BrightSource’s Commitment to Reducing Water Use Through Dry Cooling

BrightSource Energy’s solar thermal power plants are setting the bar for low water use. As stewards of the environment, BrightSource uses dry cooling systems at our plants, which reduces water usage by more than 90 percent compared to conventional cooling technologies. Dry cooling can be costly and can create efficiency losses for some solar thermal technologies. However, BrightSource’s tower technology is able to reach the world’s highest temperature and pressure steam, which makes dry cooling a responsible and economically-viable decision.

How does BrightSource’s solar thermal technology conserve water?

In BrightSource’s solar technology, we use water in two primary ways: to clean the heliostat mirrors and to produce steam for electricity generation.

Water is not consumed during power generation. To produce steam from the sun, we use tens of thousands of computer-controlled mirrors to track the sun in two dimensions and reflect the sunlight to a water-filled boiler that sits atop a tower. When the concentrated sunlight strikes the boiler’s tubes, it heats the water to create superheated steam. This high-temperature steam is then piped from the boiler to a conventional steam turbine-generator where electricity is generated. In order to conserve water, we use a dry cooling process to condense the steam back to liquid water, which is then cycled back to the boiler in a closed loop cycle.

The minimal amount of water consumed by a BrightSource power plant is used from the cleaning of heliostat mirrors, and even this water is made up of partially recycled boiler water.

How much water is used in a BrightSource Energy solar thermal plant?

The amount of water used varies depending on the size of the plant. For example, our 392 (gross) megawatt Ivanpah solar plant will use approximately 100 acre feet of water each year. This is comparable to the amount of water used by 300 households annually, and less than the amount used to water two holes of the nearby 36-hole golf course.

What is dry cooling?

In thermal steam systems, the super heated steam inside the boiler pipes must be cooled and condensed back into water in a closed loop system. Dry cooling, or air cooling, uses an air-cooled condenser comprised of many large fans to circulate air over the pipes to cool and condense the steam. By comparison, a wet cooling system will circulate water across the pipes to cool and condense the steam.

What are the benefits of dry cooling?

There are a number of benefits to using a dry cool system. The primary motivation to use dry cooling for BrightSource is to conserve scarce water resources in the arid desert climates where we build our plants. Overly taxing an area’s water resources can very seriously damage the biological ecosystem of the area, negatively impacting both animal and plant species. Dry cooling requires 90 percent less water than competing wet-cooled or hybrid dry-wet cooled systems. By using dry cooling, we are also able to
eliminate the need for evaporation ponds and extensive water treatment facilities, which provide us with greater flexibility on where we can site our solar power plants.

**What are the drawbacks of dry cooling?**

The primary drawbacks of using a dry cooling system are the added cost and the loss of efficiency. Power tower is the most cost-effective dry cooling plant because it produces more power, offsetting the additional cost per unit of electricity and has the ability to produce higher temperature steam, which results in a smaller efficiency loss when interfacing with dry cooling technologies.

Studies from the National Renewable Energy Lab (NREL) show that air-cooled condensers can add about five percent to a plant’s capital costs and experience an efficiency loss that varies depending on the ambient air temperature. By nature, dry cooling requires large fans to cool and condense the steam, and these fans require a significant amount of electricity to operate. The electricity required to operate the fans takes away from the total amount of electricity that can be sold to a customer, referred to as “parasitic loss.” The warmer the ambient temperature, the larger the parasitic loss.

**How does BrightSource’s technology overcome the challenges of dry cooling?**

BrightSource’s technology is designed to produce the highest temperature and pressure solar steam in the world. We are able to heat water to over 550 degrees Celsius, or over 1000 degrees Fahrenheit. Competing parabolic trough systems or molten salt tower systems are limited by temperatures that the heat-transfer medium such as molten salt or synthetic oils can reach. This technological advantage lets us use more of the steam’s heat energy (enthalpy) to more efficiently power a steam turbine-generator. As a result, our solar thermal power systems can produce more electricity than competing technologies.

Our ability to produce and sell more electricity makes dry cooling an economically viable choice. It significantly reduces the cost implications of using a more expensive dry cooling system, and it also reduces the percentage of overall parasitic load.

**How does an air-cooled condenser work?**

An air-cooled condenser (ACC) condenses the steam by forcing ambient air over tubes that contain the steam that exits the turbine. ACCs are typically comprised of modules arranged in parallel rows, with each module containing a number of finned tube bundles. An axial flow, forced-draft fan located under each module forces the cooling air across the heat exchange area of the finned tubes.

**What does an air-cooled condenser physically look like? What are the main components?**

The ACCs at Ivanpah provide a good example of the main components of an ACC and what the equipment looks like. The three ACCs at Ivanpah each have 15 modules, placed in a 3 x 5 arrangement, with overall plot area of ~242 ft L x 125 ft W x 97 ft H. Each module has a 36 ft diameter fan, driven by a 200 HP motor. The ACC is raised off of the ground to reduce the amount of dust and debris that enters the system.

---

**PROVEN LEADERSHIP IN SOLAR ENERGY**

BrightSource Energy is a leader in the design and development of concentrating solar thermal technology used to produce high-value electricity and steam for power, petroleum and process markets worldwide.

An ACC at Ivanpah sits at the base of the tower structure.

1999 Harrison St., Suite 2150 Oakland, CA 94612 510-550-8161 brightsourceenergy.com