# R&D&i STRATEGY OF DESALINATION IN MACARONESIA

## DESAL+ LIVING LAB

### Diagnosis, measures and action plan

**November 2018**

DESAL+

MAC 2014-2020 Cooperación Territorial

Interreg

Fondo Europeo de Desarrollo Regional

EUROPEAN UNION

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Agencia Canaria de Investigación,
Innovación y Sociedad de la Información
Gobierno de Canarias

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NOTE:

This document is an excerpt from the full text, developed from the collaboration of different public and private agents in the sector through interviews, surveys, participatory workshops, etc.

Complete document (in Spanish) available at:
https://www.desalinationlab.com/images/Publicaciones/ESTRATEGIA-IDi-DE-DESALACIN.pdf

# SUMMARY

# 1 INTRODUCTION

The objective of the strategic Plan of R&D&i in desalination which is summarised here is to define the strategic lines of specialisation of research in the Cooperation Space (2018-2025) to position Macaronesia as an innovation space in this sector.

One of the key instruments which have been proposed for achieving the goals set is the creation of an open platform for research —DESAL+ LIVING LAB—, as a physical and virtual platform which will order, integrate and coordinate all the efforts to become that emblematic innovation space.

The points and measures detailed below are formulated as an itinerary or roadmap which goes from the decision to create this space to the validation of its viability by the development of a pilot test. They are the starting point for the development of specific projects and plans which will position the Cooperation Space as an international point of reference in the above-mentioned ambits.

# 2

# DRIVING FORCES AND BRAKES FOR THE DEVELOPMENT OF R&D IN DESALINATION IN THIS COOPERATION SPACE

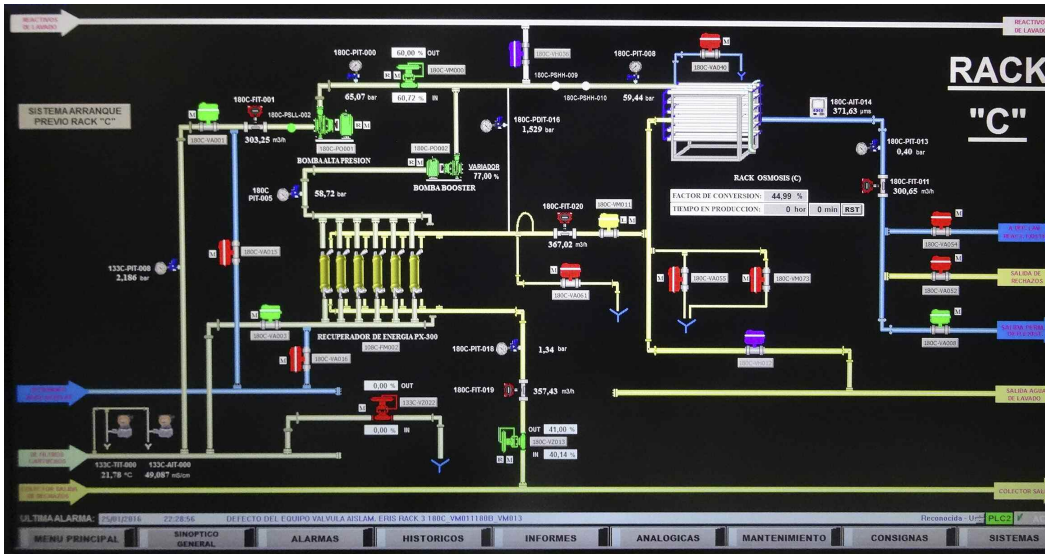
## Driving forces for R&D in desalination

- Existence of infrastructure and pilot plants for experimentation. Availability of numerous operational infrastructures with a variety of technologies in use.
- Experience and qualified staff.
- Rigorous legislation which makes the search for innovative solutions obligatory.
- External prestige (Canaries); a well-known and recognised historical background.
- Opportunities of collaboration in Macaronesia (exporting knowledge from the Canary Islands to Madeira, Cape Verde, Mauritania and Senegal).
- Exhaustive knowledge of technology. Long experience.


- Shared need for improvement.
- A desire to make the Canaries a relevant centre in desalination. There is motivation.
- Empathy between the public and private sectors.
- Need for a variety of water qualities (depending on uses).
- Abundance of renewable resources.

## Aspects which put a brake on the development of R&D in desalination

- It is not easy to gain access to information on the infrastructures and ongoing research.
- Limited collective culture and too much individualism. There is a lack of collective motivation.




- Very mature technology. Difficulty to innovate.
- Ambiguous and complex legislation: on water qualities; dumping legislation; legislation on the use of marine renewable energy; etc.
- Little Public-Private collaboration.
- Scale factor + Distance.
- Legislation which makes difficult the use of renewables in desalination.
- Lack of political initiative.
- Many of the actors operating in the Canary Islands are large companies which have their own, powerful R&D&i centres.

# 3

# OPPORTUNITIES OF TECHNOLOGICAL INNOVATION IN THE MATTER OF DESALINATION

The main opportunities for R&D&i to be integrated as possible fields of action within DESAL+ LIVING LAB are listed below.

- Automation: The number of signals and information flow to be managed requires the use of systems with complex architectures, distributed controls and advanced systems such as predictive adaptive controls. To this can be added the possibility of massive data collection that allow new technologies through sensors and measuring instruments connected to computer systems and that require a treatment that gives meaning and utility to such data to introduce improvements in efficiency and cost control (big data; artificial intelligence).
- Advanced maintenance: The intensive operation of high-performance machinery (e.g. high-pressure pumps) in a highly aggressive and corrosive environment requires the application of preventive and predictive maintenance criteria on fully automated supports in order to guarantee the efficiency throughout the facility lifetime.
- Water intake and pre-treatment: Currently, the margin of variation in the quality of raw water has been increased, which makes it possible to carry out less restrictive in-

takes, thanks to the high performance obtained in the operation of pre-treatments, maintaining the guarantee of quality demanded at the entrance to the reverse osmosis membranes.

- Reverse osmosis membranes: The testing and operation of these critical elements in production involves establishing strategies which maximise their useful lifetime, by minimising chemical washing, in such a manner that its permeability, required pressure and rejection of salts are maintained. These three factors guarantee the production and quality of the water produced thus optimising the operational costs, with pre-treatment being key. Processes that reduce reverse osmosis membranes fouling especially in open intakes or to maximize plant recovery rate are necessary.
- Desalinated water-energy nexus: the technologies for recovery and the evolution of membranes have managed to achieve a reduction over the last few years to a historical minimum of the specific energy consumption. There are still opportunities to improve the energy efficiency of the process and to make a commitment to renewable energy as an element in the reduction of our dependence on fossil fuels. Knowledge of the water-energy nexus and having a technology demonstration area in this space are key to providing solutions to reduce operating costs of desalination.
- Desalted water quality for multiple uses: Designing, testing and demonstrating solutions which make it possible to continuously improve the quality of desalinated water so as to achieve organoleptic criteria and/or for agricultural uses. This opens a path to explore R&D in terms of comparing and improving RED and Reverse Osmosis technologies for tertiary treatments in order to improve the quality of reclaimed water for agricultural purposes.

- Brine and circular economy: On the one hand, analysis, feasibility and demonstration of solutions and processes that allow the valorisation of brine (under criteria of circular economy) and on the other, the transit to the minimum possible discharge, the evolution of brine discharge systems minimising environmental risks.
- Desalination and green chemistry: Apply new processes, developments or forms of operation that reduce or eliminate the use of chemicals in desalination plants, or are replaced by other more sustainable products.
- Emergent desalination technologies: Testing and demonstration of new desalination technologies, with the aim of becoming an industrial-scale alternative or complement to reverse osmosis (Forward osmosis, Pervaporation, Membrane Distillation, capacitive deionisation, nanoporous graphene, biomimetic membranes, aquaporins, microbial fuel cells, electrodialysis with bi-polar membranes, etc.).

# 4

# THE VISION OF DESAL+ LIVING LAB LED FROM THE CANARIES

The incorporation of DESAL+ LIVING LAB requires the achievement of the following points and measures:

**Main points and measures of the Plan:**

## POINT 1. Making the space operative: giving content to DESAL+ LIVING LAB

Measure 3.1. Creation of a Living Lab. This is the fundamental measure of the Plan because it will catapult the rest of the points and in practice the measures proposed in this R&D strategy. The following sections will detail this point and an Action Plan for its immediate execution.

## POINT 2. Identification, Characterisation and Valuation of the members of DESAL+ LIVING LAB - innovation space

**Measure 2.1.** Making the capacities and potentialities of the space visible. Identification, characterization and georeferencing of existing infrastructures.

**Measure 2.2.** Identification, characterization and documentation of the value chain of the sector that will include the description of the relationships and cooperation formulas that exist between its components. Make visible the opportunities for collaboration, research and knowledge transfer from the Canary Islands to the rest of the cooperation space.

**Measure 2.3.** Development of a statistical information system of the sector endowed with reliability and continuity. The information available on the sector (industrial and research) is very scarce, it is not structured; it is produced, in large part, by the initiative of some private agents and is frequently outdated. It is necessary to develop a statistical body of information of the sector that collects in a systematic and updatable way:

The inventory of existing infrastructure and capabilities.
Economic data.
Specific R&D&i information of the sector.

**Measure 2.4.** Documentation of the characteristics and potentialities of the space for visibility and valorization. Preparation of a document that includes the characteristics and potentialities of the space, focused on the Canaries, for commercial purposes and for attracting clients, collaborators and public-private researchers (from the rest of the space and internationally).


## POINT 3. Identification of innovation opportunities and key areas of specialisation

**Measure 3.1.** Formulation of a proposal of shared value for the development of an innovation network with a tendency to be an international reference (brand, specialisation and visibility abroad). The proposal will include the determination of the positioning of the network at market level, against the development of innovation (as a platform for tests and trials, as a developer, as an operator, marketer, consultant, etc.) and customer segments.

**Measure 3.2.** Based on the proposals for innovation opportunities detected, the specific technological fields of specialisation will be identified, according to the capabilities and members of LIVING LAB. It is about determining very specific areas in which it would be possible to develop innovation trajectories in the medium and long term that allowed positioning as referents or as members of third-party projects. As an example, within the innovation in emergent desalination technologies, identify which technology for infrastructure, potential, demonstration, etc. is the most interesting in our cooperation space.

5

# DESAL+ LIVING LAB, A JOINT INNOVATION SPACE IN DESALINATION IN MACARONESIA

This joint innovation space is structured from four essential components:

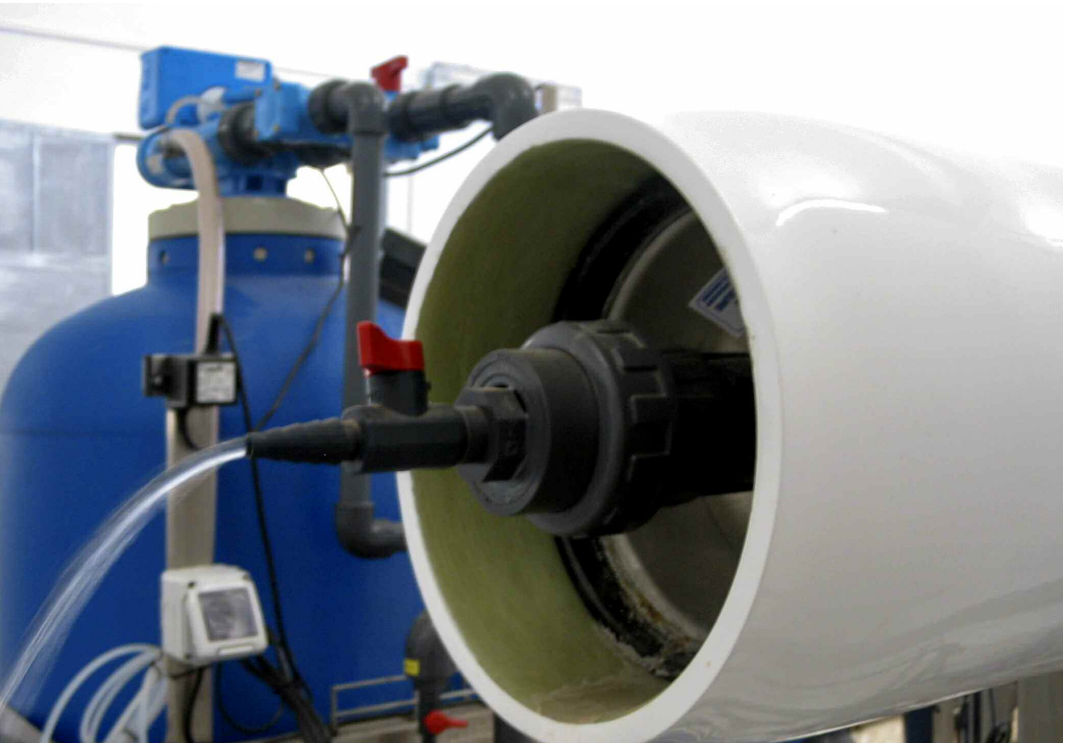
1. The development of a virtual platform as an information, training, meeting and connection space for the participating agents and potential users and, as a fundamental channel for carrying out projects and provision of R&D services.
2. The availability of infrastructures open to R&D that allows carrying out research, tests or trials that articulate the provision of services included in the catalogue.
3. The definition of internal operation protocols (participation in the space, governance and decision making, economic sustainability and return, remuneration or recognition of contributions); of collaboration between agents and with external entities, and service provision.
4. The determination of a catalogue of services based on the opportunities of innovation detected and that take advantage of the capacities and infrastructures already present in the collaboration space of the LIVING LAB.

Four types of agents participate in the space:

1. Companies. As service providers and/or infrastructures and researchers.
2. Universities. As researchers, collaborators in the provision of services and infrastructure providers of R&D&i.
3. Technological and knowledge centres assuming a role similar to that of universities.
4. Public administration related to the promotion of R&D&i as facilitators and dynamizers of space.

The main objectives of the DESAL+ LIVING LAB space are:

- Serve as a vehicle to value capacities, infrastructures and accumulated experience that have not been used so far. The space serves to structure all these resources around a shared project and gain international presence and visibility as an innovation space, improve the scope and competitiveness of companies in the sector and generate new sources of income.
- Become a world reference node for innovation and knowledge production in the field of desalination.



- Serve as a platform territory for tests and trials, taking advantage of the resources installed in the territory and creating products and services around this possibility.
- Position itself as an open innovation space that offers solutions for problems that may arise from any territory. This facilitates connections and collaborations with researchers and companies around the world.

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