

DESALRO® 2.0 achieves new SWRO energy efficiency benchmark with Danfoss pumps

Highlights

Achieved 1.84 kWh/m³ in real-world 2,500 m³/d plant

APP 65 chosen for top efficiency, reliability,
and compactness

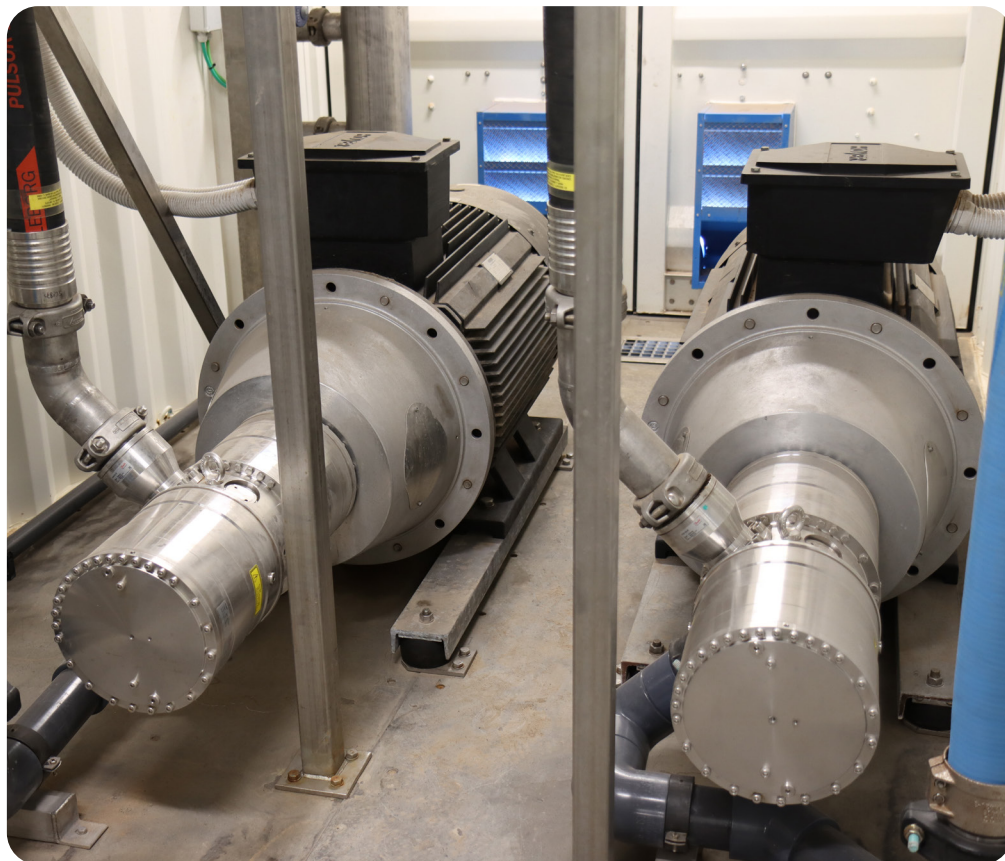
Containerized utility model ready for fast replication

In Spain's Canary Islands, where freshwater resources are scarce and desalination is essential, making seawater reverse osmosis (SWRO) as energy efficient as possible is critical – not just to reduce operating costs, but to lower the carbon footprint of securing a reliable water supply. That's why the Canary Islands Institute of Technology (ITC), leader of DESAL+ LIVING LAB, designed the DESALRO® 2.0 solution – a cutting-edge research project supported by the European Union's REACT-EU program.



New SEC
benchmark:

1.84 kWh/m³



Compact power for maximum efficiency: The Danfoss APP 65 axial piston pumps were selected for DESALRO® 2.0 due to their unmatched energy efficiency across varying flows and salinities – critical for hitting the sub-2.0 kWh/m³ energy goal. Their compact, reliable design fits perfectly into the containerized layout, enabling modularity without compromising performance or reliability.

The goal of DESALRO® 2.0 designs? To push the limits of SWRO energy efficiency by designing desalination plants, of several sizes, that consume less than 2.0 kWh of energy per cubic meter of freshwater produced – a specific energy consumption (SEC) benchmark never before achieved at such scale.

DESALRO® 2.0 solutions are designed not only to achieve a breakthrough in energy efficiency, but also to establish a replicable

utility model: a fully functional, real-world system, optimized with best-in-class, commercially available technologies and conceived for use in a wide range of future desalination projects with minimal redesign.

The DESALRO® 2.0 designs are now a reality in a 2,500 m³/d SWRO plant located in Pozo Izquierdo (Gran Canaria), which was constructed by the joint venture ELMASA-CANARAGUA.

Challenge

Specifying the most energy-efficient high-pressure pump

In line with its objective of conceiving a utility model, ITC designed the 2,500 m³/d DESALRO® 2.0 plant for mobility, fast deployment, and scalability. Fully containerized, its basic design comprises four plug-and-play units: three 40-foot containers (one each for pre-treatment, reverse osmosis, and post-treatment) plus a 20-foot unit for chemical cleaning.

To meet its ambitious SEC goal, ITC's design for the reverse osmosis stage integrates several high-efficiency components: positive displacement (PD) pumps for high-pressure delivery, isobaric energy recovery devices, variable frequency drives, and advanced hybrid membranes – together with an optimized hydraulic design to minimize pressure losses – all optimized for maximum energy performance.

ITC specified PD pumps because they offer strong efficiency advantages. Unlike

centrifugal pumps, which perform best near a fixed efficiency point, PD pumps maintain high efficiency across a wide range of flow rates and pressures. This flexibility results in consistently lower energy consumption despite seasonal variations in seawater salinity and freshwater demand.

"While every component in a project like this matters," explains Juan Antonio de la Fuente Bencomo, water researcher at ITC's Water Department, "the high-pressure pump is the single largest contributor to a SWRO plant's SEC – and a key driver of long-term operating costs and carbon emissions. To break the 2.0 kWh/m³ barrier, we had to identify and implement the most energy-efficient high-pressure pumps available in the market, and we knew that these would be positive displacement pumps."

Solution

Danfoss APP pumps chosen for best-in-class energy efficiency and proven reliability

ITC selected two Danfoss APP 65 axial piston pumps running in parallel for testing in the plant's high-pressure reverse osmosis stage.

"The choice of PD high-pressure pumps was obvious to achieve the objectives," says de la Fuente Bencomo. Not only do APP pumps consistently achieve unrivaled

energy efficiency in plants of this size, but their compact design also aligns with the plant's modular, containerized setup. Just as important, their proven reliability in the field makes them well suited for a replicable system where long-term performance, minimal maintenance, and operational stability are essential.

Results

A historic breakthrough in SWRO efficiency and a blueprint for the future

During more than one year of operation since January 2024, DESALRO® 2.0 has achieved a record-low SEC in the range of 1.840 - 1.861 kWh/m³. With this performance, the facility would be in a position to improve the current Guinness Record of 2.27 kWh/m³ held by the SWCC in Saudi Arabia.

"This is a significant milestone – not just for the Canary Islands, but for desalination technology worldwide," says de la Fuente Bencomo. "It shows what's possible when you combine robust design with innovation and proven technology."

Thanks to its modular design and scalable components, the DESALRO® 2.0 utility model is already being adopted in a range of municipal projects across the Canary Islands and beyond. One example is the construction of eight new containerized plants for irrigation based on the same configuration. Another is a 5,000 m³/day future plant for domestic purposes.

"These new installations will bring clean water to more Canary Island sectors, with lower energy use and carbon emissions, than any comparable plant," de la Fuente Bencomo concludes. "We're proud to be setting a new standard for more sustainable desalination."

"This is a significant milestone – not just for the Canary Islands, but for desalination technology worldwide. It shows what's possible when you combine robust design with innovation and proven technology."

↑ Juan Antonio de la Fuente Bencomo
water researcher at
ITC's Water Department



A replicable utility model: DESALRO® 2.0 is a fully containerized SWRO solution, designed by ITC for low energy use, scalability, and rapid deployment. Housed in plug-and-play containers, the model is already being adopted across multiple sites to deliver potable water with lower energy and carbon impact than conventional plants.

About The Canary Islands Institute of Technology

Instituto Tecnológico de Canarias (ITC) is a public research and innovation company, linked to the regional government, that is committed to developing and promoting sustainable technologies. Through projects like DESALRO® 2.0, both DESAL+ LIVING LAB and ITC are advancing real-world solutions in water treatment, renewable energy, and climate resilience.

For more information, please visit
<https://www.itccanarias.org/web/en/>
 and www.desalinationlab.com



Danfoss A/S
 High Pressure Pumps
danfoss.com
 +45 7488 2222
 E-mail: highpressurepumps@danfoss.com

Any information, including, but not limited to information on selection of product, its application or use, product design, weight, dimensions, capacity or any other technical data in product manuals, catalogues descriptions, advertisements, etc. and whether made available in writing, orally, electronically, online or via download, shall be considered informative, and is only binding if and to the extent, explicit reference is made in a quotation or order confirmation. Danfoss cannot accept any responsibility for possible errors in catalogues, brochures, videos and other material. Danfoss reserves the right to alter its products without notice. This also applies to products ordered but not delivered provided that such alterations can be made without changes to form, fit or function of the product. All trademarks in this material are property of Danfoss A/S or Danfoss group companies. Danfoss and the Danfoss logo are trademarks of Danfoss A/S. All rights reserved.4

© Danfoss 2025

AE537355232018en-000101