

Extracting water, minerals and energy from seawater desalination brine

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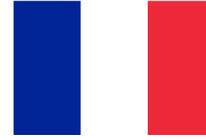
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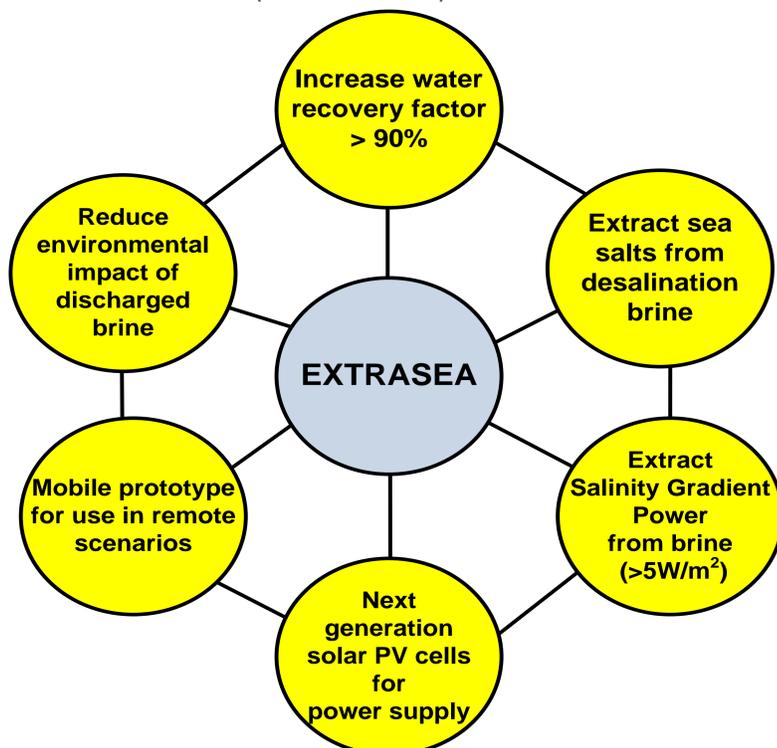


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► OBJECTIVES

EXTRASEA aims at designing a mobile, solar-powered desalination prototype for use in remote location scenarios, integrating next-generation membrane separation technologies in order to target the following objectives:

- increase the quality of desalted water (TDS <100 mg/l; arsenic <0,01 mg/l; boron <0.3 mg/l);
- produce 1 m³/day of desalted water at high recovery factor (> 90%) and reduce the volume of discharged brine (**Zero Liquid Discharge**);
- extract valuable raw materials in the form of sea salts crystals from desalination brine, with bulk production of NaCl and MgSO₄*7H₂O (**Circular Economy**);
- generate renewable energy (>5 W/m²) from Salinity Gradient Power by exploiting Gibbs energy of mixing resulting from seawater and brine (**Blue Growth**).



► METHODOLOGY

The methodological approach of EXTRASEA, coherent with the **Process Intensification** concept, is based on the development of:

- Plasmon-enhanced Solar Membrane Distillation Crystallization (MDCr) unit, a hybrid membrane-thermal process able to increase the overall water recovery factor and to reach sea salt supersaturation;
- Salinity Gradient Power Reverse Electrodialysis (RED) system, where Ion Exchange Membranes are used to extract renewable energy from seawater and desalination brine;
- innovative Silicon Solar Cells for process power supply, based on ultra-thin transparent conductive oxide films with less solar cell base/low cost materials.

► EXPECTED OUTCOMES

- Improved water management capacity of local communities in rural, remote and arid areas through the realization of a mobile, solar-powered desalination prototype;
- Enhanced innovation in water- energy nexus;
- Increased desalination affordability through valorization of desalination brine considered not as a waste but as a source of sea salts whose revenue has the potential to offset the unit cost of desalted water.

