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New Concentrating Solar Tower Is Worth Its Salt with 24/7 Power

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Deep in the Nevada desert, halfway between Las Vegas and Reno, a lone white tower stands 195 meters tall, gleaming like a beacon. It is surrounded by more than 10,000 billboard-size mirrors focusing the sun's rays on its tip. The Crescent Dunes "concentrating solar power" plant looks like some advanced communication device for aliens. But the facility's innovation lies in the fact that it can store electricity and make it available on demand any time—day or night.

Crescent Dunes, the flagship project of Santa Monica–based firm SolarReserve, has achieved what engineers and proponents of renewable energy have struggled with for decades: providing cheap, commercial-scale, non–fossil fuel electricity even when winds are calm or the sun is not shining. The facility is touted as being the first solar power plant that can store more than 10 hours of electricity, which translates into 1,100 megawatt-hours, enough to power 75,000 homes. "We can ramp up electricity generation for utilities based on

the demand. We can turn on when they want us to turn on and we can turn off when they want us to turn off," SolarReserve CEO Kevin Smith says.

The trick is to have all those mirrors heat up a massive tank fullof sodium and potassium nitrates that are pumped up to the top of the tower. There the molten salt can reach temperatures as high as 565 degrees Celsius. When electricity is needed, the hot salt is used to boil water and produce high-temperature, high-pressure steam, which turns turbines that generate electricity. The rest of the time, the molten salt can be stored in another insulated tank on the ground.

Large tracking mirrors, called heliostats, follow the sun throughout the day, reflecting and concentrating sunlight onto the top of Crescent Dunes' central tower. *Credit:* *SolarReserve*

Molten salt's physical and thermal properties make it a

particularly good candidate for energy storage. It can be pumped just like water and stored in tanks just like water, says Cliff Ho, an engineer at Sandia National Laboratories who studies heat transfer and fluid mechanics for technologies such as concentrating solar power, but is not involved in Crescent Dunes. And although a handful of other concentrating solar plants around the world use solar rays to heat water directly into steam, it is much more volatile than molten salt and cannot be easily stored, Ho explains. That is why the Ivanpah Solar Electric Generating System in California, the world's largest concentrating solar-thermal plant at 377 megawatts, has no way to store all the energy it produces.

Although a few other plants like the Solana Generating Station in Arizona have used molten salt as a storage medium, they heat the salt indirectly, using solar energy to first heat other fluids such as oil. The benefit of using molten salt as both the energy collector that creates steam and the energy storage mechanism, however, is that it eliminates the need for expensive heat exchangers to go between different fluids. And with molten salt, Crescent Dunes can operate at much higher temperatures than plants using other heat transfer fluids, which makes electricity generation more efficient, Smith says. Plus, the molten salt medium is cheaper, more environment-friendly, nontoxic and nonflammable compared with oil.

But molten salt technology itself is not new. "What Crescent

Dunes brings to the table is that it proves that we can use this technology with concentrated solar power to generate nonintermittent electricity," says Yogi Goswami, a professor at the University of South Florida and an expert on solar power. The payoff, he adds, is that 10-hour storage eliminates the need for a fossil fuel power plant to back up electricity production on cloudy days and at peak usage hours in the evening. It also relieves anxiety for utilities concerned with overproduction of electricity by solar power plants during the day, which sometimes forces them to curtail electricity production or pay customers to take the extra power.

Ultimately, though, concentrated solar power plants must compete on price with photovoltaic power plants that convert sunlight directly into electricity, using solar cells. The price of photovoltaic panels has plummeted in recent years, making plants cheaper than concentrating solar plants. But photovoltaics cannot guarantee continuous electricity, certainly not at night, unless they are paired with their own storage medium, which is usually a big bank of batteries. But Ho says that when the cost of even the best battery technology is taken into consideration, photovoltaics are more expensive than concentrating solar power, which is now down to 10 to 12 cents per kilowatt-hour.

That is still nearly double the goal set by the U.S. Department of Energy to reduce the cost of solar power to six cents per kilowatt-hour by 2020. And skeptics doubt that concentrating

solar power, even using molten salt, will be able to match coal- and natural gas–powered electricity. “Concentrated solar power plants are massive projects, requiring lots of steel and glass, which are unlikely to see significant changes in efficiency or cost,” says Adam Schultz, a senior policy analyst for the Oregon Department of Energy. He thinks photovoltaic panels and batteries are more likely to drop in cost because “we continue to see newer technologies in that field.”

SolarReserve’s Smith, however, is confident that Crescent Dunes is just the first of many big molten salt towers. Concentrating solar power can be scaled up to provide more electricity and meet more of the grid’s demands, he says. Crescent Dunes is already nearly six times bigger than Torresol Energy’s 20 megawatt demonstrationscale plant that was completed in 2011 in Spain. And SolarReserve is planning to break ground on a second plant roughly the same size as Crescent Dunes in South Africa later this year. Other solar-thermal developers also have large towers under construction in Morocco and Chile that will use molten salt. With the first utility-scale plant completed, costs could eventually come down. “We've got a bit of a ways to go,” Smith says. “But molten salt–powered technology has the most promise for energy generation and storage from solar power.”