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Desalination Making a Splash in California.

California has grappled with water scarcity for generations and now the San Diego Water Authority is betting on desalination.

When thinking of California, Hollywood, Silicon Valley and even the Gold Rush are likely among the first things that come to mind. But more than anything else, water has defined the state and shaped its history. Cities throughout the state have thrived – or withered – depending on how successful they were at securing water rights.

The legendary California Water Wars of the early 1900s still elicit strong responses, especially from those who continue to call California's Owens Valley home. Owens Valley was the epicenter of the struggle between the water-rich eastern Sierra farmers and the growing city of Los Angeles. Famously recounted in the 1974 film *Chinatown*, Los Angeles water chief William Mulholland engineered the Los Angeles Aqueduct that brought water to millions in Southern California while devastating the Owens Valley.

Today, water is still perhaps the most important issue California contends with. It's such a divisive topic that it has many times over the years yielded various movements to divide California into two or more separate states. Currently a "Six Californias" plan is being touted by Silicon Valley venture capitalist Tim Draper. In Sacramento, Governor Jerry Brown's \$25 billion proposal to construct two massive water-diversion tunnels in the Sacramento-San Joaquin Delta have further polarized residents. Those in the northern third of the state, where most of the water (usually) resides tend to resist efforts by Central Valley farmers and Southern California metropolises to have "their" water taken from them.

Currently, California finds itself in the midst of a severe – though historically commonplace – drought. Talks of water diversification that extends beyond relying on the Colorado River and the California Water Project are again ramping up.

In Carlsbad, Calif., however, such talk about diversification has been replaced by action. Carlsbad, which lies about 35 miles up the coast from San Diego, is the site of a \$1 billion desalination plant that is currently under construction. Under the jurisdiction of the San Diego County Water Authority, the plant is expected to come online in 2016 and provide San Diego County residents with 50,000 acre-feet of water (more than 16 billion gallons) every year.

The bulk of the funding for the plant comes via \$734 million in bond financing. The plant is being built, and will be operated by, Poseidon Resources of Stamford, Conn. As part of the deal to build the plant, the authority has agreed to purchase those 50,000 acre-feet of water every year for 30 years, with a safeguard in place that the authority can reject any water that doesn't meet its standards. At a current price of \$2,000 per acre-foot, which is double what it pays for the water it receives from the Metropolitan Water District of Southern California, the authority is gambling that as water scarcity in California continues, desalinated water will pay off in the near future. The desalination plant will provide 7 to 10 percent of San Diego County's water supply by 2020.

Historically, desalination has not been considered a viable option in the United States. Though the basic technology has been around for decades, the cost and energy requirements have not penciled out here, especially as water in the U.S. has been relatively cheap and abundant. In the Middle East, desalination plants are common and necessary. Israel, for example, has three of the largest desalination plants in the world, churning out as much as 40 percent of that country's water supply. Those plants are operated by Israel's IDE Technologies. At the Carlsbad plant, IDE will share operations with Poseidon.

The first big attempt at desalination in the U.S. began in 1997 in Tampa Bay, Fla. That project, on which Poseidon also worked, was fraught with financial setbacks and wasn't completed until 2007. Currently, the Tampa Bay facility outputs approximately 25 million gallons of fresh water every day - about half the output expected from the Carlsbad plant. Aside from a handful of small scale facilities, that's really about it for American desalination efforts.

While the present drought in California is a handy reminder that water shortages are a regular occurrence, the Carlsbad plant has been in the works for years. Like the ever-increasing miles per gallon feats automobile manufacturers are able to conjure, desalination technology has benefited from decades of small but numerous improvements.

So why is San Diego investing a billion dollars into desalination?

"The cost of desalting seawater has come down significantly over the last two decades or so," said Bob Yamada, Water Resources Manager at San Diego County Water Authority. "Previously, ocean desalination was not in the ballpark with other new water supplies. Improvements in the reverse osmosis technology and improvements related to energy recovery have contributed to a now cost-competitive water supply option."

Many of the improvements Yamada cites have been shepherded at IDE's desalination plants in Israel.

"The technology has improved incrementally," Yamada said. "In particular, reverse osmosis technology, which was first commercialized in the 1960s, there have been incremental improvements in that technology over the last 50 years but in the last 20 years we've seen significant incremental improvement in things like salt rejection, the membrane area, all of these things that manufacturing processes have improved."

In addition, Yamada said that there have been a significant changes in energy recovery technology. A company called Energy Recovery, based in San Leandro, Calif., manufactures devices called pressure exchangers, which transfer the pressure that's produced in the desalination process to pressurize the feed water stream coming into the plant. The Israeli plants all use pressure exchangers manufactured by Energy Recovery, as will the Carlsbad plant

"These things have all come together to reduce the cost of seawater desalination," said Yamada.

Desalination itself is a relatively straightforward process. At a very simplistic level it's just filtering seawater. But it's not quite that easy. Generally it takes two gallons of sea water to make one gallon of fresh drinking water. The seawater is drawn into the desalination system for the first step of the process - removing the suspended particles in the seawater. This occurs through a filtration process. In the case of Carlsbad there are large filter basins wherein the water is filtered through a combination of sand and anthracite, a type of coal. This process removes the suspended particles. The water is then further purified through reverse osmosis. In reverse osmosis desalination, water is pressurized and that pressure forces water molecules through a semipermeable membrane. The

membrane rejects the salt molecules and creates two streams of water. One stream is called permeate, water that has gone through the membrane and is now essentially fresh water. The other stream created is called the brine stream. The brine stream exits the system with twice the salinity of normal sea water and still at very high pressure. The energy in that pressure is recovered by the pressure exchangers and transferred back to the feed water stream. The permeate stream is disinfected and then pumped to a storage tank where it is blended with water coming from water treatment plants. That blended water flow is then distributed within the aqueduct system.

Construction on the Carlsbad plant is more than 40 percent complete. Part of the project also includes a 10-mile pipeline that connects the plant to the authority's water treatment site in San Marcos, Calif. More than three miles of the pipeline have been built so far.

In the early 1990s San Diego was getting virtually all of its water from the Metropolitan Water District. However, severe droughts in the late seventies and late eighties prompted water officials to set upon a diversification strategy. While the desalination plant will only contribute 7 to 10 percent of the region's water supply, it makes up what will be one of the most diverse water supplies in the state. By 2020, the authority will get water from eight different sources, including Metropolitan but also from the nearby Imperial Valley, from ground and surface water, from recycled water, and from the desalination plant.

"The obvious benefit from a desalination project is we've got the largest reservoir in the world at our doorstep," said Peter MacLaggan, Senior Vice President of Project Development at Poseidon. "It's not subject to snow pack or rainfall. It's truly drought-proof. It truly has some inherent reliability features that aren't present with the other supplies in the region and as such it represents a hedge against droughts."

It may be that the time has come for desalination to take its place in California's water ecosystem. There are 15 proposed desalination plants for California that are in various stages of planning. Poseidon is close to beginning working on a second, similar facility in Huntington Beach, Calif. That project, MacLaggan said, is waiting on one final permit from the California Coastal Commission.

The Carlsbad plant, MacLaggan said, will be the biggest and "most technologically advanced and environmentally sensitive desalination plant in the western hemisphere."

For more than a century and a half California has been fighting itself over water. The Carlsbad desalination plant is giving rise to optimism that there is at last a viable solution to easing the state's perpetual water woes that amounts to more than just a drop in the bucket.

FutureStructure

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