Desalination Plants Get a Reboot to Fight Water Shortages

New technology is making the energy-hogging facilities more efficient and less harmful to marine life.

Carlsbad Desalination Plant, Carlsbad, CA. (Photo: Courtesy Jessica Jones)

JUL 6, 2016 YOUR REACH

Erica Gies' work has appeared in *The New York Times*, *The Guardian*, *Scientific American*, *The Economist*, and other outlets.

Bio

SANTA BARBARA, Calif.—On an overcast day in May, construction is in full swing on the Charles E. Meyer Desalination Facility in this affluent enclave on the Central California coast. Several workers fine-tune rebar in foundations for processing units, while two others deploy a large spinning plate to melt the edges of an ocean intake pipe so it can be attached to another pipe.

In response to California's epic drought, the Santa Barbara City Council voted last year to reactivate a desalination plant built in 1992 to fight an earlier drought. It operated for only six weeks before being shuttered. "Something terrible happened right as they were getting that started up," said Carlos Sanchez, construction manager for the current project, with a twinkle in his eye. "It rained." The "March Miracle" deluged the region with enough rain to effectively end the drought. The $35 million plant has been in standby mode for nearly a quarter century.

For Santa Barbara, bringing the facility back online is not a matter of just flipping a switch. Desalination technology has changed a lot in 25 years, so the city demolished the old plant and is building a new one for $55 million that will use 40 percent less energy and reduce harm to marine life.

The city was able to fast-track the project because it kept 1990s-era permits active by keeping the

plant in standby mode, said Joshua Haggmark, water resources manager for Santa Barbara. The new plant will connect to the old intake pipe and a pump station. It is on schedule to begin delivering 30 percent of the city's drinking water demand in October, or about 1 billion gallons of water annually.

With current rainfall at 70 percent of normal this year, could the charming Central Coast city be on the brink of another expensive, energy-hogging boondoggle, with water needs better met by alternatives such as reuse, conservation, and rainfall catchments? Or is Santa Barbara protecting its future in a world in which years-long droughts will be the new normal as climate change accelerates? The answer has implications for water-stressed regions around the world.

Energy Recovery System at the Carlsbad Desalination Plant. (Photo: Courtesy Jessica Jones)

Despite this winter's El Niño storms, California remains in drought, with the area around Santa Barbara categorized as in "exceptional drought." Although the city built a pipeline in the 1990s to tap into water from the state water system, deliveries have become irregular because of the drought.

Santa Barbara's dilemma is not unique. Of the approximately 14,000 desalination plants in operation, about 95 percent are used regularly at some capacity, said Tom Pankratz, an independent desalination consultant and editor of the *Water Desalination Report* for Global Water Intelligence. Most of these plants are in countries that lack freshwater supplies, such as Saudi Arabia. "Zombie" plants are more likely in places like Santa Barbara that have access to other water sources but want a desalination plant as a backup. Desalination is an energy-intensive, expensive process, so when other, cheaper sources are available, cities tend to use those first. That makes zombie plants financial albatrosses, raising costs for customers with seemingly little to show for it.

Take Australia. The country spent more than $8 billion to build six large desalination plants in response to a decade-long drought that began in the late 1990s. Most were completed just before the rains of 2011 ended the dry spell, and four of the six are mothballed or in standby mode.

In the United States, the largest desalination plant in the western hemisphere just came online in San Diego County and will produce 50 million gallons a day, supplying about 7 percent of the district's water. Water from the $1 billion Carlsbad plant will cost about $0.006 a gallon, adding at least $5 to monthly utility bills, according to a San Diego County Water Authority report. That's roughly double the cost of recycling wastewater and quadruple the cost of saving water through conservation and rebates for drip irrigation, lawn removal, or water-efficient toilets, according to data from the California Department of Water Resources.

Although San Diego is a good candidate for desalination, given its lack of rain and groundwater supplies, other California cities are considering alternatives. There were just nine proposed plants in California as of May, according to the Pacific Institute, down from 21 in 2006. Corpus Christi, Texas, is considering a desalination plant, and California may build some of the nine it's considering, but likely not all, said Pankratz.

Now researchers in Australia are mulling options to revive the country's expensive desalination plants. It takes a lot of energy to clean water and transport it to people. It also takes a lot of water to produce energy—to cool power plants, produce oil and natural gas, and wash coal. Historically, water and energy managers have operated independently of each other. But increasingly they're teaming up to figure out how to deliver both energy and water more efficiently.

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Oz Sahin, a research fellow in the school of engineering at Griffith University in Queensland, Australia, and his colleagues are using computer modeling to find a way to deliver energy and water reliably at the lowest possible cost while minimizing the impact on the environment and people.

In Sydney, for example, water agencies must manage for both drought and flood. The city is considering spending between $378 million and $604 million to raise the height of the Warragamba Dam to allow a reservoir to store more water while still keeping space available to prevent floods during heavy rains.

“We said, ‘Hey, don’t do that,’ ” Sahin said. “We are simply saying that it is better to utilize our existing technologies in an integrated way rather than individually, to save taxpayers money, to save the environment, and to make people more comfortable by having enough water.”

The researchers’ computer models showed that reactivating a mothballed desalination plant could ensure water demand would be met while allowing water levels in the reservoir to be lowered for flood prevention. No need to spend hundreds of millions of dollars to raise the walls of the dam.

With the desalination plant adding to supplies, water could be released from the reservoir to power turbines to generate electricity that would help offset the energy used to desalinate water.

Desalination plants have other environmental impacts besides their energy consumption. Most plants suck in seawater through a pipe in the ocean. That can trap larger animals against the pipe. Newer plants have fine mesh screens to prevent ingesting fish, but plankton, fish eggs, larvae, and other organisms at the base of the food chain get pulled into the plant, where they die from heat and pressure. This is also a problem for coastal power plants that use ocean water for cooling. In 2012, California required power

plants to take water from beneath the seabed if possible. The law was applied to desalination plants in 2015. The Santa Barbara project was exempt because it's using 1990s-era permits.

After desalinating water, operators are left with a sludge about twice as salty as seawater. Typically this is dumped into the ocean. The Santa Barbara plant will mix its waste brine with treated sewage to reduce the salinity.

Environmentalists who opposed the plant, such as Kira Redmond, executive director of the nonprofit Santa Barbara Channelkeeper, have largely resigned themselves to its revival. But Redmond said she hopes the city chooses other strategies for future water needs.

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"We believe that any other alternative is better than desalination," she said. Conservation, efficiency, and expanded storm water capture are "much more sustainable and less harmful to the economy and the environment."

Santa Barbara has long used recycled water to irrigate landscaping, but Redmond wants to see water recycled for drinking. "We think the same technology being used to take salt out of seawater can more cheaply and easily take pollutants out of sewage and turn it into drinking water," she said. "You'd also be avoiding dumping treated sewage into the ocean."

In addition to the desalination plant's $55 million price tag, it will cost about $5 million annually to operate the facility at full production and $2.5 million in standby mode, according to the city.

"User rates have already gone up 38 percent on average," said Redmond, referring to hikes largely used to fund the desalination plant. Rates increased again on July 1.

Haggmark said the cost of desalinated water is reasonable now

compared with the prices of other sources. “It’s no longer this crazy expensive source of water,” he pointed out. Desalinated water is less than water the city gets from state projects, he said.

The city decided to rebuild its desalination plant to increase the number of sources it has for water, said Haggmark. For desalination, the pros are “it’s reliable; we control it; it’s local. Cons are energy usage,” he said.

Still, the availability of water resources in Santa Barbara is changing. The San Ynez River is home to endangered steelhead trout, which might lead to restrictions on water withdrawals. After a 2007 forest fire, dirt washed from a denuded hillside into a key reservoir for Santa Barbara, reducing its capacity by 30 percent.

“That’s why we’re keen on supply diversity,” said Haggmark. “It helps to manage those changes. When the drought is over, we’ll discuss with the city council what the long-term use of the desalination plant should be.”

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