Energy and Water: Water-Related Impacts of Concentrating Solar Power (CSP)

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Project Description

Water is a critical commodity, and its use is an important factor to consider when evaluating large industrial systems such as power plants. Current water analyses of electricity-generating technologies typically focus on aggregate quantity measures (e.g., gallons/kWh), which can mask important attributes of water (e.g., seasonal changes in water use, water quality requirements) that can vary across these technologies. In this research, we collect and analyze existing water-related data on concentrating solar power (CSP) technologies, focusing on measured/actual data from CSP plants. Our results, although preliminary and based on limited data, do point to some significant seasonal variations in overall water use, and varying water quality requirements across plant components. Given the potential policy relevance, we propose further studies focusing on expanded data collection.

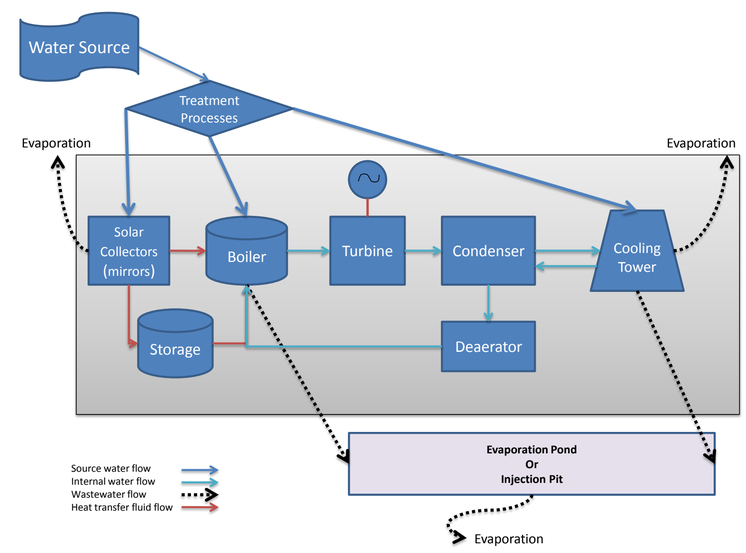

Figure 1. Simplified schematic of a CSP system and the water flows to, within, and out of the system.

Findings to Date

We find water use at CSP facilities (figure 1) to be more complex than what can be conveyed in annual averages. Water use at CSP facilities varies seasonally and correlates well with generation: both peak in the summer (figure 2). This can exacerbate water availability issues, as water is generally more scarce in the summer. Wastewater flows also show significant seasonal variability (figure 3). Different levels of water quality were identified for different processes (figure 4), laying the foundation for targeting opportunities for water use mitigation. Finally, water use varied significantly by year (figure 5), raising questions about the accuracy of annual estimates of water use.

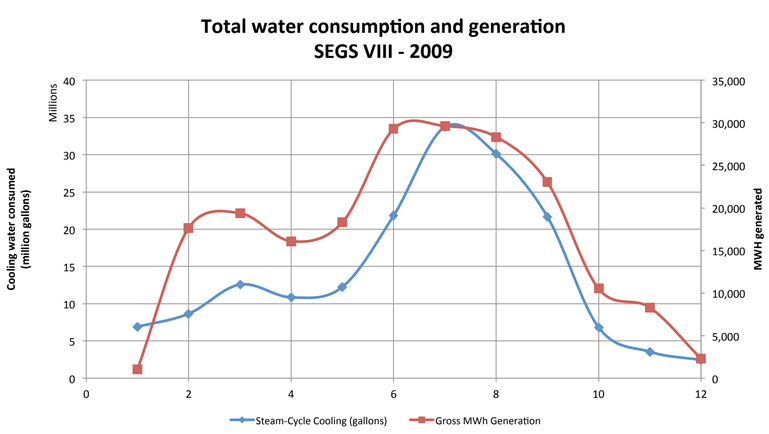

Figure 2. Monthly generation and cooling water requirements for SEGS VIII in 2009 (CEC, 2009).

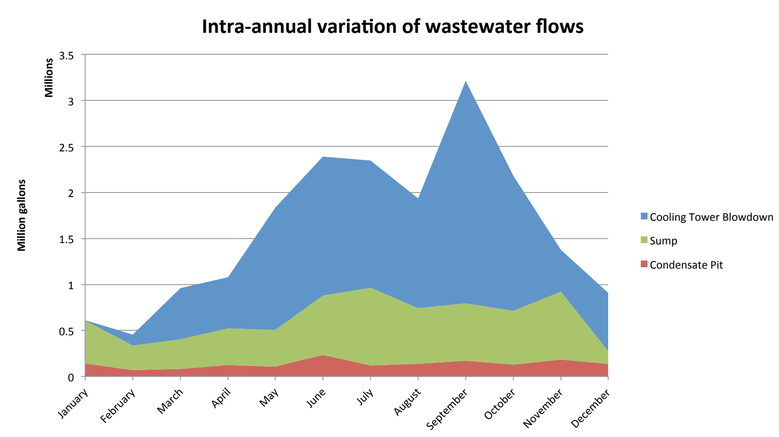

Figure 3. Monthly flow of wastewater at SEGS VIII in 2009 (Frier, 2011).

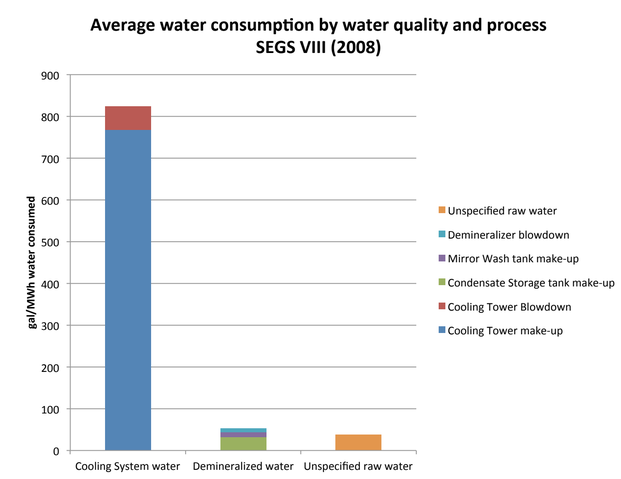

Figure 4. Average uses of water for operation of SEGS VIII facility (2008) by the quality of water required (CEC, 2009).

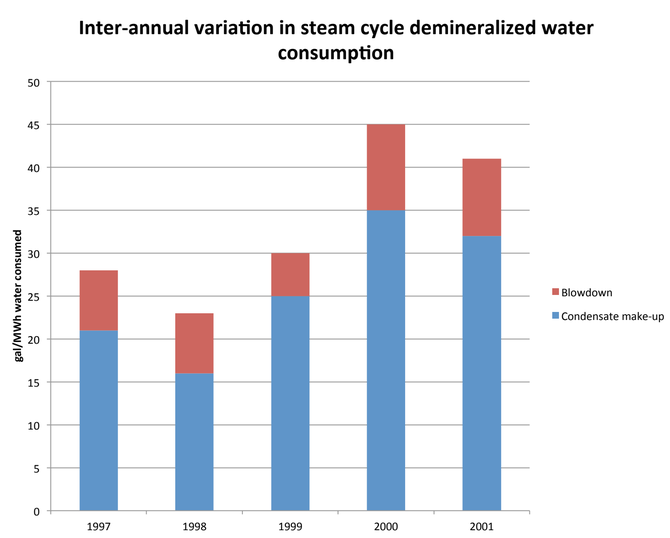

Figure 5. Average demineralized water consumption, in gallons per MWh, for the steam cycle processes at SEGS plants II-VII from 1997-2001 (Frier, 2011).

Conclusions and Next Steps

Decisions of permitting and siting facilities must consider water use impacts in the arid regions where CSP is likely to be deployed; more detailed water data is necessary to fully assess the potential water-related impacts of new energy developments, including CSP facilities.

As a next step, we propose an in-depth data collection effort at existing CSP facilities. This effort should include water quality measures (e.g., temperature, salinity), as well as detailed temporal water flow information.

References
CEC, 2009: *Quarterly Fuel and Energy Report (QFER) CEC-1304* California Energy Commission.
Frier, S. (ed.), 2011: *Personal Communication. Former SEGS Plant Manager*. May 10.

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