Agricultural Irrigation Pumping as a Grid Resource

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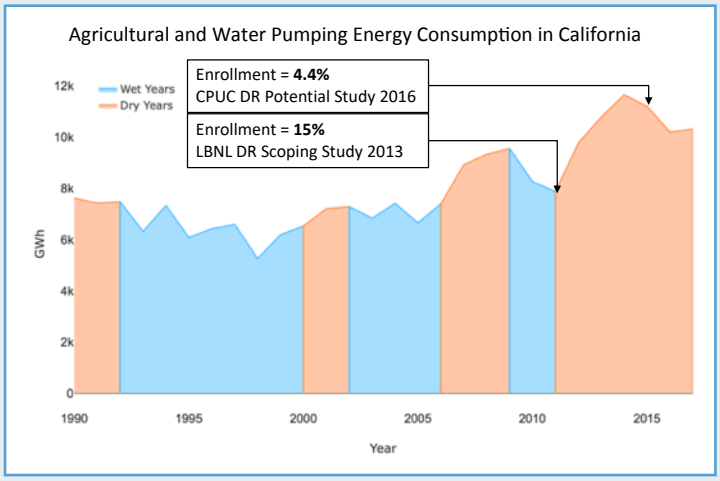
Motivation

California's electricity system is undergoing unprecedented changes. With higher penetration of intermittent renewable sources, the grid needs to deal with generation variability. Intra-hour variability and short-duration ramps are immediate challenges if we are to meet the state's goal of a 50% renewable grid. Agricultural irrigation pumping is a significant component of California's electric demand and a resource that can provide Demand Response (DR) services to the grid.

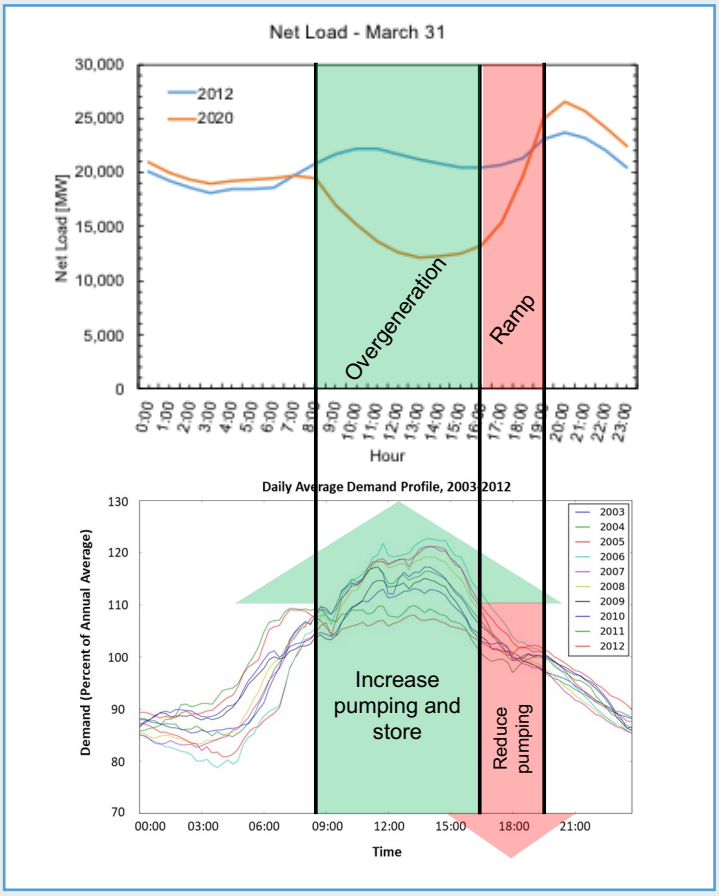
Agricultural irrigation has the potential to add 3GWh of shift resources (double the energy storage mandate for 2020), and 1.2GW of shed capacity (60% of existing existing retail DR procured by California investor owned utilities).

Technological Challenges

Most agricultural irrigation systems operate in a manual or semi-automated fashion which require long notification periods in order to participate in DR programs. This along with challenges such as lack of communications, manual controls, and farm operational limitations (irrigation capacity, water delivery schedules, and labor) has led to low participation in DR programs by agricultural customers (Olsen 2015).



Agricultural Energy Use in California has been steadily growing, with extended drought periods exacerbating the problem. However, Agricultural DR enrollment has been declining.



Agricultural irrigation pumping can shift its pumping load to mid-day hours utilizing solar overgeneration during the day and lessening the steep evening ramp up.

Research

Irrigation planning for providing grid services requires advanced planning, higher levels of automation, and low latency telemetry. To make agricultural DR a reality, an irrigation Decision Support Systems (DSS) needs to be developed. The DSS's primary objective would be irrigation scheduling while facilitating load control automation, improved DR program participation and customer cost optimization under available electricity tariff structures.

Alstone, P., et. al., 2025 California Demand Response Potential Study - Charting California's Demand Response Future: Final Report on Phase 2 Results. 2017. LBNL-2001113.
Olsen, D., et. al., Opportunities for Automated Demand Response in California Agricultural Irrigation. 2015. LBNL-1003786
California Energy Commission, Mid Case Revised Demand Forecast - February 21, 2018
California Public Utilities Commission, Order Instituting Rulemaking Pursuant to Assembly Bill 2514 to Consider the Adoption of Procurement Targets for Viable and Cost-Effective Energy Storage Systems. Filed December 16, 2010

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