Can Sun and Wind Make More Salt Water Drinkable?

*Here are four arid regions looking to renewables for the energy-intensive work of squeezing drinkable water from the ocean.*

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The oceans have long taunted those who thirst.

Records dating to A.D. 200 show that sailors boiled seawater and used sponges to absorb fresh water from the steam. Today, desalination is more sophisticated: multistage flash distillation, reverse osmosis, electrodialysis, and more.

But one thing hasn't changed since the time of the ancient mariners: It takes a lot of energy to squeeze drinkable water from salt water. So even though more than 70 percent of the Earth's surface is covered with water, civilization has quenched its thirst mainly by tapping the one percent of world water that is unfrozen and fresh.

The one notable exception: Oil-rich Saudi Arabia and neighboring arid nations have used their wealth to purify ocean water. Yet their water demand is rising with population growth and industrialization at the same time that climate change is shrinking supply. Oil states, which depend on selling crude overseas for revenue, are loath to burn more barrels to keep drinking water flowing at home. So some aim
to fuel new desalination operations with another abundant resource—the sun.

Other water-starved regions around the world want to do the same.

"Desalination is energy-intensive, but it doesn't have to be fuel-intensive," said Aaron Mandell, co-founder and chair of WaterFX, one of the companies pioneering the renewables approach. "That's what really matters. The focus should be not so much on consumption, but where the energy comes from."

Here are four places trying to tap the sea and brackish underground water supplies with the help of solar and wind energy:

**The Middle East**

In the United Arab Emirates (UAE), construction begins in the coming weeks on four small pilot desalination plants. But the world's sixth largest oil producer (second in the Middle East only to Saudi Arabia) is not rushing into the solar part of the equation. Instead, UAE energy company Masdar plans to test four companies' different technologies to determine which is most energy-efficient.

By mid-2016, Masdar will select a system to couple with solar power, a decision sure to be closely watched by its neighbors. Fresh water available per citizen in the Middle East is just one-seventh the world average, and scarcity is growing. Climate change could shrink rainfall and fresh water availability by 40 percent by 2050, says the World
Bank.

The bank has urged the region to take advantage of its enormous solar energy potential—several orders of magnitude larger than current total world electricity demand. Solar radiation per square kilometer in the region each year is equivalent to the energy generated by one to two million barrels of oil.

Australia

Solar desalination got a boost last month in one of the most arid states on the driest inhabited continent on Earth. Global investment firm KKR announced it was investing in a project developed by Australia's Sundrop Farms that will use concentrated solar power to turn ocean water into fresh water for irrigating crops. The system, now being expanded with KKR's capital, generates the heat to keep the plants growing in specially designed greenhouses in a region of South Australia that otherwise could not grow crops.

"We grow food where land is too arid for farming, fresh water is in short supply and domestic food security is a concern," said Sundrop CEO Philipp Saumweber, in a statement announcing the deal. "Farming with typical agricultural inputs would be unsustainable in these regions."

Sundrop and KKR intend to develop a technology hub in South Australia, and plan to market the approach to other regions facing water and climate stress.

Texas
For years, Texans have talked about tapping into the Gulf of Mexico to address chronic water woes, and interest grew after 2011, when the state experienced its worst one-year drought in recorded history. Wildfires were rampant, and ranchers had to sell off cattle.

"You've heard the expression, 'Whiskey's for drinking, and water's for fighting?'" asked Kate Zerrenner, project manager for Environmental Defense Fund. "It's a very emotional issue here."

The high cost of seawater desalination has stymied development. Texas does have about a hundred inland desalination plants that tap into the state's large stores of brackish underground water, but they rely on coal- and natural gas-fired electricity for energy.

Zerrenner said that instead of increasing carbon emissions with more fossil-fueled desalination, Texas should focus on renewable energy. The Lone Star State leads the nation in wind power, with 20 percent of the country's installed capacity, most on the West Texas plains. With so much brackish water beneath that same landscape, the economics for turbine-powered desalination would be good, University of Texas researchers said in a study last year.

So far, only the city of Seminole has a small demonstration project at the National Wind Institute at Texas Tech University.

One potential problem, the UT researchers said, is that the membranes in some water desalination systems are designed to operate under constant pressure, and wind
power is intermittent. Zerrenner said that the state should study whether adding solar energy could complement wind to provide more constant power. She notes fossil-fueled desalination also has its problems, including the fact that coal and gas plants consume water.

"Using a water-intensive resource to make water doesn't make sense," said Zerrenner. "We need to have the concept of water as an energy resource and energy as a water resource."

California

Amid the worst drought in California's history, there are proposals for more than a dozen desalination plants on the Golden State coast. Most would rely on natural gas-fired electricity for power.

A $1 billion coastal project under construction at Carlsbad, Poseidon Water, aims to be the biggest desalination plant in the Western Hemisphere. San Diego has agreed to buy Poseidon's water at double the cost of conventional water supplies.

Inland, WaterFX's Mandell said the solar thermal system it has developed for Panoche Water District, in the Central Valley, turns desalination economics around. He said it can produce water at half the cost of Poseidon because it doesn't use solar to produce electricity. Instead, parabolic trough mirrors direct 100 percent of solar radiation into heat to distill salty water. Essentially, it's a modern version of the process sailors used when they boiled seawater. It also has no membranes, so no worries about solar energy's
"We're hoping that this is a model people will replicate and improve," Mandell said, noting WaterFX has made its technology open-source. "We firmly believe the best path to sustainable water supply in California is solar desalination."

But the Panoche pilot project, now raising money for a $30 million expansion, may be unique, because production of fresh water is essentially a side benefit. Its primary purpose is to rid the agricultural district of its long-standing problem of saline drainage water from farm fields.

"It's unlikely they would be doing it just for water supply, because it would be prohibitively expensive," said Heather Cooley, director of the water program at the Pacific Institute.

Cooley said the state needs to look at opportunities beyond desalination—such as reducing water consumption. "We've been thinking about water and energy separately," she said. "We've managed them separately, thinking the other is going to be abundant, cheap, and plentiful."

She said using less water will save energy in California, where so much water delivery relies on electric pumping. She added: "There can be a lot of win-win opportunities."

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