PhD in Energetics

Research Title: Innovative membrane technologies integrated with solar thermal energy, low-grade and waste heat

Funded by	Clean Water Center (CWC) @POLITO

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Context of the research activity	Growing requirements of freshwater and unsustainable use of fossil fuels are driving the interest in supplying renewable energy for water treatment applications. For example, in isolated communities where potable water sources as well as energy grids are limited or nonexistent, treating brackish groundwater aquifers with small-scale desalination systems may be a viable alternative to existing water infrastructures. Efforts are ongoing to integrate renewable energy (wind, solar, geothermal, and tidal) with membrane-based treatment operations.

Objectives	For this PhD project, we propose the coupling of forward osmosis (FO) and membrane distillation (MD), two innovative membrane technologies for the treatment and the desalination of contaminated water, with renewable energy sources. The driving force of MD-based water purification and of draw solute recovery

	in FO may be efficiently provided by a temperature difference, where one stream is usually in the range 60-80 ºC and the other near ambient temperature. Solar thermal energy may be effectively used to provide heat to achieve a suitable driving force in those processes, as well as low-grade and waste heat. The activities will involve: (i) optimization of system coupling, (ii) modeling of the systems in terms of heat and mass transfer, as well as energy efficiency, (iii) experimental investigations to demonstrate effective treatment of contaminated streams by purposely designed prototypes, (iv) experimental demonstration of long-term efficiency of the coupled systems.

Skills and competencies for the development of the activity	• Expertise in heat and mass transfer and applied thermodynamics is mandatory. • Good understanding of thermo-technical systems. • Proficiency in prototyping and experimental characterization. • Previous experience with CAD design and 3D-printing will be a plus. • Previous experience with renewable energy sources will be a plus.