

Case Study 2

Almería Spain

 Desalination/Sea-mining



 Sea Mining
Desalination

 Urban Mining
Urban wastewater

 Industrial Mining
Industrial used stream

CS3

CS2

CS5

CS1

CS6

CS4

Case Study 2

Almería Spain

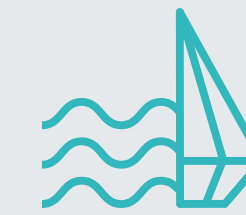


Desalination/Sea-mining

Photo: Plataforma Solar de Almería. CIEMAT.



Overview



Sea-mining



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CS2 is researching the feasibility of the Zero Liquid Discharge concept from a thermal desalination process fed by seawater treated by Nanofiltration (NF) and fuelled by heat collected from solar energy. It will demonstrate a circular economy approach by extracting high value salts and elements from the water during the process.

At the case study site at the Plataforma Solar de Almería, a pilot-scale NF plant removes divalent ions from the seawater, which is then fed through a thermal-powered MED system to produce high quality water and brine close to saturation conditions. From the brine, researchers can collect sodium chloride (NaCl) and valuable elements that are combined with NF reject to produce mineral-rich irrigation water. The Zero Liquid Discharge approach means no environmentally damaging brines are released into the sea.



Main challenges



Sea-mining



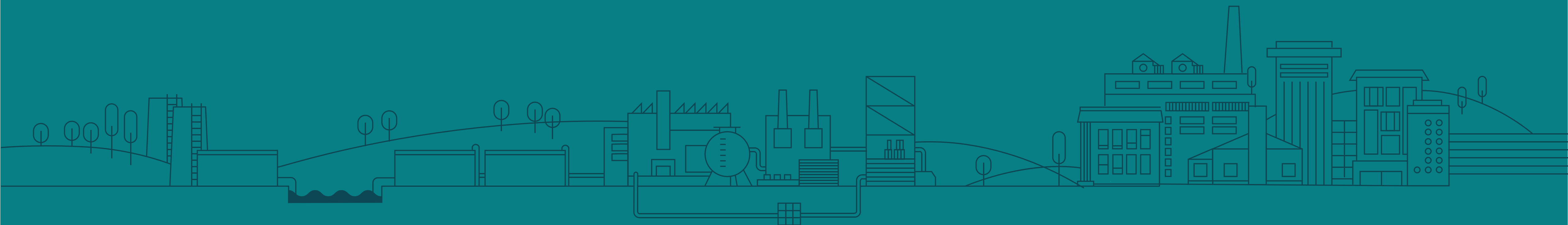
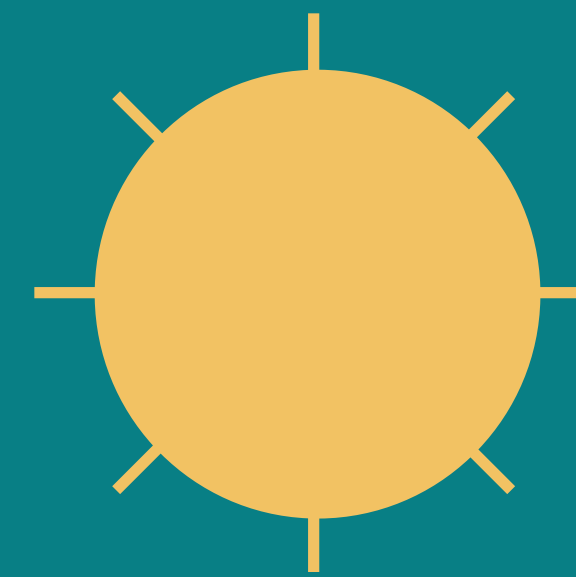
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Use of solar thermal energy: The fluctuating nature of solar energy due to factors such as weather conditions could present challenges when it comes to powering the MED unit in such a way as to provide a constant output.

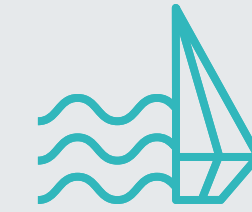
Scaling in the MED unit: The very high temperatures used to operate the MED unit could lead to scaling forming on the heat exchange surfaces, thereby reducing heat transfer.

Managing excess retentate from the NF process: Excess levels can pose a challenge when producing water that is suitable for irrigation purposes.

Quality of water produced by the NF unit: Low rejection factor in divalent ions or high rejection in monovalent ions could compromise the use of the permeate from the NF unit to feed the MED and the use of retentate from the NF for irrigation water.



Key innovations



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Solar power as energy source: The MED process is powered by thermal heat collected from solar energy, which contributes to the decarbonisation of the desalination sector. This thermal energy can be provided by waste heat from a Concentrating Solar Power (CSP) plant of solar thermal collectors.

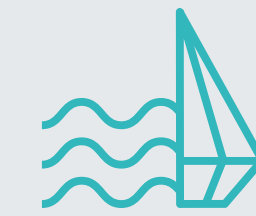
High Efficiency MED: Removing divalent ions from the seawater feed allows the MED plant to operate at higher temperatures, which increases the number of evaporation stages decreases energy investments costs.

High value salts: The removal of divalent ions also facilitates a higher recovery ratio in the MED process, where highly concentrated brines can be crystallised to obtain high purity sodium chloride.

Irrigation water production: The distillate produced in the MED process will be mineralised with the retentate of the NF, which is richer in divalent ions and can be used as a fertiliser in irrigation water for greenhouses.



Technical outcomes



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More than 50% of total energy requirements covered by renewable energy.



Reduction in MED energy consumption by >10%

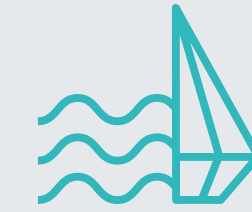


Increase in Recovery Ratio of up to 70% compared to the typical recovery rate of between 30-40% at an MED seawater plant

NaCl

Purity of obtained sodium chloride higher than 90%

Expected impact on society



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CS2 promotes the use of thermal desalination technologies to reduce the environmental impacts of discharging brine into the sea and maximise circular economy approaches by recovering valuable materials such as salt. In addition, the use of solar energy makes the desalination process more sustainable from an environmental point of view.

The agricultural sector can also benefit from the by-products obtained at CS2 thanks to production of water rich in divalent ions, which can act as a fertiliser in irrigation water. The creation of a Living Lab has helped to engage various stakeholders and will remain active beyond the conclusion of the WATER-MINING project.



Reduce environmental impact

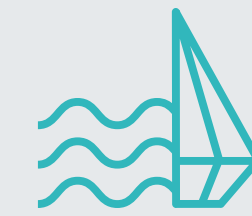


Produce valuable products such as sodium chloride



Production of water rich in divalent ions

Business opportunities



Sea-mining



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The business opportunities are based on the production and sale of:



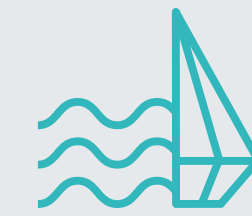
High quality water



High purity salt



Pure water enriched with divalent ions for irrigation



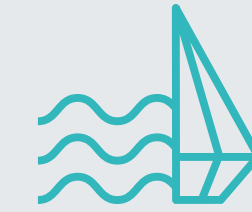
“For me WATER-MINING has a special significance, because it’s a project we have worked on from the very beginning (...) I am especially fond of this project because it’s the result of a lot of work and a lot of faith that we had in our ideas. I’m very happy to see that it has had good success.” Guillermo Zaragoza, Senior Researcher at CIEMAT-Plataforma Solar de Almeria, head of the Living Lab study.

Patricia Palenzuela



“The research and innovation that we are carrying out in CS2 will represent an achievement in the advance towards the better use and valorisation of water, and the development of sustainable solutions to the main challenges related to this resource. We are involving relevant stakeholders in the energy-food nexus from the beginning in all the technological development and innovation processes proposed in this case study,” Patricia Palenzuela, Senior Researcher at CIEMAT-Plataforma Solar de Almería, owner of CS2.

Guillermo Zaragoza



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**water
mining**

value for society