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Design recommendations and cost assessment for off-grid wind-powered - seawater reverse osmosis desalination with medium-size capacity

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ABSTRACT

A technical and economic assessment has been made to simulate the operation of a wind energy-driven seawater reverse osmosis (SWRO) desalination plant (10,000 m^3/d). Three different generation systems were compared: wind and batteries; wind and diesel; wind and photovoltaic (PV). In each case, two options of the SWRO plant were considered: variable operation high-pressure pump and modular plant consisting of three different trains operated independently. The ranges of power demand of said options are 81%–100% and 20%–100% of the nominal value, respectively. The energy lost, operation time, water production and water costs for each case were calculated, concluding design recommendations with the best technical and economic criteria. Water cost was identified in the range 1–1.35 €/m^3, operation time under renewable energy supply can reach 75% of the year for modular reverse osmosis plant. A sensibility study for the water cost, for different parameters (capacity of batteries, diesel price, and PV power) was carried out for the different off-grid generation systems.

Keywords: Wind-powered desalination; Seawater desalination; Reverse osmosis; Wind/PV-driven desalination; Design configurations; Water cost

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