The California Energy Commission

California's Drought: Impact on Hydroelectricity

The most widely recognized aspect of the water-energy relationship is hydroelectric generation. A vast system of reservoirs and dams, pumped storage, and run-of-river facilities helps provide reliable electric service to consumers throughout California. These hydroelectric generation facilities are operated by the state's electric investor-owned utilities (IOUs), publicly-owned utilities (POUs), state and federal agencies, irrigation districts, and other entities.

What Is Hydroelectricity?

Hydroelectricity is an established renewable electric generation technology with more than 100 years of commercial operation. Hydroelectricity is produced when moving water rotates a turbine shaft; this movement is converted to electricity with an electric generator.

There are three basic types of hydroelectric generation facilities within California: conventional, pumped storage, and multipurpose reservoirs.

1. **Conventional Hydroelectric Generation:** These facilities are far more numerous than the other two combined, but account for less than half of the state's hydroelectric generation capacity. Most were built by the state's electric IOUs and POUs in mountainous areas and depend heavily upon snowmelt runoff in the spring and summer.

2. **Pumped Storage:** Pumped storage moves a supply of water from an upper body of water, drops it through electric generators, and then collects the water in a lower basin. This generation takes place when electricity demand and prices are high, such as a summer afternoon and evening. Water is pumped from the lower to the upper basin when electricity demand and prices are low, to be used during the next high demand period. Reuse of water in pumped storage makes these facilities far less dependent on precipitation than the other two types.

3. **Multipurpose Reservoirs:** Multi-purpose reservoirs are more numerous than pumped storage. The main purpose of these reservoirs is to provide water for municipal, industrial, and agricultural uses. They also provide flood control and recreation uses. Hydroelectric generation is a lower priority for these facilities.

Hydroelectric Generation in California

Hydroelectricity dates back to California's Gold Rush. Hydraulic technology was used for gold mining and provided the early infrastructure for widespread hydroelectric generation development. By the early 1900s, 40 percent of California's electricity consumed came from hydroelectric generation. Hydroelectricity continued to expand, and by 1941, hydroelectricity represented 75 percent of all electricity consumed in California and throughout the Pacific Northwest.

Hydroelectric generation in California centers on three snowpack regions: the Northern Sierra and Trinity, Central Sierra, and Southern Sierra. California's Sierra Nevada topography and seasonal rainfall patterns have required a technological approach unique to other areas of the United States.

Impact of California's Drought on Hydroelectricity

California is one of the leading hydroelectric generating states. In a typical year, hydroelectricity provides roughly 15 percent of California's electricity supply. During the current drought hydroelectricity has declined. For the three most recent years, hydroelectricity has dropped by more than half to about 7 percent. In fact, according to official California water monitoring records dating back to 1896, 2014 represents the third driest year in the state's history.

Today California is becoming far less dependent on hydroelectricity than it has in the past. This is because California has a more diversified supply of electric generation that consists of natural gas fueled and renewable electric generators. These electric generators are expected to generate significantly more electricity in the future than in past years to fill in reductions of in-state hydroelectric generation. Depending on the available water supply, California's electric IOUs and POUs will continue to use stored water to produce electricity during hot summer days, and will continue to import hydroelectricity from the Pacific Northwest and Hoover Dam in the Southwest.

Drought Impact on Electric Service Reliability

The Energy Commission does not anticipate any drought-related electric service outages as a result of reduced hydroelectric generation in the state. The state recognizes that climate change is contributing to the state's severe drought with higher than average temperatures – we have seen an increase of 2 degrees over the last 125 years. Unfortunately, climate change and droughts are producing extremely dry conditions throughout the state that increase the risk of wildfires. Of the top 20 recorded major wildfires in California's history, 11 have occurred in the last decade.

In 2015, the state witnessed an increase in wildfires that threatened people's lives and the environment. These wildfires burned rapidly and traveled further and in different directions even without heavy winds. These wildfires can impact the state's electric system making the state more susceptible to electric service outages due to wildfire burning through electric substations and high-voltage transmission lines. These impacts are more of a concern than electric service outages resulting from a reduced supply of hydroelectricity.

Meeting Greenhouse Gas Emission Reduction Goals

California's Global Warming Solutions Act (Assembly Bill 32, Núñez, Chapter 408, Statutes of 2006), mandates that the state reduce greenhouse gas emissions to 1990 levels by 2020. The state's electricity sector is a major source of these emissions and if more natural gas fueled electric generation is needed to replace hydroelectric generation in the coming years due to the drought, then there could be an increase in greenhouse gases emissions from this sector. However, increased development of renewable electric generation is likely to replace a large portion of hydroelectricity and reduce the long-term need to use natural gas fueled electric generation.