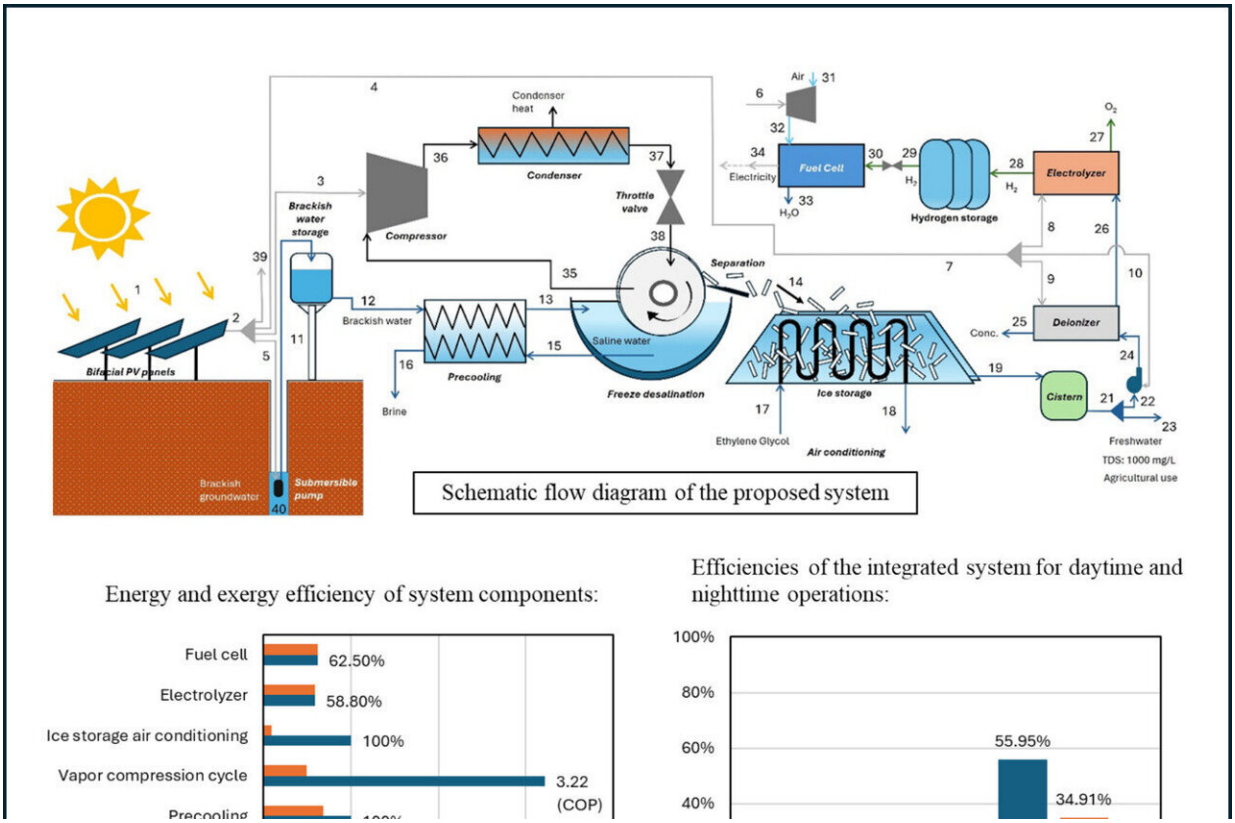
Desalination system also produces hydrogen, electricity and cool air for refrigeration

December 10 2024, by Bob Yirka



Credit: *Desalination* (2024). DOI: 10.1016/j.desal.2024.118321

A pair of engineers at Hamad Bin Khalifa University has developed a desalination system that also produces electricity, hydrogen and cool air for refrigeration. In their paper published in the journal *Desalination*

Nurettin Sezer and Sertac Bayhan describe their modularized system.

Climate change requires adaptation in places that are already hot and dry. Mitigation typically involves developing technologies for removing salt from ocean water or brackish marshlands; generating renewable energy sources, such as hydrogen; and building devices to cool homes and buildings. In this new effort, the team in Qatar has developed a modularized system that can do all three.

The system starts with an array of bifacial c-Si PV (solar) panels, each able to produce up to 600 watts, with an estimated efficiency of 23.2%. The system, the team notes, should be able to produce up to 1.5 MW of electricity using 10,785 m^2 of the panels. The system divides that electricity: 100 kW is used as a direct energy supply, and the rest goes to a system used to precool groundwater and power water pumps.

Another module uses a vapor compressor along with a refrigerant to chill the saline water to the degree that ice crystals form. The ice crystals are fresh water; the remaining salt is removed. The ice is placed in a storage container and air blown over it chills air pumped into a room, providing air conditioning. After the ice melts, it can be used for a variety of purposes, including providing drinking water or irrigating crops.

Yet another module takes some of the water and electricity produced and further purifies it using electro-deionization. A proton exchange membrane electrolyzer deionizes the water, resulting in the production of hydrogen gas, which can be collected and used as an energy source.

In the system they built, the desalination and air conditioning run during the day, while the electrolyzer runs at night. According to the paper, each day, the system can generate 2.4 WMh of electricity, 52.8 m^3 of fresh water and 6.3 MWh for air conditioning as well as 177 kg hydrogen to store energy for nighttime use.

More information: Nurettin Sezer et al, Integrated solar-powered freeze desalination and water electrolysis system with energy recovery and storage for sustainable agriculture in desert environments, *Desalination* (2024). DOI: 10.1016/j.desal.2024.118321

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