

SOURCE

CALIFORNIA-NEVADA SECTION AWWA

V33 • N3 • Summer 2019

COLORADO RIVER ISSUE

PLUS
Spring Conference
Highlights and
Awards

CALIFORNIA'S CLEAN ENERGY CONUNDRUM

How Water Agencies Can Help Reach Climate Goals



By Gary Bousquet and Mike Lee

San Vicente Reservoir near Lakeside, Calif., would serve as the lower reservoir in a potential pumped storage project being assessed by the San Diego County Water Authority and the City of San Diego. Photo courtesy of SDCWA.

CALIFORNIA IS WIDELY RECOGNIZED AS A WORLD LEADER in green energy production, but growing in the shadows of the state's sprawling renewable energy infrastructure is a little-known problem that could undermine efforts to reduce greenhouse gas emissions

While California draws nearly one-third of its power from renewables, solar and wind energy systems are periodically pulled offline because there's not enough demand when the wind is blowing and the sun is shining. These so-called "curtailments" increased significantly between 2014 (when they were almost non-existent) and today. They could soon become a major barrier to a more sustainable future as more and more renewable energy sources are developed to meet peak demands.

Thankfully, California water agencies are well-positioned to play a pivotal role with a solution that makes the state's electrical grid more flexible, stable and efficient. Strategic deployment of large-scale, long-duration pumped-storage facilities could minimize curtailments and provide many other benefits. That would help California achieve its aggressive targets to supply at least 60 percent of the state's energy from renewables by 2030 and 100 percent from clean energy sources by 2045.

The concept is simple: Store renewable energy during the day when it is plentiful by using it to pump water from a lower reservoir to an upper reservoir. By releasing water from the upper reservoir to the lower reservoir through turbines, energy is generated as demand rises in the evening and solar production dwindles, or at other times when power is needed quickly.

State legislation introduced in 2019 attempts to address the disconnect between renewable energy production and demand by promoting the development of initial pumped storage projects as part of the solution, a signal that the issue is starting to reach critical mass. Already, a few pumped storage projects are in various stages of assessment and development across California, including one at a reservoir in San Diego County that could provide a roadmap for a successful pumped-storage strategy statewide.

The Growing Curtailment Challenge

Like any major technological shift, California's embrace of renewable energy has created significant complexities and challenges that must be addressed for the effort to reach its full potential.

The central challenge is addressing cyclic imbalances between renewable energy production and energy demand that result in curtailment. A standard response is to cut back clean energy production. But curtailment comes with significant environmental costs: Statewide curtailments of renewable power reached 460,000 megawatt hours in 2018 — the amount used by 80,000 homes during a year. Being able to use that energy (instead of energy from fossil fuels) would have reduced greenhouse gas emissions by the same amount as removing about 69,000 cars from roads for a year.

Another challenge is the variability of solar and wind. Of course, there's no solar output when the sun fades each night. But clouds also significantly reduce solar production, and wind generation can vary significantly from day to day or even hour to hour. This high degree of variability creates reliability challenges for grid operators.

Today, curtailments are growing into what could become a major barrier to meeting California's renewable goals.

A 2015 study by the Union of Concerned Scientists predicts a 70-fold increase as renewables increase to 50 percent of California’s energy supply.

Dr. David Victor, who co-directs the Deep Decarbonization Initiative at the University of California, San Diego and works as a consultant for the City of San Diego, co-authored a March 2019 white paper highlighting the challenges facing renewables. “Without strategic planning and investment in storage, the amount of over-building and curtailment can rise sharply as excess generation events become more frequent. During these periods power prices can also swing wildly — leading even to negative prices,” wrote Victor, et al. “Other harmful consequences include under-utilization of expensive transmission lines and heavy reliance on natural gas power plants to fill in the gaps – a process that leads to emissions of carbon dioxide and other pollutants, which undermines the state’s climate goals.”

Today, the state’s gas plants play a central role in providing reliable power supply; unless zero-emission gas technologies can be deployed those plants will be constrained in their ability to help integrate renewable power on the grid in the future.

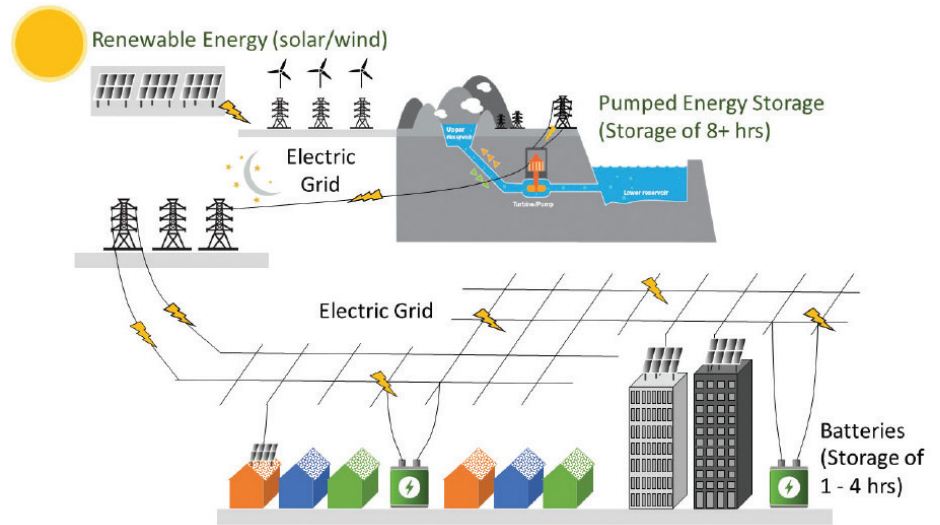
FURTHER READING

Read the white paper “Pumped Energy Storage: Vital to California’s Renewable Energy Future” at: www.sdcwa.org/san-vicente-energy-storage-facility

The Potential of Pumped Storage

A variety of solutions can help address curtailment, and the size and intricacy of California’s energy grid means several different approaches will be needed. Industrial-scale batteries can and do play a role. But they typically are limited to a few hours of storage, and they are much costlier over decades than pumped storage.

Large-scale pumped storage facilities not only can help solve the curtailment problem, but they also provide several other benefits to the electrical grid. As identified by Victor et al., large-scale energy storage provides four essential interconnected services in a cost-effective fashion: 1) balancing generation and demand; 2) improving transmission



Large-scale energy storage plays key role in grid reliability. Image courtesy of SDCWA.

efficiency; 3) providing electric grid stability; and 4) shifting power supplies over long periods.

Although batteries have a role to play in the state’s energy system, they are fraught with technical and environmental issues regarding disposal. Pumped storage offers much longer run times; pumped storage projects can consistently provide eight hours of storage or more each day, whereas battery projects provide fewer than four hours of storage.

A 2015 study by the California Independent System Operator (CAISO) found that a 500 MW pumped storage project in Southern California could avoid nearly 4,000 gigawatt hours of curtailment and save up to \$51 million a year due to more efficient system operation. CAISO concluded that large-scale projects like this also would reduce carbon dioxide emissions and minimize the overbuilding of renewable generation capacity.

The Need for Initial Projects

While the need for pumped storage is growing, current markets and regulations don’t create enough incentives to develop those projects. In fact, neither the California Public Utility Commission’s annual Integrated Resource Planning process nor the CAISO’s Transmission Planning process has looked fully at the potentially pivotal role of large-scale bulk storage in meeting California’s clean energy goals.

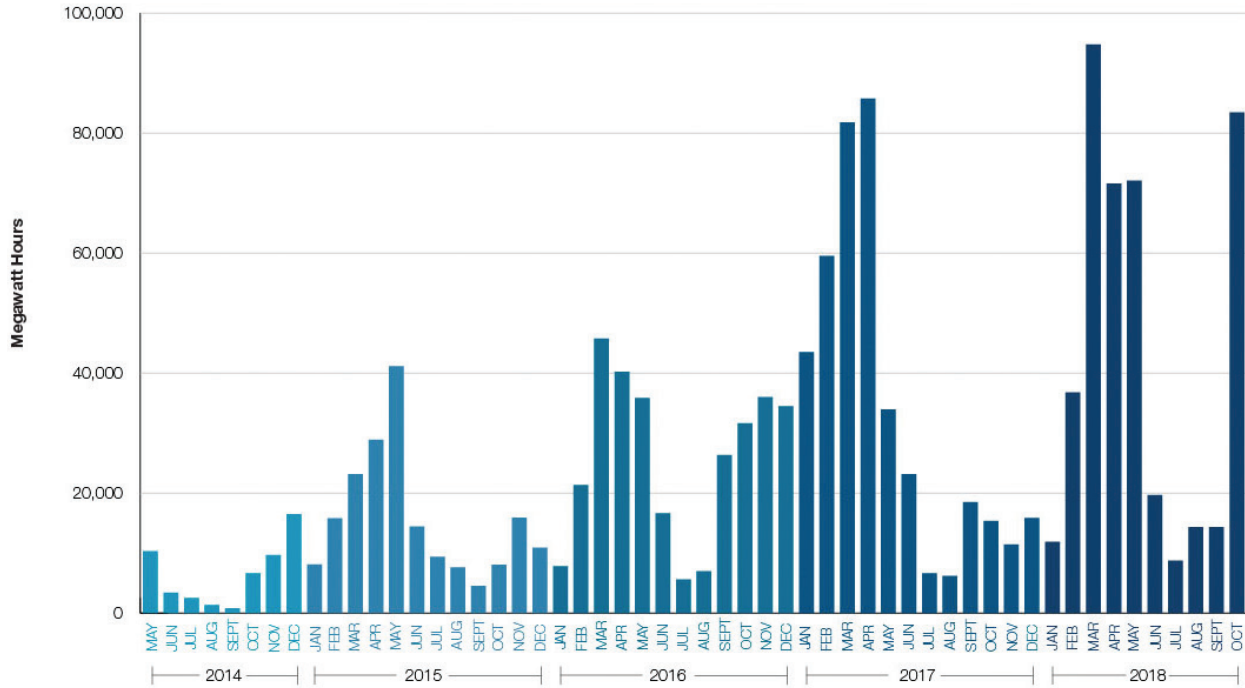
A central challenge is that pumped

storage requires a long planning, design and construction process to comply with state and federal environmental laws, obtain licensing from the Federal Energy and Regulatory Commission, and design and construct facilities. In fact, all of that can take years, which is why action is necessary now to ensure pumped storage projects are on-line before curtailment becomes a major cost and impediment to meeting state climate mandates.

What’s becoming clear through academic and agency reports is that California should incentivize private-sector investments and public-private partnerships; remove regulatory bottlenecks; aggressively study the future demands on the state’s rapidly evolving energy grid; and identify early projects that can be activated to provide examples for future pumped storage projects.

“With incentives, practical experience, and real projects moving ahead in the 2020s, the private market will follow along and build more projects as needed,” wrote Victor, et al. “That practical experience can also guide additional reforms in policy that will be needed as the California grid continues to move toward increased renewables.”

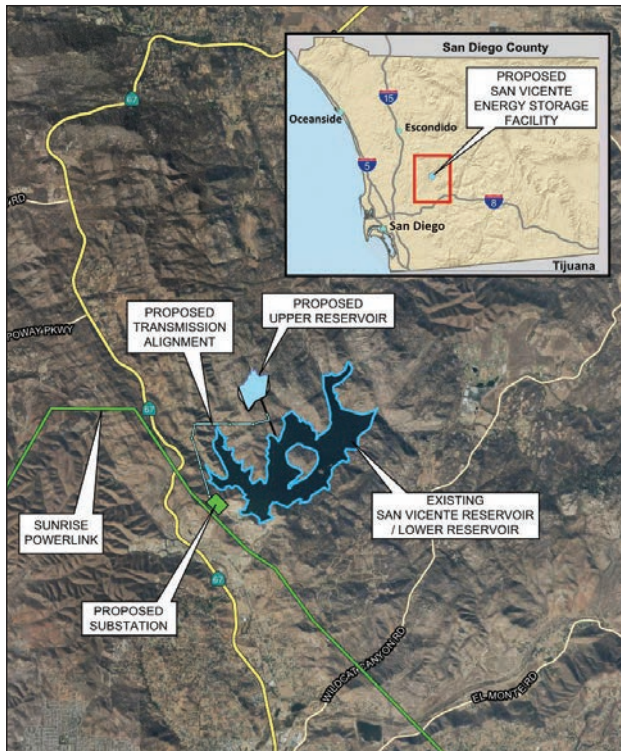
Once state regulators establish and support the long-term benefit of bulk storage, public agencies in key locations will be well-positioned to develop pumped storage projects. Using reservoirs that are in place greatly reduces



Renewable curtailments increase since 2014.

development costs and environmental impacts, potentially providing agencies with a revenue stream to offset upward pressures on water rates.

The City of San Diego and the San Diego County Water Authority have partnered to pursue one such opportunity —



Proposed San Vicente Energy Storage Facility.

a 500-megawatt project that could provide up to eight hours of stored clean energy to the San Diego region. The City and Water Authority jointly own 247,000 acre-feet of storage in San Vicente Reservoir, which would serve as the lower reservoir for this pumped storage project.

New project facilities would include a small upper reservoir, a pump house, penstocks and local transmission lines to deliver power to the regional grid a few miles away.

The City and the Water Authority have a FERC preliminary permit, and they are working on a project development agreement with a private developer. However, such arrangements are complex for a variety of reasons, not the least of which is the need for agencies to ensure that water quality and reliability are not jeopardized by pumped storage operations and facilities.

Policymakers at the project level also need to determine how much risk is right for their ratepayers, decisions that will shape any project development agreements with private companies. Unique risks at each site involve financing, land acquisition, environmental issues and construction. Through development agreements, risks can be mitigated or shifted to private sector partners that may be better positioned financially and politically to shoulder those risks.

Particularly at the starting point for large-scale pumped storage, projects will involve some manageable risks. But there's a greater risk of doing nothing. Without a coordinated effort involving legislators, regulators and public agencies to induce smart pumped storage projects, California likely will remain tied to carbon-based energy sources much longer than necessary. 💧



Gary Bousquet is deputy director of engineering for the San Diego County Water Authority.



Mike Lee is a public affairs supervisor for the agency.