, 2024, 121618



This study describes the initial start-up and subsequent stable operation of an electro-bioremediation pilot plant for the treatment of nitrate-contaminated groundwater on-site (Navata site, Spain).

5. KNOWLEDGE AND TECHNOLOGY TRANSFER

Relevant data

- 10 research projects in collaboration with business organizations
- 9 research contracts with non-academic entities
- 2 industrial doctorates completed and 4 under development
- 1 project to valorize and transfer research outputs

Highlighted projects and contracts with business organisations

 Role: sole beneficiary PI: Narcís Pous and Sebastià Puig Duration: 2024 Funding entity: Catalan Research Agency AGAUR	Aquaria4All - Smart WATER management contributing to a sustainable TOURISM. The Aquaria4All project has created an electrified biofilter device (eFilter) designed to effectively eliminate nitrates and phosphates, thereby maintaining their levels within safe values (target $< 50\text{mgNO}_3^- \cdot \text{L}^{-1}$; $< 1 \text{ mgPO}_4^{3-} \cdot \text{L}^{-1}$). This innovation aims to significantly decrease the necessity for aquarium maintenance and water replacement (UN-SDG6). The eFilter uses minimal amount of electricity as the sole external input, thus suppressing the need of chemicals addition (UN-SDG12). Instead, it takes advantage of electroactive bacteria, which can remove pollutants by exchanging electrons with an electrode (Microbial Electrochemical Technologies, METs).
WATOURLISM Role: partner PI: Manel Poch Duration: 2024-2027 Funding entity: Spanish Research Agency AEI	WATOURLISM - Smart WATER management contributing to a sustainable TOURISM. Coordinated by Aigües de Barcelona, the WATOURLISM project proposes a set of developments based on the digitalization of the water cycle to guide territories towards a sustainable tourism model. By harnessing the power of smart metering and artificial intelligence techniques, the project not only improves operational efficiency and regulatory compliance but also unlocks innovative opportunities for territorial management.
DEPURHOB Role: partner PI: Sebastià Puig Duration: 2024-2026 Funding entity: Catalan Ministry of Agriculture (DARP)	DEPURHOB – Development of an integrated system PPB/HOB for the valorization of digestates and, carbon dioxide, and the production of sustainable fertilizers. The DEPURHOB project seeks to turn manure into a business opportunity by valorizing anaerobic digestion waste using an alternative approach. The proposed process uses purple phototrophic bacteria to reduce organic matter, nitrogen and phosphorus, as well as hydrogen oxidizing bacteria to convert the remaining nutrients and the CO₂ emitted (after a biogas upgrading process), into valorizable slow-release fertilizer. The project is coordinated by BETA Center of University of Vic.

6. AWARDS

- Prize by Associació Catalana d'Amics de l'Aigua awarded to Manel Poch for his trajectory in the water field
- Prize by Fundació Catalana de Recerca awarded to UdG and ICRA for the foundation of spinoff company Ecomemb S.L.
- Prize by Observatorio del Agua de la Fundación Botín awarded to Oriol Carbó for his contribution to the development of PROGRAMOX® process within the framework of his industrial doctorate with GS INIMA
- Prize by Càtedra ATL de l'Aigua Potable awarded to Alba Ceballos-Escalera's doctoral thesis
- Prize by ISMET, the International Society for Microbial Electro-Technologies, awarded to Alba Ceballos-Escalera for the article "Advancing towards electro-bioremediation scaling-up: On-site pilot plant for successful nitrate-contaminated groundwater treatment"



Prize awarded to Manel Poch's trajectory in the water field by Associació Catalana d'Amics de l'Aigua.



Prize awarded to UdG and ICRA by Fundació Catalana de la Recerca for their contribution to the foundation of spinoff company Ecomemb S.L. Co-founded by five LEQUIA researchers (Raquel García, Joaquim Comas, Hèctor Monclús, Ignasi Rodríguez-Roda and Albert Galizia). Ecomemb regenerates reverse osmosis membranes for water treatment.



V Fòrum LEQUIA at UdG Research Park. Focused on circular solutions for drought, the workshop brought together more than 120 people.

7. FUNDING

- Annual turnover: 2,59M€
- 33% RDI projects and contracts with business participation
- 28% of public funds for RDI by international entities

