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Turning seawater into drinking water with sun and wind power

A commercial-scale, seawater desalination plant powered by solar and wind energy that produces freshwater and dry salt, has been designed by Spanish researchers. The new process does not discharge highly concentrated salty water back into the sea as a by-product, ensuring that there is little damage to the marine environment.

Desalination plants extract freshwater from seawater and the technology is seen as one way to meet rising demands for drinking water in drier climates. Inflowing seawater is used as both a coolant and as feedstock for the separation of salt and freshwater, but the process is energy intensive and environmental damage can occur if brine water, which has a higher salt concentration than seawater, is produced as a by-product and returned to the sea.

The plant was designed to minimise the overall impact on the environment. Renewable energy in the form of solar and wind power is used instead of energy derived from fossil fuels and salt is extracted as a valuable by-product.

The desalination process consists of two integrated steps, which produce about 100 cubic metres of freshwater per hour (m^3/h). During the first stage, a distillation plant concentrates the seawater, using heat supplied by an array of solar cells. About 37.5 m^3/h of freshwater is produced during this stage. In the second stage, saltwater flow from the first step is fed to a vapour compression system where the final separation of salt and water occurs. Electricity required for this stage comes from wind power, and about 62.5 m^3/h of salt-free water is obtained. Salt is separated and completely recovered during this stage.

Energy consumption of the proposed plant is 2,362 kWt-h, (measured in kilowatts thermal units), for the distillation system and 1,944 kWe-h (measured in kilowatt electrical units) for the compression plant. The researchers suggest that the energy input of the compression step can be offset by selling surplus electricity generated by the wind turbines and selling the recovered salt.

Wind energy is variable, depending on wind speed and the amount of time it is windy. If the plant is connected to the national grid, surplus energy can be sold when available and supplementary power from the grid can be used when there is no wind. This would allow the plant to operate continuously. Using renewable energy sources can also reduce costs, by taking advantage of subsidies.

The total cost of producing one cubic meter of desalted water is estimated to be 4.22 Euros (when the study was conducted in 2007), including factors such as initial capital and labour. However, this figure drops to 0.59 Euros if the income from the sale of salt and energy is included. Any energy subsides would reduce this price further.

Source: Fernández-López, C., Viedma, A., Herrero, R., Kaiser, A.S., (2009). Seawater integrated desalination plant without brine discharge and powered by renewable energy systems. *Desalination.* 235:179-198.

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