Irrigation Optimization and Well Pump Monitoring to Reduce Water and Energy Consumption

EPIC Showcase

December 3, 2015

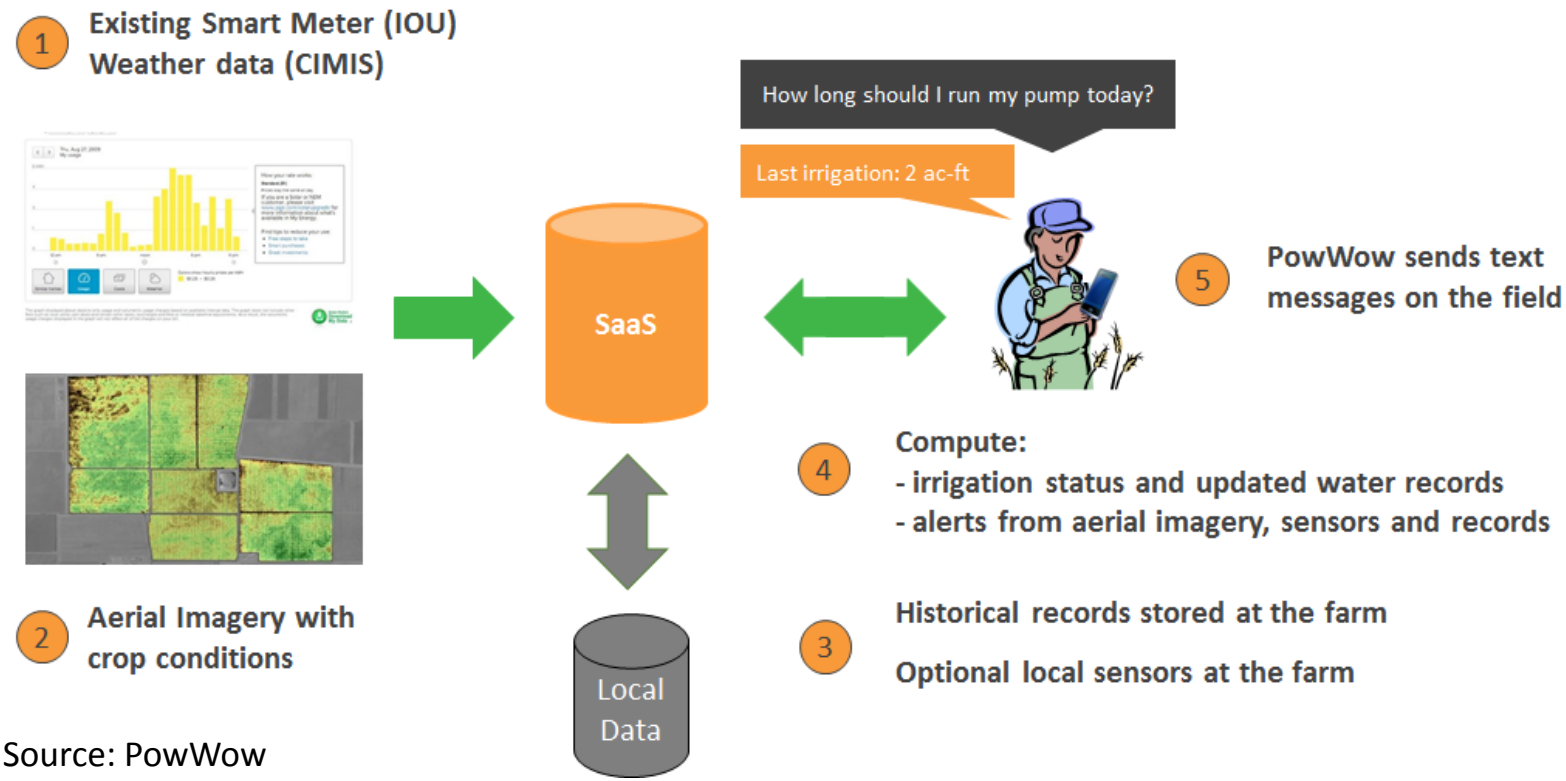
Collaborators: PowWow, UC Davis, and UCSB

Primary Investigator: Olivier Jerphagnon

Problem: dichotomy between grid and user

Solution: align intrinsic and extrinsic interest

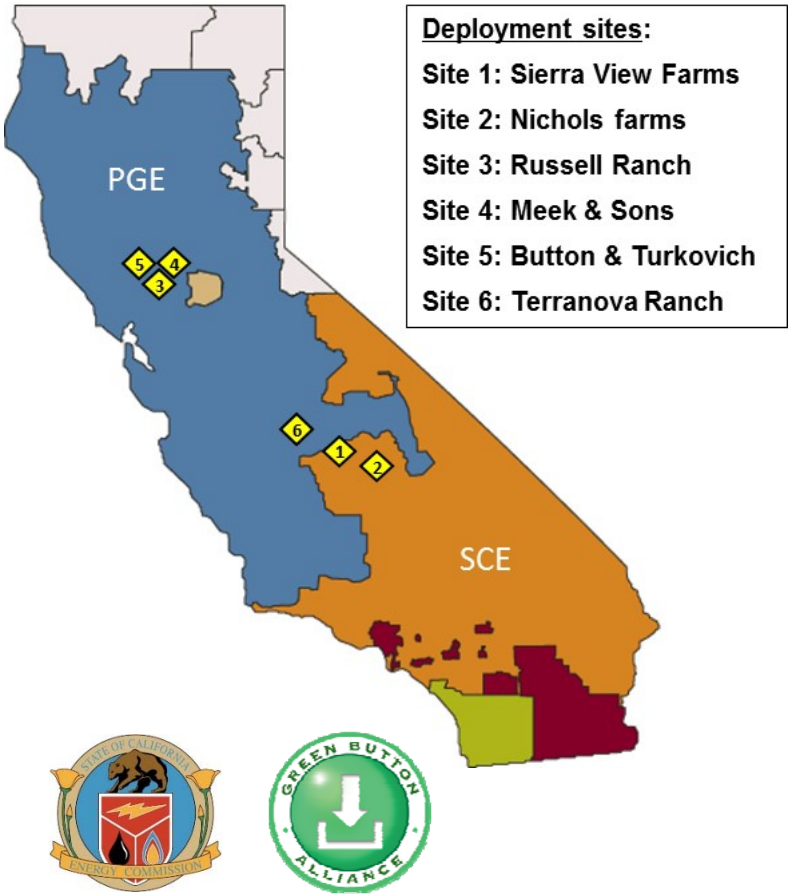
- Data analytics can turn data into valuable answers
- Present the information in the context of the daily activities of growers (goal orientation)



Source: PowWow

Project overview: July 2015 to Dec. 2017

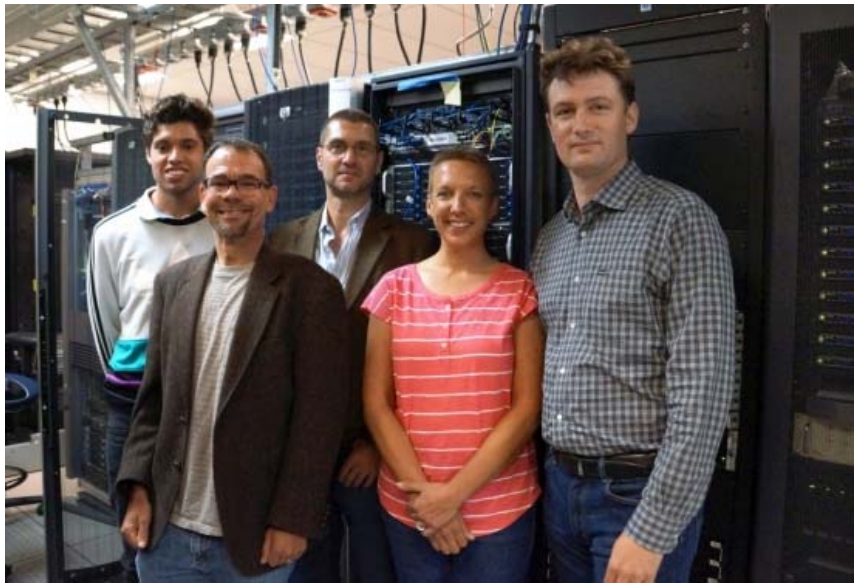
- **Technical tasks:**
  - Task 2: Water measurement*
  - Task 3: Irrigation models (ET, ET-SMM, and partial ET with RDI)
  - Task 4: Data integration
  - Task 5: Reduced irrigation SaaS**
  - Task 6: Deployment
  - Task 7: Measurement & Verification
- **Typical benefits:**
  - No up-front capital cost
  - Lower operational costs
  - Energy efficiency up by 20%
  - Water Use Efficiency up by 20% (water savings & yield improvement)



*, **: Critical Project Review

Project team: PowWow, UC Davis and UCSB

- PowWow: Olivier Jerphagnon (PI, Task 2), Stan Knutson (PM, Task 5), Jim Klingshirn (co-PI), Jason Worden, Justin Muncaster, and interns
- UCSB: Dr. Chandra Krintz (co-PI Task 4), Dr. Roland Geyer (co-PI Task 7), Dr. Richard Wolski, Dr. Bob Wilkinson, and graduate students
- UCD: Dr. Kate Scow (co-PI Task 6), Dr. Zaccaria (co-PI Task 3), Dr. Daoyuan Wang, Teresa Carillo-Cobo, Israel Herrera, and staff

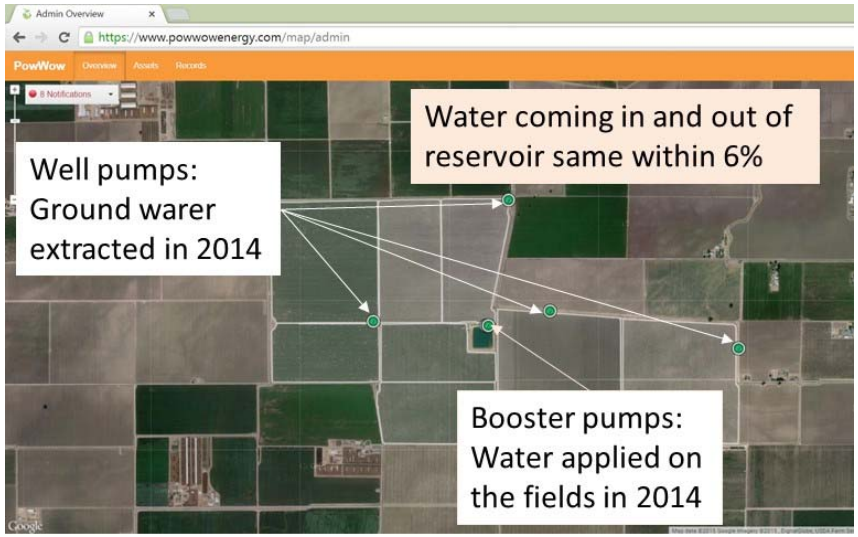


Source: Institute for Energy Efficiency at UCSB

Source: Russell Ranch at UC Davis

Challenge #1: measure water from energy *

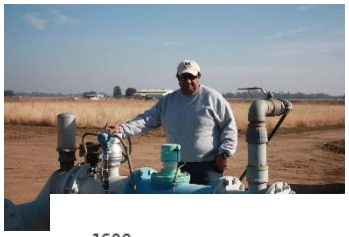
Single speed pumps

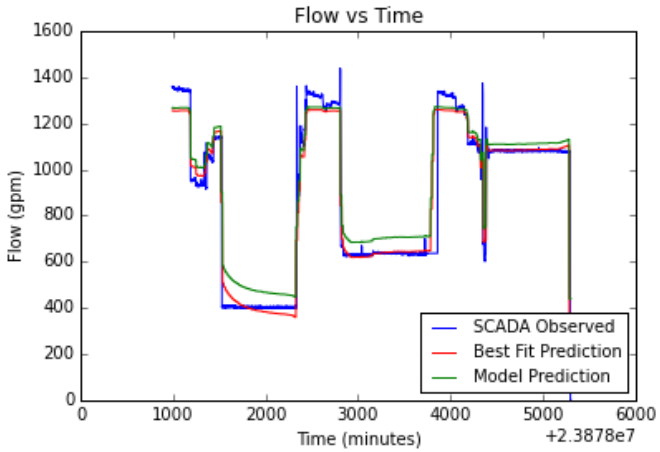


Source: PowWow

TAC feedback: gather more statistics on measurement accuracy (over 30 pumps)

Variable speed pumps (VFD)





Expanded method to VFD pumps (difficult)

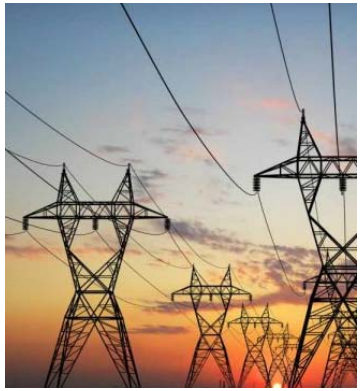
** patent pending: Anomaly detection and water measurement from pump energy data*

Challenge #2: flexible platform across crops *

- Energy data and aerial imagery allow us to close the loop

Socially responsible "feedback loop" to optimize crop

Utility grid



Pump

Energy usage
(water)

Variety of crops, irrigation systems, and on-farm sensors

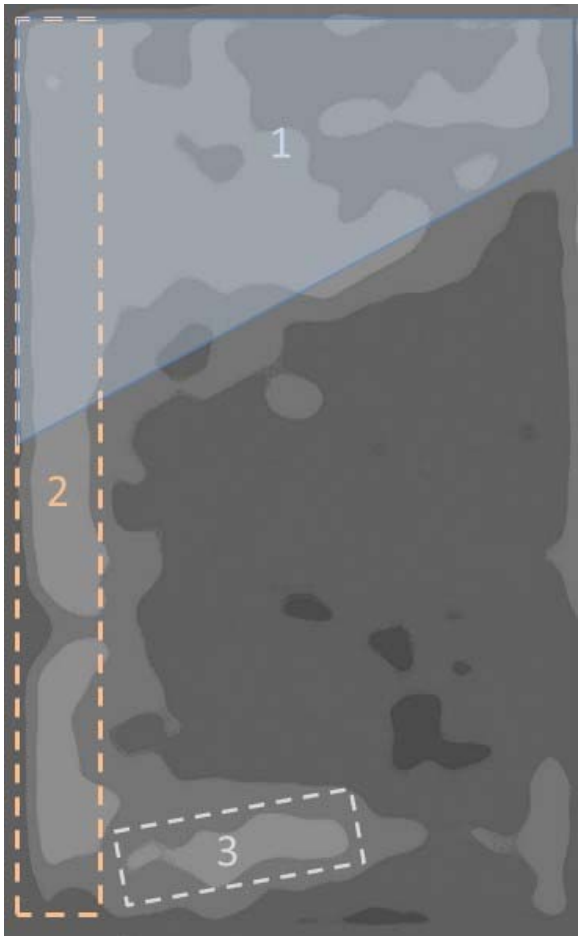
Farming practice

Plant health
(yield)

** patent pending: DU and other farming prescriptions from aerial imagery and energy data*

PowWow

Early result: data driven irrigation of almond



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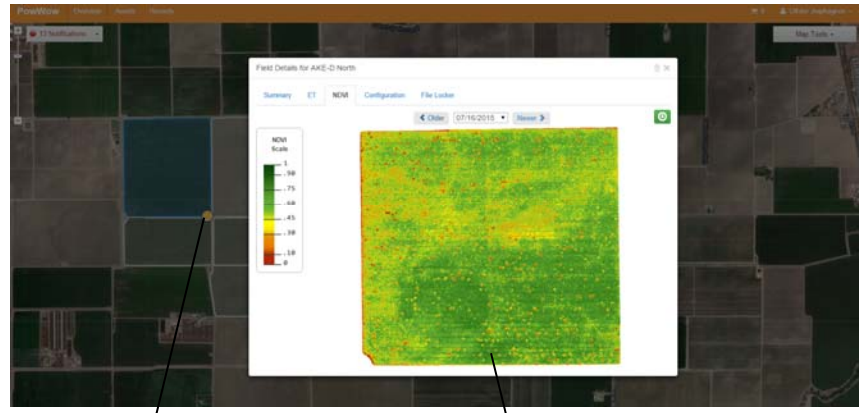
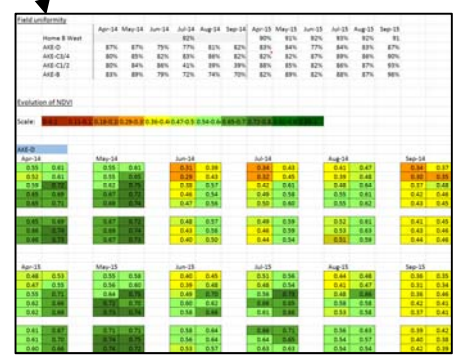


Report cards by email



Alerts on the field (falling water table, right booster settings, etc.)

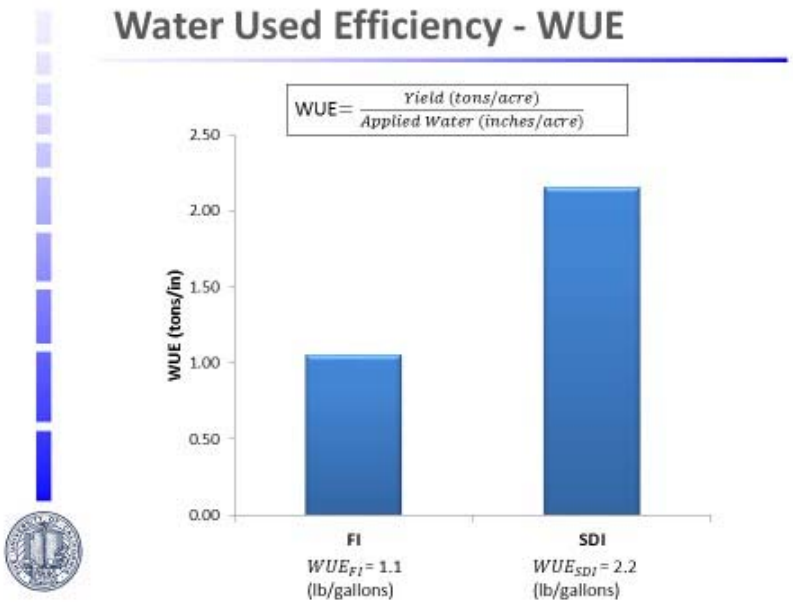
<u>Results for 2015</u>:
Energy efficiency up by 7%
Water use efficiency up by 6%
Lower operation costs (harvest) and yield up by 15%
(Next step is to use partial ET irrigation in 2016)

Site 2 (Tulare, CA)

Early result: water use efficiency for tomato

<u>Results for 2015</u>: water use efficiency (WUE) for 2 types of irrigation

Source: UC Davis



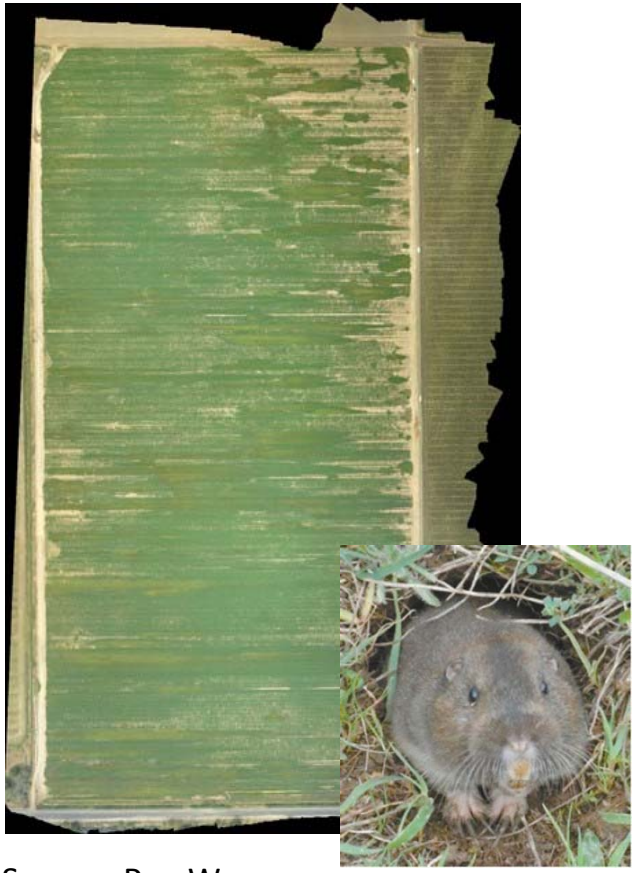
Source: UC Davis

<u>Plan for 2016</u>: comparison of ET and partial ET on 8-acre field. Drip lines are being installed as we speak. Planned outreach to growers (Field Day).

Site 3 (Davis, CA)

Early result: surface vs. ground water for alfalfa

Sub-drip irrigation: reality check



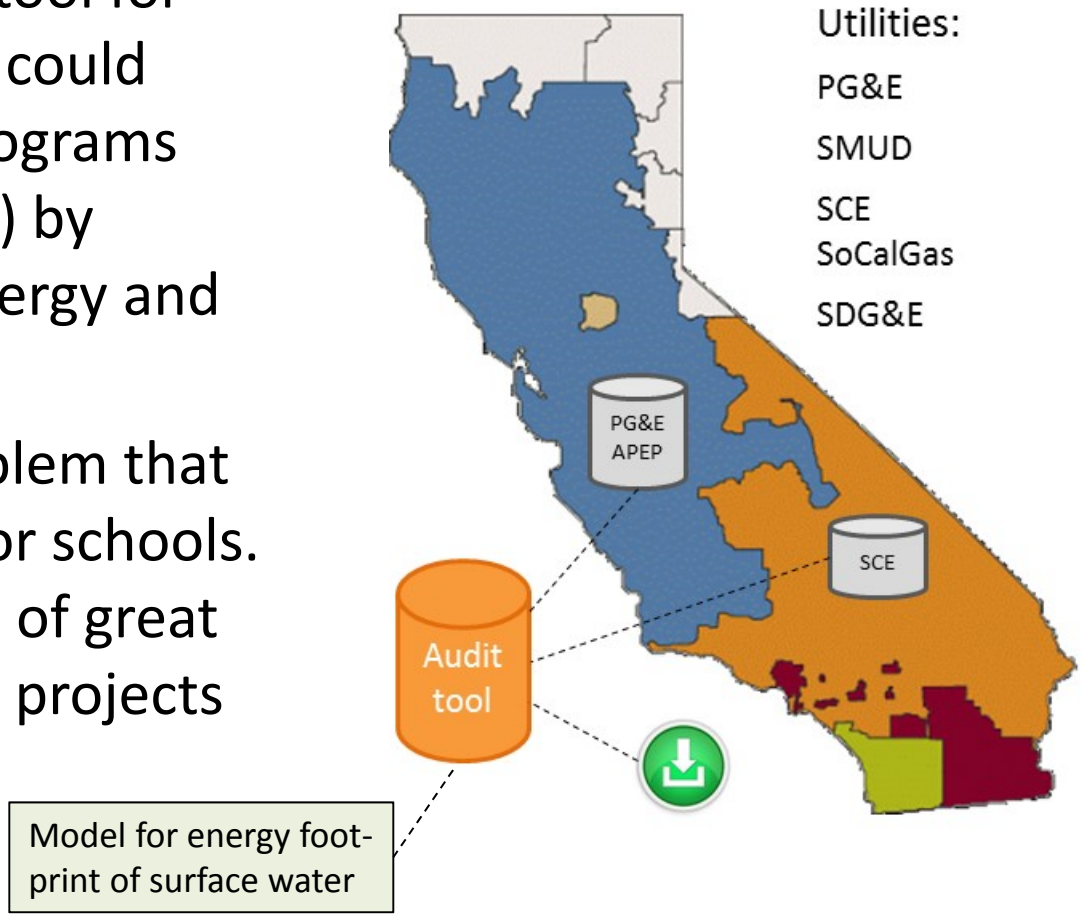
Source: PowWow

Switch to surface irrigation

(lower energy foot-print)

Source: Button & Turkovich

Site 5 (Winters, CA)

Idea for other project: energy and water audit

- Automated audit tool for energy and water could facilitate other programs (SWEEP, WET, etc.) by tracking actual energy and water savings
- Analogy with problem that Prop 39 created for schools. Green Button was of great help to accelerate projects