

Sessione pitch: spazio alle idee



Nanoporous graphene membranes for sustainable desalination processes

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Horizon Europe e il bando orizzontale **Clean Industrial Deal**

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Roma Tre University

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- Topic of interest: nanostructured membranes for desalination
- Keywords: Nanoporous graphene, Reverse Osmosis, Pressure Retarded Osmosis, Plasma etching, nanostructured polymeric membranes

Expertise of your organisation

Roma Tre University participates in the Rome Technopole Innovation Ecosystem (<https://www.rometechnopole.it/>), which includes 9 universities in Lazio, 4 large national research centers, 7 local and national institutions, 20 large companies and multinationals, 2 business associations and one SME.

Flagship 1: **Decarbonization and digitalization in research on new green energy sources**

- Lead company: **ENI**
- Universities and Public research Institutions: **Sapienza University of Rome, University of Rome Tor Vergata, Roma Tre University, University of Cassino and Southern Lazio, University of Tuscia, Campus Bio-Medico University of Rome, National Research Council, National Agency for New Technologies, Energy and Sustainable Economic Development**
- Industries and other entities: **Rome Airports S.P.A., ACEA SPA, Catalent Anagni srl**
- Thematic table: **Graphene**

58 international research projects based on competitive tenders in the period 2020-2024, 31 of which in the STEM departments. Interested in a partnership, not in being the lead partner

Challenges and objectives

- *What problem are you trying to solve?*

Water is the next raw material to be scarce due to climate change. Desalination is one answer to the problem, but desalination processes are extremely energy-intensive.

- *Is your project suitable for the CID call for funding? Why?*

Making the industrial desalination process energy-sustainable by increasing membrane performance falls within both the area of **technological solutions for climate change mitigation** and **the decarbonization of energy-intensive industries**.

- *Give concrete example of potential results and expected impact*

Highly permeable, salt-rejecting membranes reduce energy costs in reverse osmosis processes and allows for greater osmotic energy gain in PRO brine treatment processes. In the combined process of desalination and energy recovery from brine, 30% energy can be gained.

Main activities

TRL1- Basic principles observed

TRL 2- Technology concept formulated

TRL 3- Experimental proof of concept

TRL 4- Technology validated in lab

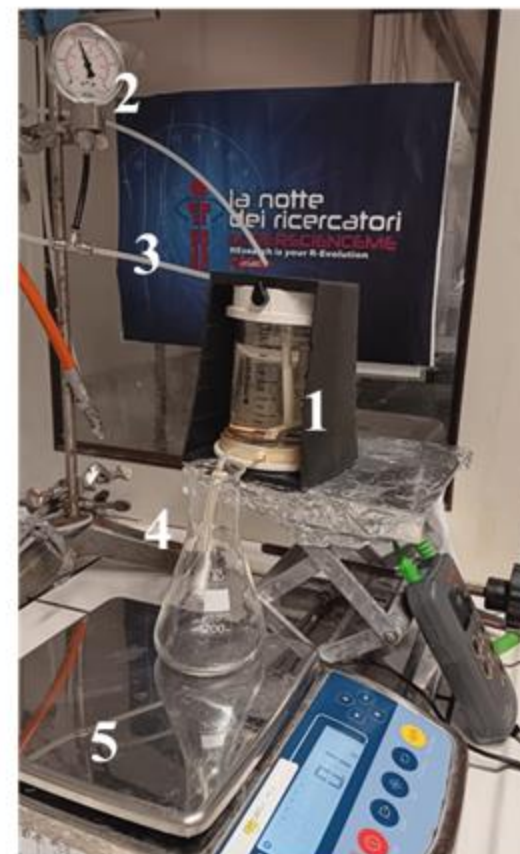
TRL 5- Technology validated in industrially relevant environment

TRL 6- Technology demonstrated in industrially relevant environment

TRL7- System prototype demonstration in operational environment

TRL 8- System completed and qualified

TRL 9- Actual system proven in operational environment



1. Cell
2. Pressure gauge
3. Gas pipe
4. Permeate pipe
5. Precision scale

The polymer membrane was synthesized, functionalized to bind graphene with robust bonds and etched with hydrogen plasma; nanofiltration testing was carried out in the laboratory.

Expertise and resources offered

The research team includes engineers, chemists, and physicists, university professors, and researchers from the National Research Council (CNR). Institutions involved:

- 2 STEM Departments of Roma Tre University,
- Department of Chemistry and Chemical Technologies of the University of Calabria,
- Department of Chemistry of the Aldo Moro University of Bari,
- CNR-ITM Institute of Membrane Technology, CNR-ISTP Institute for Plasma Science and Technology
- STAR infrastructure of the University of Calabria.

Expertise requested

- Companies operating directly in desalination
- Companies producing polymer membranes and looking to expand into the growing desalination market
- Companies producing graphene

Both large companies and small and medium-sized enterprises as long as they are interested in research and development projects

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Over 90% of desalination worldwide is achieved through RO processes

The energy efficiency of the RO processes relies on the permeability and the selectivity of the membranes used.

From the brine osmotic energy can be obtained through PRO membrane processes, whose efficiency depends on the permeability and selectivity of the membranes used.

The state of the art in RO desalination membranes is represented by multilayer thin-film composite polymeric membranes (TFC), which have now reached their technological limit.

Graphene-based membranes are the long-awaited paradigm shift.

It has been predicted that approximately 30% of the EU's territory will face water scarcity by 2030.

European Parliament approved the new Regulation 202/714 (coming into force in 2026), which defines minimum requirements for the safe use of urban wastewater for humans and the environment.

The desalination global market is growing: from the current \$1.54 trillion, the market is expected to reach \$2.35 trillion by 2029, growing at a CAGR (Compound Annual Growth Rate) of 8.91% from 2024 to 2029.