Use of High Frequency Pump Monitoring to Reduce Energy Consumption

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Purpose/Objective(s):

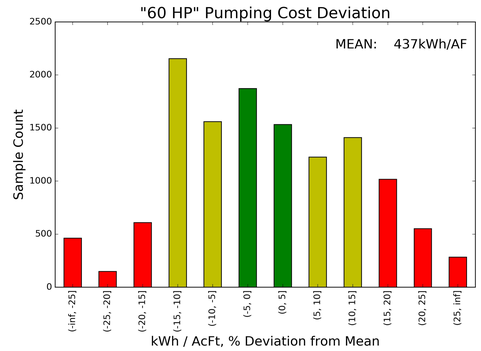
Increased reliance on groundwater has made pumping cost a significant factor in California agriculture. In addition,migrations towards highly interconnected irrigation networks and penetration of variable-frequency drives (VFDs) have increased the complexity of managing pumping cost. Our goal was to quantify true pumping cost by using high-frequency monitoring methods.

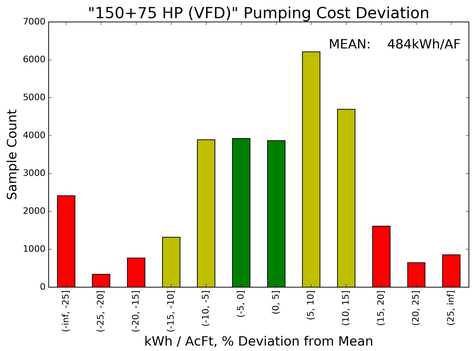
Materials/Methods:

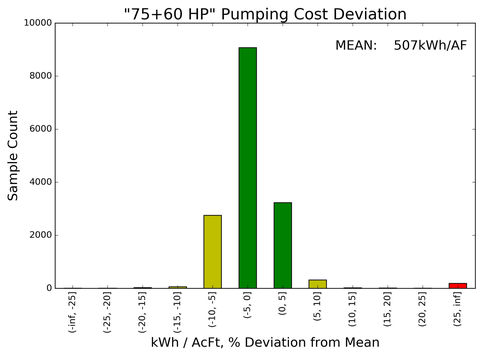
Pumpsight monitoring systems were installed on a number of pumps in the Central Valley and Northern California. The systems measured flow, pressure, energy consumption, and depth of the water in the well. Data was sampled at 5 minute intervals. Samples while the pump was inactive or with known sensor failures were removed from analysis.

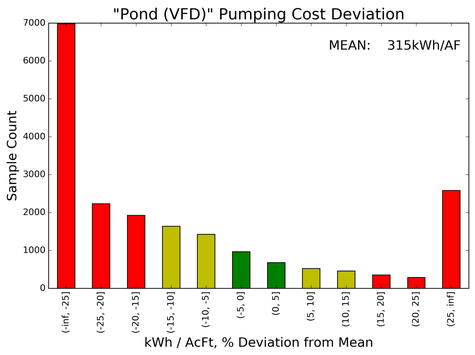
Results:

Most pumps showed significant deviation in pumping cost. Graphs below represent the distribution of pumping cost (as represented by kWh of electricity per acre-foot of water) for each pump.

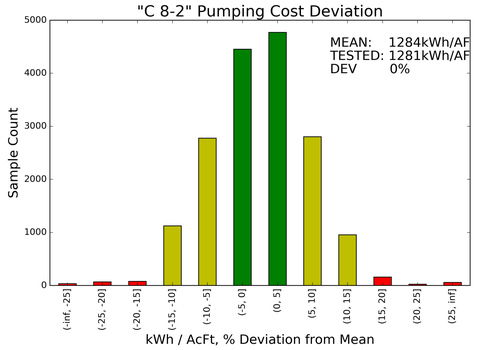


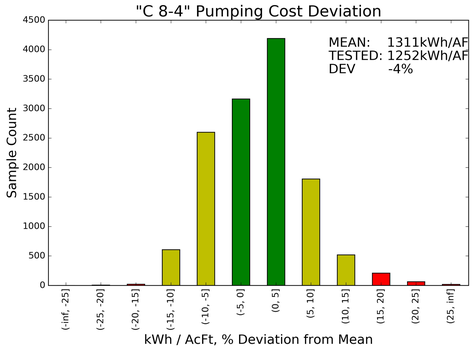






Four pumps connected on a single mainline in Northern California. The first two pumps show large deviation from the mean pumping cost, implying significant opportunities for optimization. The third pump (75+60 HP) is used only in particular situations to which it is well-suited. It has a very tight distribution around the mean pumping cost. The last pump (Pond) is used as a filler pump, but is not well-suited to the task. In addition, it has a pressure relief valve, which is often triggered by irrigation equipment failure, causing the pump to circulate water in the pond. This pump could see significant optimization in equipment and operation.

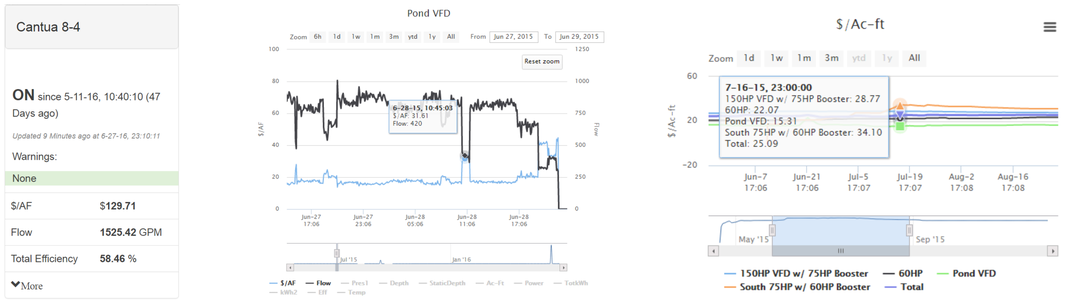




Two pumps (of four) connected on a single mainline in the Central Valley. These pumps are very tightly managed and are efficiency tested twice per year. Despite user vigilance, they see significant pumping cost deviation.

User Education:

Pumping cost histograms provide valuable long-term information on the performance of the pumping plant, but are difficult to use in the short term. Other types of data reports and graphs can provide more actionable data. Future work aims at providing immediately actionable alerts and suggestions to users to reduce pumping cost.



Examples of actionable user interfaces

Conclusions:

Pumping cost can vary significantly for even a single pump, especially if it is part of an interconnected pumping system. By using high-frequency measurements, users can obtain more accurate data about pumping cost. This, in turn, will lead to better optimization of pumping systems and lower pumping costs.

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