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# How sustainable is renewably powered desalination?

**Desalination technologies** could help alleviate water shortages, but they need to have low environmental impact. A new life-cycle analysis of desalination options for water supply in off-grid areas indicates that a photovoltaic-powered reverse osmosis system has the least environmental impact of the three technologies considered by the study.

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**Source:** Jijakli, K., Arafat, H., Kennedy, S. *et al.* (2012) How green solar desalination really is? Environmental assessment using life-cycle analysis (LCA) approach. *Desalination* 287:123-131. Doi: 10.1016/j.desal.2011.09.038.

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**An increased use of technologies** to remove salt from seawater or brackish water may provide a more plentiful water supply, but they are typically very energy intensive. This study was conducted in the United Arab Emirates which has many isolated rural communities at risk of water shortages. Since these communities are off-grid and receive high levels of sunlight, they are good candidates for renewable energy powered decentralised desalination plants.

The researchers applied life-cycle analysis (LCA) to three options for desalination in off-grid areas:

- A solar still, which uses solar radiation directly to evaporate water and remove salt
- A local photovoltaic powered system, which generates electricity to run reverse osmosis (PV-RO) that forces water through a filter to remove salt
- A traditional centralised RO system that transports desalinated water for an average of 500 kilometres to remote locations.

They compiled a list of all the necessary inputs to produce 1250 litres per day (enough for a community of 25 people) using the desalination technologies. This included materials for construction and operation of plants, and energy consumption to pump and/or transport the water. The impact of the technologies on the environment was assessed using the Eco-Indicator 99 (H) which considers health impacts, climate change impacts, land use change and toxicity to wildlife.

Across all categories of impact, apart from ecotoxicity, minerals and fossil fuels, the PV-RO system had the least environmental impact. The system with greatest impact alternated between the solar still and the centralised RO system, depending on the type of impact considered. For example, the solar still has the largest impact in terms of carcinogens (expressed as 0.0036 disability adjusted life years), whilst truck delivery of desalinated water from a centralised RO plant has the largest impact in terms of climate change (0.007 disability adjusted life years).

When a single score was calculated to combine all impacts, the PV-RO had the lowest impact score at just over 1000, followed by the truck delivery from centralised RO plant at about 1600, and, lastly, the solar still at 3400.

The poor performance of the solar still was mainly due to emissions of $CO_2$, sulphur oxides and chloride produced in the manufacture of steel and stainless steel for the unit. Changing the material used for the solar still plant to recycled steel would reduce its total impact score to about 1200. Using PV to power the centralised RO instead of gas would lower its total impact score to 500, by reducing impacts on climate change and emissions.

For renewably powered desalination to become truly sustainable, it also needs to be economically acceptable. Recent estimates for the cost of a PV-RO are $7 (€5.30) to produce 1$m^3$ of water, whilst those of a conventional RO plant are $1-2 (€0.75-1.50) per $m^3$ of water.