

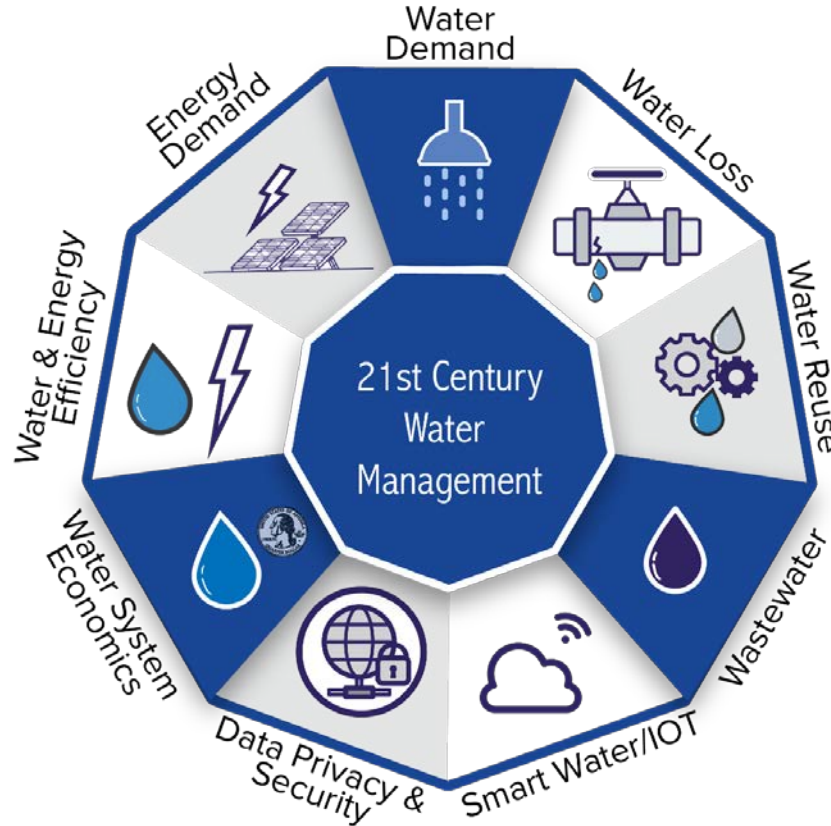
Opportunities for Energy Efficiency and Demand Management in Agriculture

Frank Loge

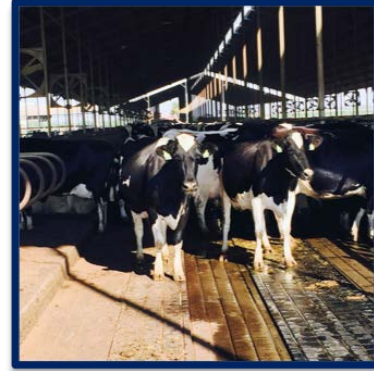
Director, Center for Water-Energy Efficiency
Professor, Civil and Environmental Engineering
University of California, Davis



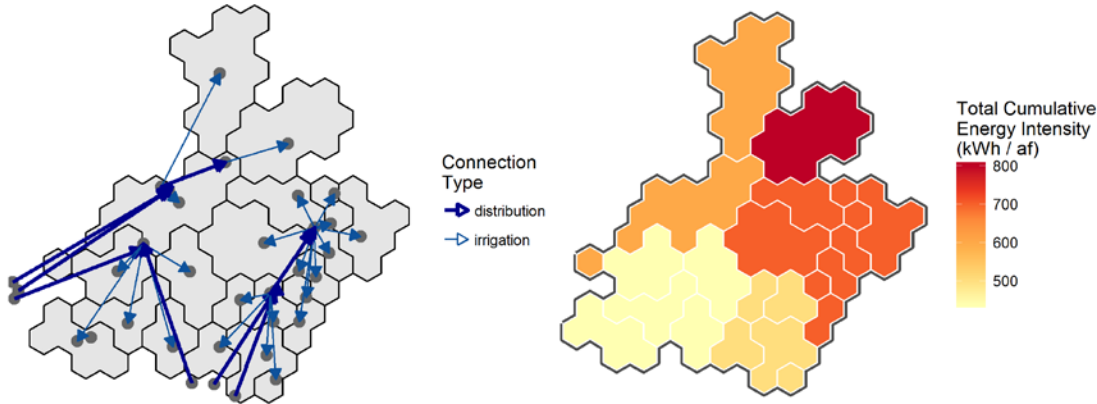
Center for Water-Energy Efficiency



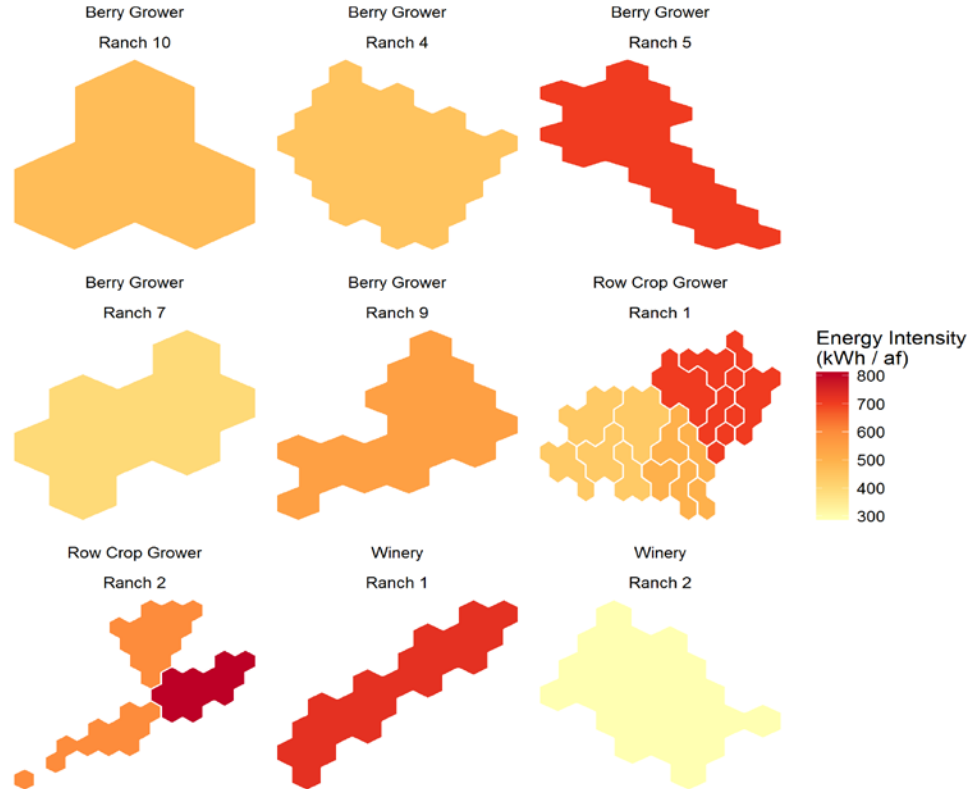
Farm Sites in Research Study



Farm Energy Intensity Map

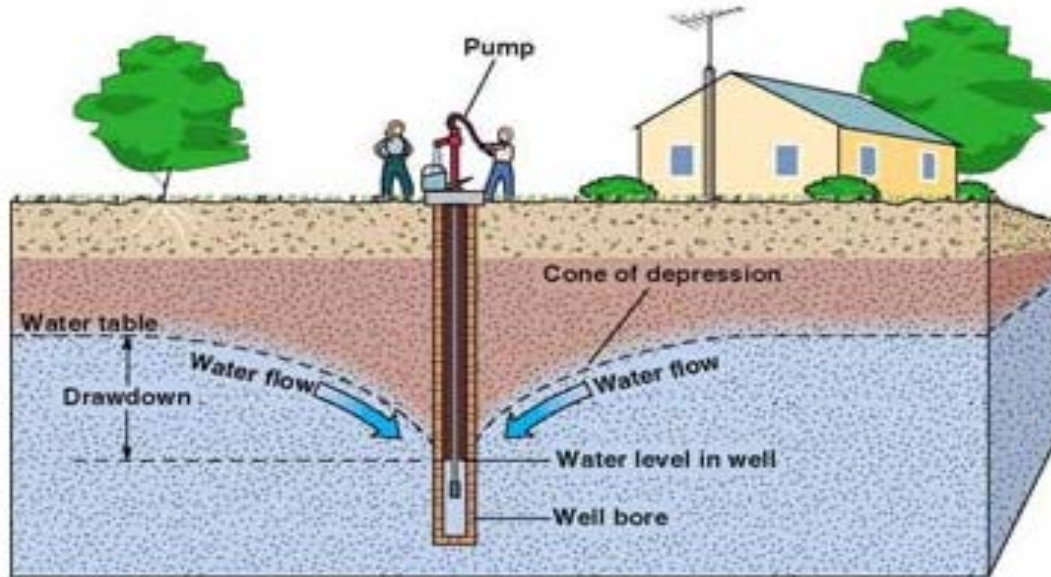


Cumulative Energy Intensity Results for Individual Ranches



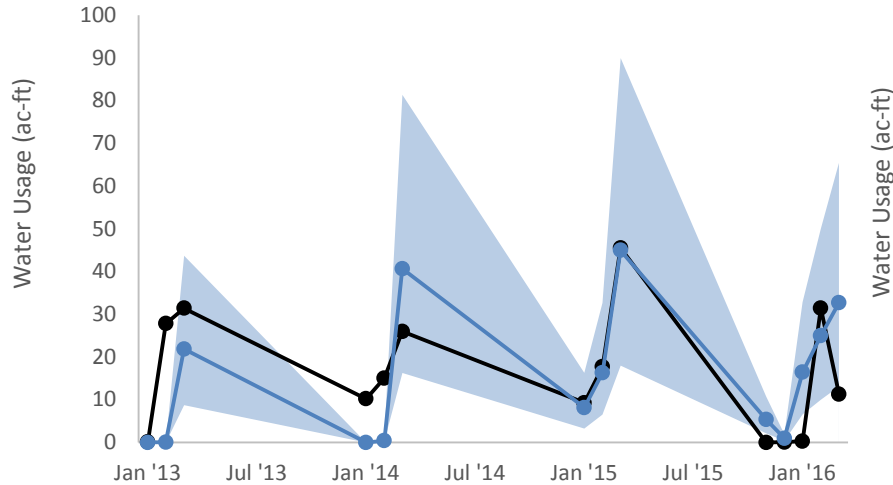
Method of Calculating Quantity of Groundwater Pumped

$$\text{Water Use (ac - ft)} = \frac{\text{Energy Use (kWh)} \times \text{Pump Efficiency (\%)}}{1.024 \left(\frac{\text{kWh}}{(\text{ac - ft})\text{ft}} \right) \times \text{Depth (ft)}}$$

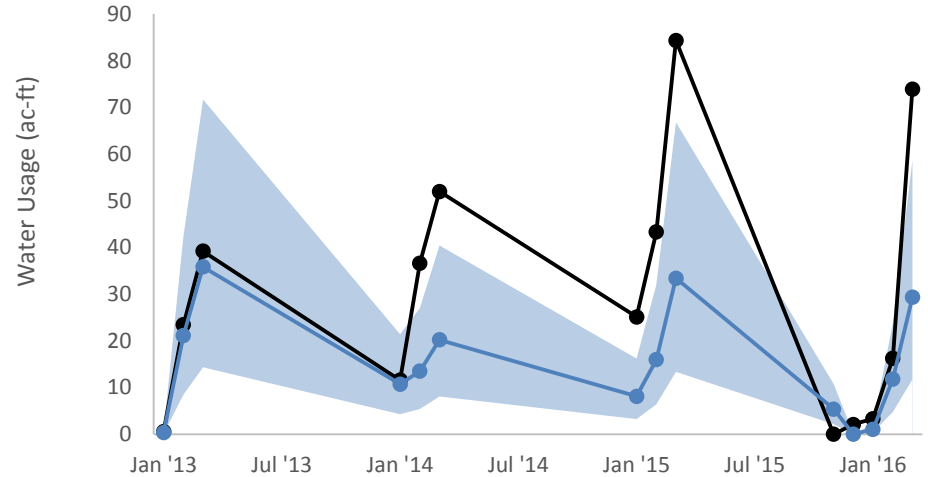


Water Use Estimates vs. Actual Water Use Data




Pump 3090



Pump 3080



Legend

-  Error Range
-  Given AF
-  CWEE Estimate

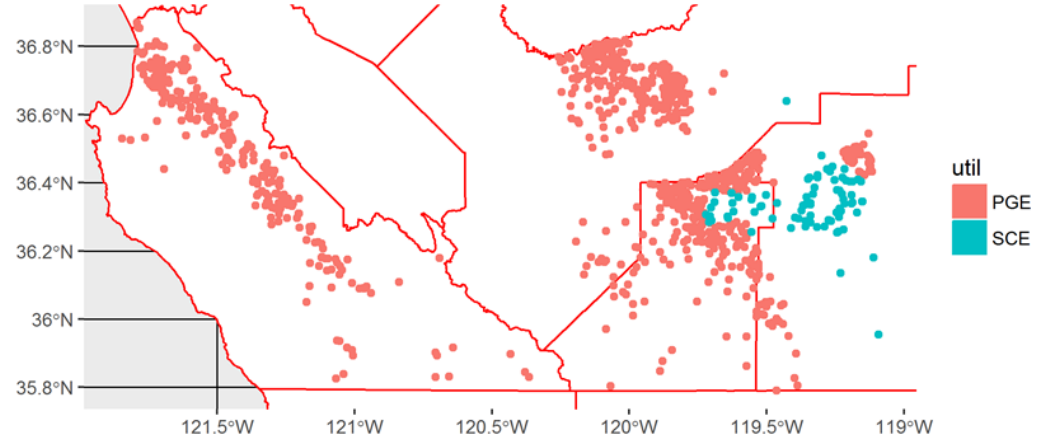
Agricultural Electricity

Agricultural Accounts

- PG&E ~ 13,300 meters
- SCE ~ 3,400 meters

In Total,

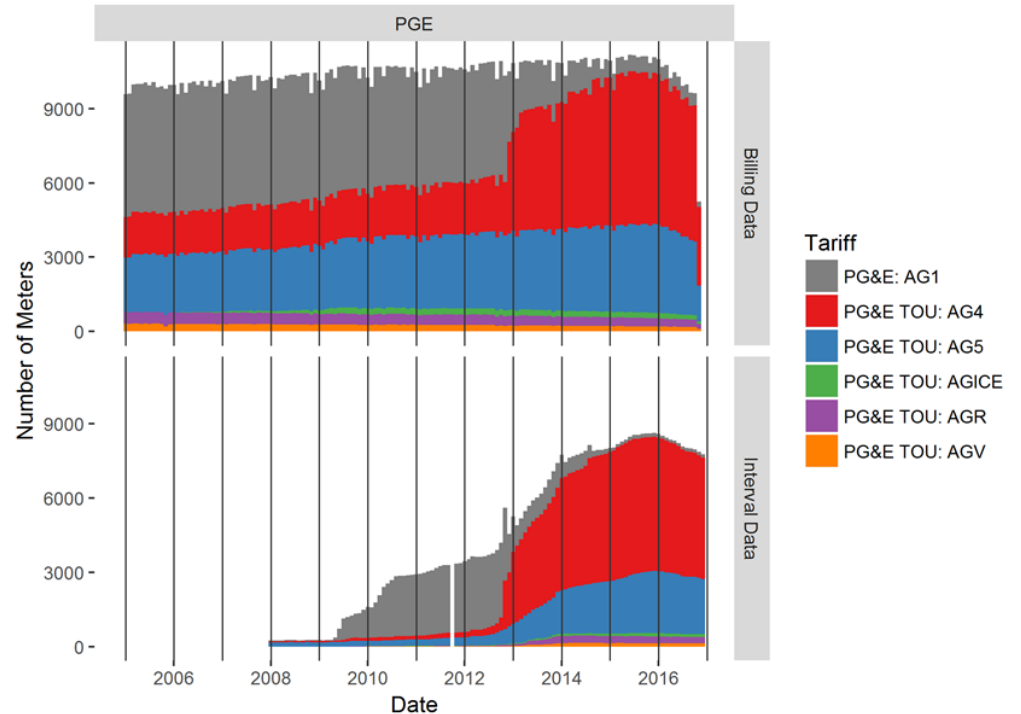
- ~ 1,900,000 billing records
- ~ 450,000,000 hourly kWh records



Ag Time-of-Use (TOU) Tariffs

Most Ag customers are now on TOU rate plans

Hourly interval data is increasingly available from smart meters

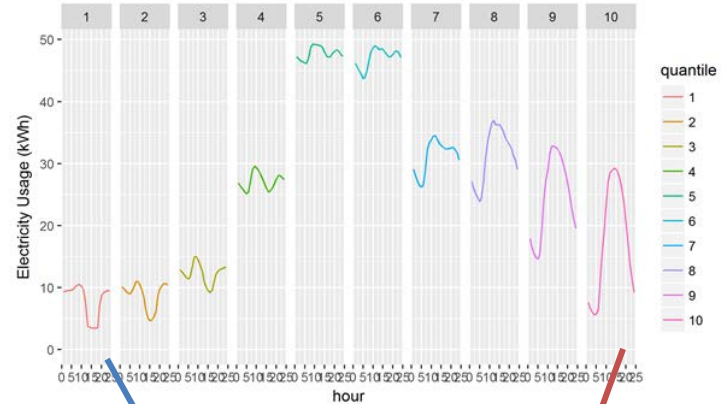


Demand Response

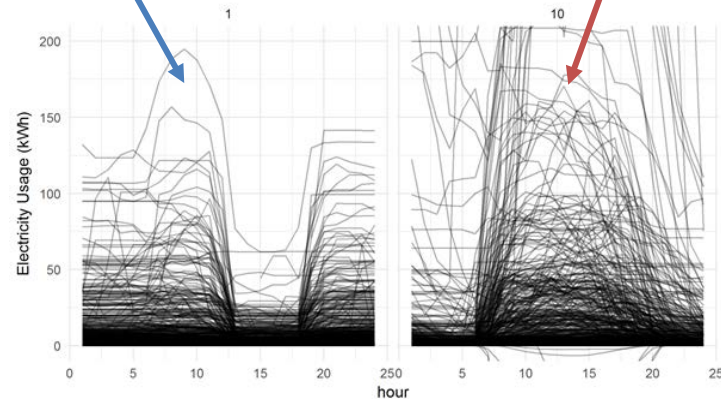
Ranked by average use pattern

responsive ←

→ not



Wide range of demand response behavior





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