Climate Change Effects on Hydropower Generation

OVERVIEW

The effects of climate change have the potential to alter the streamflow and runoff patterns which govern the ability of hydropower to provide flexible, low-carbon electricity generation and grid reliability services. In this study, we assess changes in hydropower reservoir behavior and hydropower participation in the electricity system to determine what shifting climates imply for the role of hydropower in the future electricity system in California.

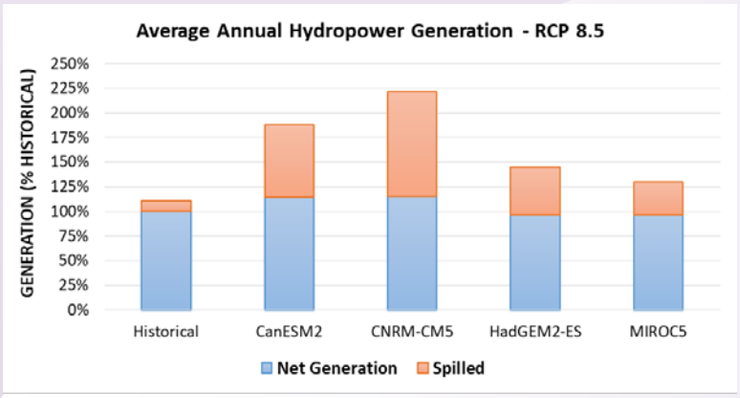
GOALS

1. Characterize the effects of climate change on hydropower system electricity generation and dispatch.

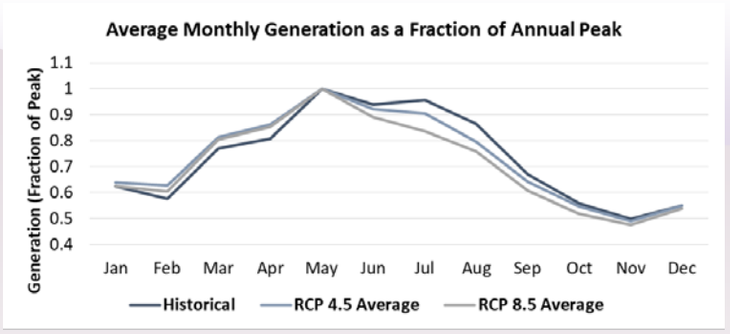
2. Characterize the effects of climate change on hydropower system provision of grid ancillary services.

RESULTS

Results indicate that under climate change in California, increased precipitation and runoff in the northern part of the state increases the overall availability of water for hydropower generation. Due to rising temperatures, however, a larger fraction of this precipitation falls as liquid rain rather than snow and immediately contributes to river systems. Coupled with increased storm intensity, this causes streamflow to occur in intense bursts which can overfill hydropower reservoirs and cause releases to prevent dam failure. Spilled water does not contribute to hydropower generation, therefore while additional water is available for potential generation, the increase in spillage limits the extent to which hydropower generation is increased. Net generation, therefore, is only slightly increased in the wetter projections and slightly decreased in the drier models. The change in streamflow timing also shifts the peak of hydropower generation to earlier in the year, imposing difficulty for managing water resources for the summer months.



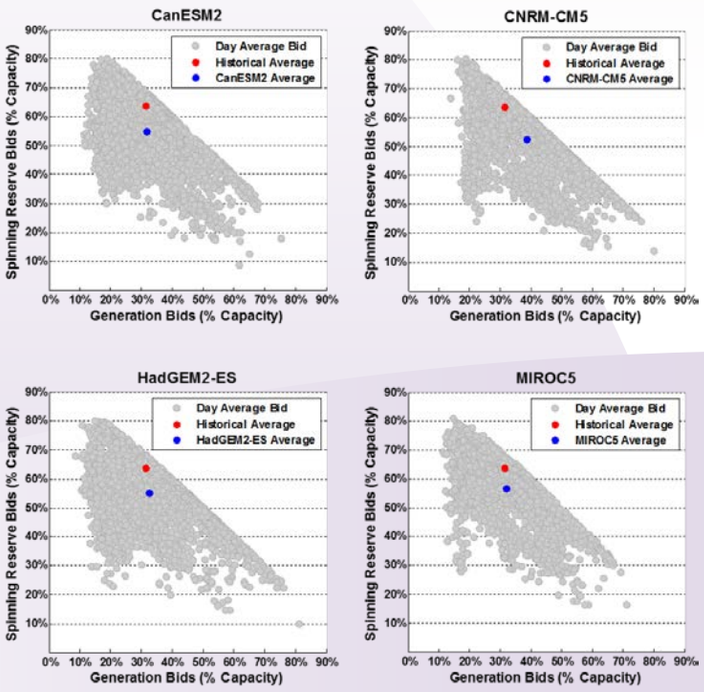
Hydropower Generation: Historical vs. Climate Change for the RCP 8.5 Climate Scenario



Monthly Distribution of Hydropower Generation Under Climate Change for RCP 4.5 and RCP 8.5 Climate Scenarios

RESULTS (continued)

It was also discovered that under climate change, hydropower reservoirs are likely to provide a lower amount of spinning reserve services for the electricity system regardless of whether more or less water is available. In the wetter cases, bidding to provide generation is more valuable than spinning reserve. In the drier cases, periods of low reservoir levels limit the ability of hydropower reservoirs to bid high capacity amounts into the electricity markets.



Hydropower Spinning Reserve & Generation Bids Under Climate Change using 4 Different Climate Models

PERSONNEL

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