Drought Diminishes Hydropower Capacity in Western U.S.

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Hydropower production is taking a hit in river basins in the U.S. West, where prolonged drought has reduced water volumes available for power production. The generation of hydroelectricity depends on the funneling of large quantities of water from elevated heights through power plants typically found inside dam structures. When the water levels at lakes and reservoirs held back by these dams drop below benchmark elevations, the force of water pressure needed to turn the blades of hydro turbines is lessened, affecting productivity. As a result, electricity production on these dams has been curtailed or even discontinued.

Hydropower represents 19 percent of total electricity produced globally. It is one of the cleanest forms of energy production and the most widely-used renewable source of energy in the world. It is also one of the cheapest forms of energy, outside of the considerable initial costs of dam infrastructure, which are primarily government financed. The United States is one of the largest producers of hydroelectricity, along with China, Canada, and Brazil.

Water levels on Lake Mead on the Colorado River, the largest reservoir in the U.S., are managed through releases from Lake Powell found 370 miles upriver behind the Glen Canyon Dam. For more than a decade, the flow of water to Lake Powell from key tributaries in the river basin has been decreasing due to drought-related drops in overall precipitation, less

snowpack and earlier snow melt. The current 14 year-long drought is the most extreme drought since measurements began in the 1900s. And with less water in Lake Powell, there is less water for Lake Mead.

Since 1999, the water level at Lake Mead has plunged 130 feet to a low of 1081 feet above sea level in July 2014. Levels below 1,084 feet have not been recorded since a period of sustained drought in 1956. With low water levels at Lake Mead, Hoover Dam's electricity output has been significantly curtailed. In July, the facility was derated from 2,074 megawatts to 1,592 megawatts. Going forward, the U.S. Bureau of Reclamation projects that Hoover Dam power production will fall again to 1,120 megawatts by May 2015.

Future shortages loom on the horizon for the Colorado River basin. The Department of Interior issued its December 2007 Record of Decision on the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations of Lake Powell and Lake Mead. In the guidelines, shortage criteria basically state that at certain Lake Mead elevations, as downstream water demands are curtailed, power production will be concurrently curtailed. A first-tier shortage is declared at 1075 feet above sea level at Lake Mead. For the first time since 2007, in November 2010, the Hoover Dam elevation came within 7 feet of triggering shortage. Drought conditions may also cause extraordinary demand for electricity, which can lead to adverse effects on communities as power generation fails to meet demand.

Improved technology can reduce some of the loss. In response to reduced volume in Lake Mead, the first of five wide-head turbines, designed to work efficiently with less flow, were installed last year. The final turbine is scheduled to be installed in 2016. Previously, a minimal level of 1,050 feet above sea level in Lake Mead served as the benchmark to guarantee safe power generation, but the new turbines will make it possible to revise the minimum water level to 950 feet.

The iconic Hoover Dam, the largest concrete structure ever built and the

largest hydro plant in the world when it came on line in 1936, has been corralling water for flood control, Southwest agricultural, tribal, and municipal needs, and supplying renewable, carbon-free energy for more than 77 years. The hydro plant was installed to finance the production costs of the dam as well as produce electricity for a bourgeoning region. Hoover Dam satisfies peak-demand electricity for Las Vegas, Los Angeles and other southwestern cities.

Glen Canyon Dam, at the southern tip of Lake Powell, is the largest hydropower producer in Reclamation's Colorado River Storage Project. As a result of lower water levels, power production there is also expected to drop by 8 percent in 2014 from 2013 levels. At Lake Powell, when the water level drops below 3,490 feet above sea level, 100 feet below its August 2013 level, vortex action would draw air into the turbines and damage them, according to Jane Blair, Upper Colorado power manager at Reclamation. If the situation does not improve, power generation at Glen Canyon Dam would have to cease. Currently, engineers at Glen Canyon are not planning to install any wide-head turbines like those at Hoover Dam.

There are more than 53 dams on the Colorado River and its tributaries. Twelve of these produce hydropower.

In response to lower hydropower on the Colorado River, electricity must be purchased from other sources to supply demand. The Western Area Power Administration, one of four power marketing administrations within the U.S. Department of Energy, whose mandate is to market and transmit wholesale electricity from multi-use water projects, sells power from four dams on the Lower Colorado River: Davis, Glen Canyon, Hoover and Parker dams. As the drought has lowered hydropower generation, Western Power has purchased more power to meet its commitments to customers primarily from thermoelectric power plants in the region. For more than ten years, Western has seen higher expenses for power purchases.

Battling a three-year drought, California is also experiencing the impacts of

lower total rainfall, less snowpack in the mountains and earlier snowmelt. As a result, three of the state's largest hydroelectric dams have been forced to reduce production due to lower water levels: Lake Shasta, Folsom Lake and Lake Oroville. In Fall 2014, the water levels on these lakes were 41 percent, 62 percent and 47 percent, respectively, of their storage capacity. Four hundred hydropower plants in California have the capacity to satisfy up to 20 percent of California's electrical demand. Between 2004 and 2013, hydropower accounted for 20 percent of California's total energy generation during the first six months of each of those years. However, in the first six months of 2014, that capacity fell to 10 percent.