CASE STUDIES

GANDIA

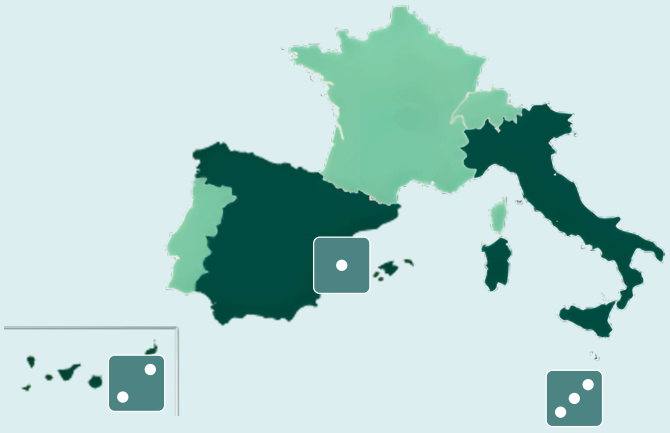
2 Reverse Electrodialysis Water Treatment Plants with Granular Activated Carbon filters supply 32,000 m^3 of water daily, increasing to 40,000 m^3 during summer. Nitrates exceeding EU standards in aquifers are treated, with water sourced from the electrodialysis process.

GRAN CANARIA

Water in La Aldea de San Nicolas for human consumption comes from groundwater and desalinated seawater. Water demand for domestic and tourism for 2021-2027 is estimated. Nitrate concentrations are high due to pollution from agriculture and urban development discharges.

MALTA

Bingemma pumping station takes groundwater for drinking water supply with flow rates of 18-38 m^3/h and pressures of 1.4-3.5 bar. The water has high nitrate content, averaging 124 mg/l in 2021.



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Universitat de València

REDINN Rete Europea Dell'Innovazione

Consejo Insular de Aguas de Gran Canaria

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ELEKTRA

CIRCULAR ECONOMY APPLIED TO NITRATE REMOVAL: HYDROGEN GENERATION AND WASTE RECOVERY IN DRINKING WATER

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Co-funded by the European Union

THE PROBLEM

According to the last report on the status of Europe's waters published by the EEA, nitrates were considered the main pollutant in the EU, affecting over 18% of the area of groundwater bodies, being agriculture the main cause of groundwater's failure to achieve good chemical status. Nitrate concentrations above 50 ppm are very harmful. As far as ecosystems are concerned, nitrates and phosphorus in surface waters can lead to eutrophication. Excess nutrients make plants and other organisms grow in abundance, consuming large amounts of dissolved oxygen and affecting the quality of water.

Despite the efforts made to prevent nitrate pollution, there are still infringement procedures against Member States by the European Commission, including Belgium, Germany, Italy and Spain.

According to the latest Nitrates Directive Implementation Report, published in October 2021, between 2016 and 2019, over 20% of Danish, Spain and Malta groundwater stations kept measuring more than 50 mg/L of nitrates. At a European level, 14.1% of groundwater stations kept measuring values over 50 mg/L, exceeding the values recorded in the previous reporting period, which was 13.2%.

SPECIFIC AIMS

SA1 **Development of Tandem Prototype**: Validate an ion exchange, osmosis, electrochemical denitrification tandem prototype for treating streams with high nitrate concentrations. Transform nitrates into nitrogen gas, releasing it into the atmosphere without environmental impact.

SA2 **Valorization of Waste:** Valorize waste produced during pre- and post-water conditioning stages of electrochemical denitrification. Aim for Zero Liquid Discharge, with a planned 15% water residue, contributing to the recovery of 8.5% of total water discharged into the sewage system.

SA3 **Energy Hybridization**: Utilize high-purity hydrogen gas from the denitrification process to feed a fuel cell. Integrate photovoltaic solar energy to provide direct current supply for the electrochemical reactor, minimizing fossil energy use and aligning with the Energy Efficiency Directive 2018/2002.

SA4 **Contribution to European Policies**: Align with European Green Deal objectives, EU energy efficiency policy (Directive 2012/27/EU), the new REPowerEU Plan, and hydrogen strategies for Europe. Contribute to adapting water treatments for high nitrate concentrations to environmentally friendly processes.

SA5 **Impact Assessment**: Monitor and assess project impacts in environmental, social, and economic terms through Life Cycle Assessment (LCA), Life Cycle Cost Assessment (LCC), and Social Life Cycle Assessment (S-LCA).

THE APPROACH

Based on the research carried out previously, LIFE ELEKTRA aims to demonstrate the validity of electrochemical denitrification technology and hybridization with renewable energies to scale processes and allow the treatment of larger flows (1 m^3/day in Gandía case study and 0,5 m^3/day in Malta/Gran Canaria pilots entering the electrochemical cell).

The methodology to be used will include the following steps:

- Pre-treatment of softening of reject water.
- Reverse Osmosis System.
- Electrochemical denitrification.
- Post-treatment of demineralization.
- Valorisation of the hydrogen stream.
- Hybridisation with renewable energies.
- Recovery of 8.5% of total water currently discharged into the sewage system.

KEY FIGURES

8%

Recovery of total water currently discharged into sewage system

15%

Targeted Zero Liquid Discharge (1.5% of RED treatment process rejection)

2018/2022

Contribution to the Energy Efficiency Directive, through energy hybridization, minimizing fossil energy use.