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SPECIAL REPORT: ENVIROTECH

Treasure from the Deep: Drinking Water

Thanks to huge technology improvements, desalination is fast becoming the answer to "Where will we get the water to support growth?"

As the American West enters its fifth year of drought -- the longest stretch in 108 years -- the region's cities are instituting sweeping water-usage restrictions and conservation programs. In Aurora, Colo., where the reservoir system is at just 26% capacity and is expected to reach only half of normal levels by summer, planting new trees and shrubs is prohibited, and privately owned pools may not be filled. In Las Vegas, golf courses are being required either to take out some of their turf or let the grass turn brown. In Santa Fe, residents are being charged \$15 per 1,000 gallons of water above the allocated 10,000 gallons per month per home.

In the thirsty, growing cities of Southern California, however, simple conservation simply won't do the trick. This region imports more than 80% of its water from neighboring states. And even though it jealously guards those arrangements, they won't be enough to compensate for the rapid growth that lies just ahead: San Diego County's population alone is projected to rise about 29% by 2020, from 2.84 million to 3.67 million.

California has a crisis on its hands. According to the San Diego Water Authority, water demand in its area will grow 20% by 2020, from 650,000 acre-feet annually to nearly 800,000 acre-feet. (An acre-foot is the volume of water that would stand a foot deep over an acre. That translates into 325,551 gallons, enough to supply five people for a year.)

DRINKING THE SEA. Drastic times call for drastic measures, so state water agencies are turning to desalination, a technology that makes ocean and brackish water drinkable by stripping it of salt and other minerals. California has plans in various stages to build 13 desalination plants along its coastline. The projects will cost billions, but planners say they'll provide a far more reliable supply for California residents than waiting for Mother Nature to adjust her weather patterns.

Since just 3% of water on earth is fresh, this is a step that would have to be taken anyway as the global population grows. "Desalination will create a drought-proof supply of water," says Bob Yamada, the San Diego Water Authority's seawater-desalination program manager. He adds that 20 years from now, 10% to 20% of the state's water could come from the ocean. The American Water Works Assn., a Denver-based nonprofit dedicated to improving drinking-water quality and supply, predicts that the market for desalination plants and equipment, now just \$2 billion, will grow to more than \$70 billion over the next two decades.

Not surprisingly, such growth potential has attracted the world's largest construction outfits. Leading the charge in the U.S. is Poseidon Resources, a privately held water-management concern. Poseidon was lead developer on a just-completed \$110 million desalination plant in Florida's Tampa Bay. It's also working on projects in San Diego, Huntington Beach, Calif., and Freeport, Tex.

OSMOSIS IN REVERSE. Besides its water expertise, Poseidon takes on much of the risk of building desalination plants --- a great benefit to municipalities facing severe budget shortfalls. In San Diego, it will build, own, and operate the plant for five years before turning it over to the water authority. Other big players in this industry include construction giant Stone & Webster, a division of Shaw Corp. ([SGR](#)); Israel's Engel Construction; Osmonics, which in November, 2002, was purchased by GE ([GE](#)); and Ionics ([ION](#)) in Watertown, Mass.

To understand how desalination works, think back to your high school biology class: The principle of osmosis says if you divide two bodies of water with different concentrations of salt or other minerals by a semipermeable membrane, the water will flow between the two parts to equalize the concentration. Desalination achieves the opposite, using a technique called reverse osmosis.

Water from the ocean is forced at a very high pressure -- about 1,000 pounds per square inch -- through a dense membrane. The water molecules, which are smaller than most impurities, are able to pass through, while salt and other minerals can't. The remaining liquid is discharged as brine. The newest state-of-the-art plant in Tampa Bay, which came online in February, produces 25 million gallons of fresh water a day and serves 2 million people.

50% IMPROVEMENT. Processing seawater, of course, is nothing new. Oil-rich Saudia Arabia, Kuwait, and other Middle Eastern states have been using desalination and distillation, which uses heat to evaporate salt and other impurities, for more than half a century. (Saudia Arabia gets about 70% of its water from the ocean.) But distillation and desalination have been too expensive and energy-intensive for use in the U.S., where fresh water is available within a few hundred miles -- until now.

Advances in membrane technology mean desalination can produce one gallon of fresh water from every two gallons of seawater, an improvement of 50% over 20 years ago. Engineers have also cut energy costs by locating desalination facilities next to coastal power plants. This provides both a source of power and an existing infrastructure to draw water in and release it back to the ocean because power stations use seawater as a coolant.

So in the future, they could combine that with brine from a nearby desalination plant and release both back into the ocean. "Improvements in the technology have brought the cost down to a point where desalination is competitive with other new water-supply options," says Yamada.

COW POWER. San Diego is leading California's desalination charge. This year, in partnership with Poseidon Resources, it will break ground on a \$270 million plant in Carlsbad, next to the Encina Power Station. Upon completion in 2008, it will be the largest seawater-desalination facility in the Western hemisphere, producing 50 million gallons of fresh water each day, or 8% of the San Diego region's drinking supply. The local water authority is also evaluating the feasibility of two other similar plants -- one adjacent to the South Bay power plant in Chula Vista and another near the San Onofre Nuclear Generating Station at the border of San Diego County and Mexico.

Further north, in the lush valleys of San Bernadino County, Inland Empire Water Utility is already using desalination to clean up contaminated ground water. The \$80 million project uses manure from local dairy farms to create methane, which in turn is used to power the plant. It strips nitrites and salt -- runoff from the region's orange groves and vineyards -- from groundwater. Affectionately dubbed the Cow Power project, it was launched in June, 2002, and is expected to provide 25,000 acre-feet of water annually -- or 20% of the local population's drinking supply.

"We're really into recycled water," says Inland Empire General Manager Richard Atwater. "We believe

every drop of water should be reused or conserved." Today, Atwater's area serves 700,000 people (and 300,000 cows). In 25 years, the human population is expected to more than double to 1.5 billion. Without such innovative water cleanup projects, experts say, the taps would run dry.

GREENER OPTION. Environmentalists also embrace desalination. Studies show that pumping the cooling water and concentrate back into the ocean raises its salinity by less than 1%, which is equivalent to the natural rise and fall. Barry Nelson, a senior policy analyst with the Natural Resources Defense Council, says he became a proponent of desalination when a June, 1999, California report demonstrated that it was cheaper than building new dams, which often have a huge environmental impact.

Nelson still worries about energy consumption and coastal disruption. But he adds that "desalination is no longer on the lunatic fringe. It has entered the mainstream. That means we look at desal projects on a case-by-case basis, as we would any other legitimate water policy."

As the technology continues to improve, experts say it'll fast become a solution not only for municipalities but for hotels and resorts, corporations, and, someday, homeowners. Privately held water-treatment outfit Matrix Water, based in Fort Lauderdale, Fla., is installing a desalination plant that will process 800,000 gallons of water per day for the new Emerald Bay Four Seasons Resort in the Bahamas. And the new U.S. Homeland Security Dept. is investigating ways of using reverse osmosis to protect the nation's water supply from bioterrorism.

Clearly, desalination is a technology whose time has arrived -- not only to combat the effects of drought but to provide cleaner, safer drinking water everywhere.

By [Jane Black](#) in New York

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