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NATIONAL CONFERENCE

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NEW ORLEANS

52 YEARS

2022 ASIC National Conference

Welcome to New Orleans!

Stacy Gardner, ASIC President

Bob Scott, Conference Chairman

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Energy Load Shifting in the Water Sector

Robert Good, Engineering Manager

Center for Water-Energy Efficiency,
University of California Davis

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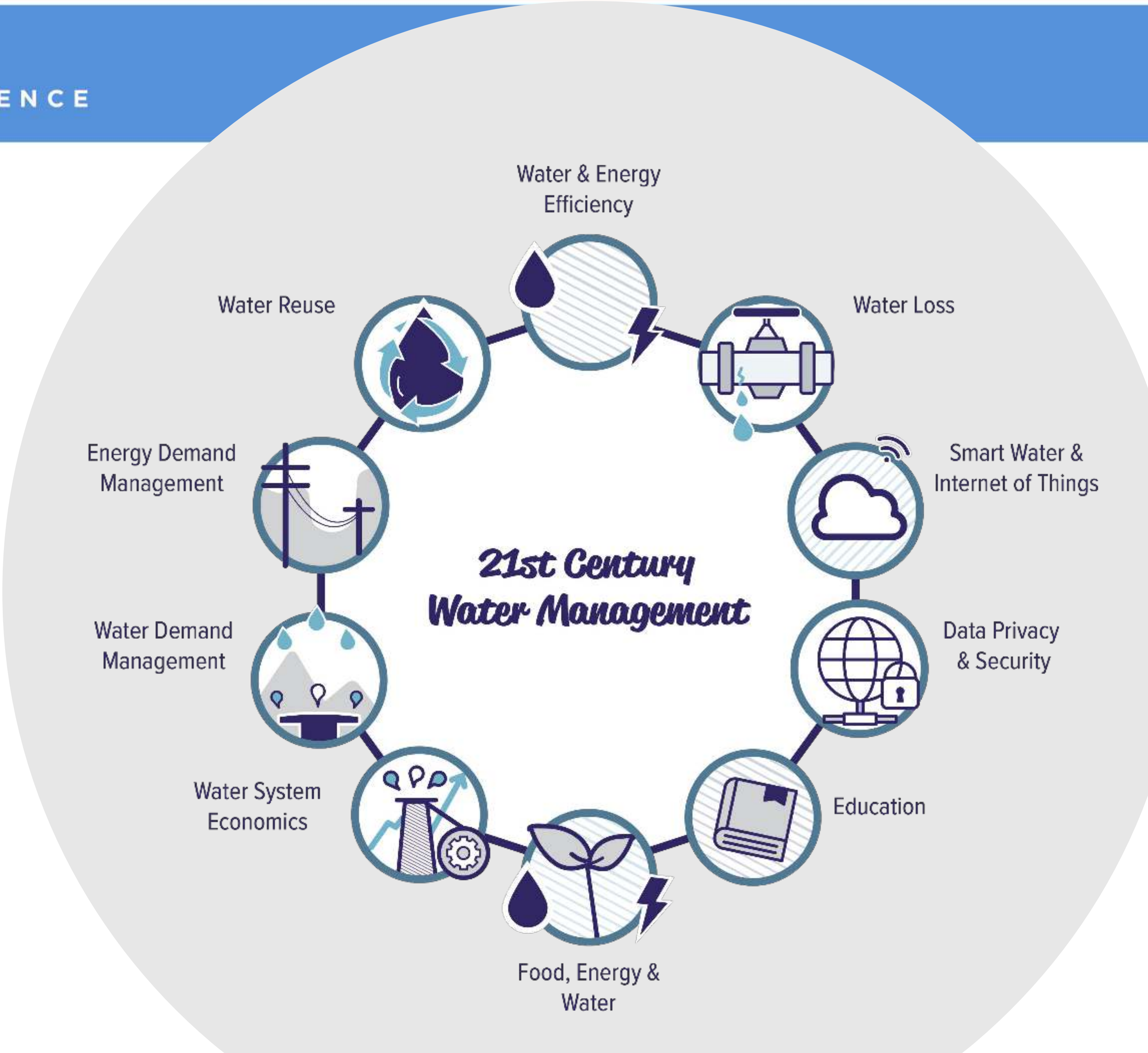
Our Mission

Advance water management solutions for the integrated savings of water and energy resources.

My Research Topics

Focused on developing new computer models and analytics to support the water and energy sector through real-time calculations or visualizations.



UC DAVIS

Center for Water-Energy Efficiency

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In pursuit of increased utilization of wind and solar power in California, we are challenged with using it when available.

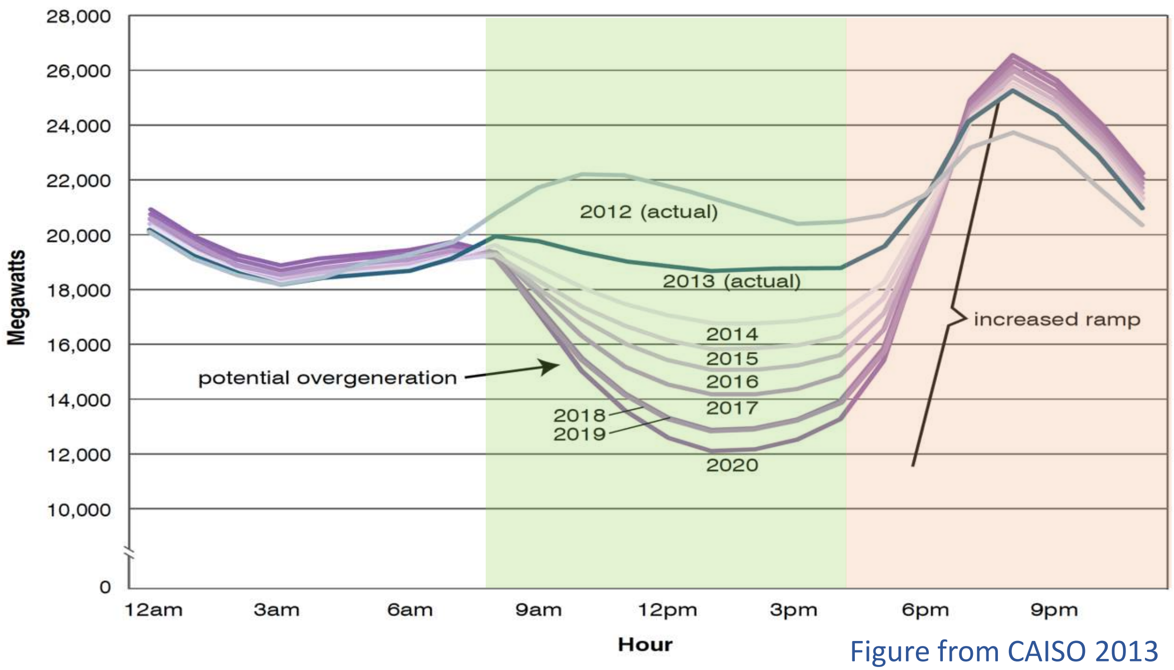


Figure from CAISO 2013

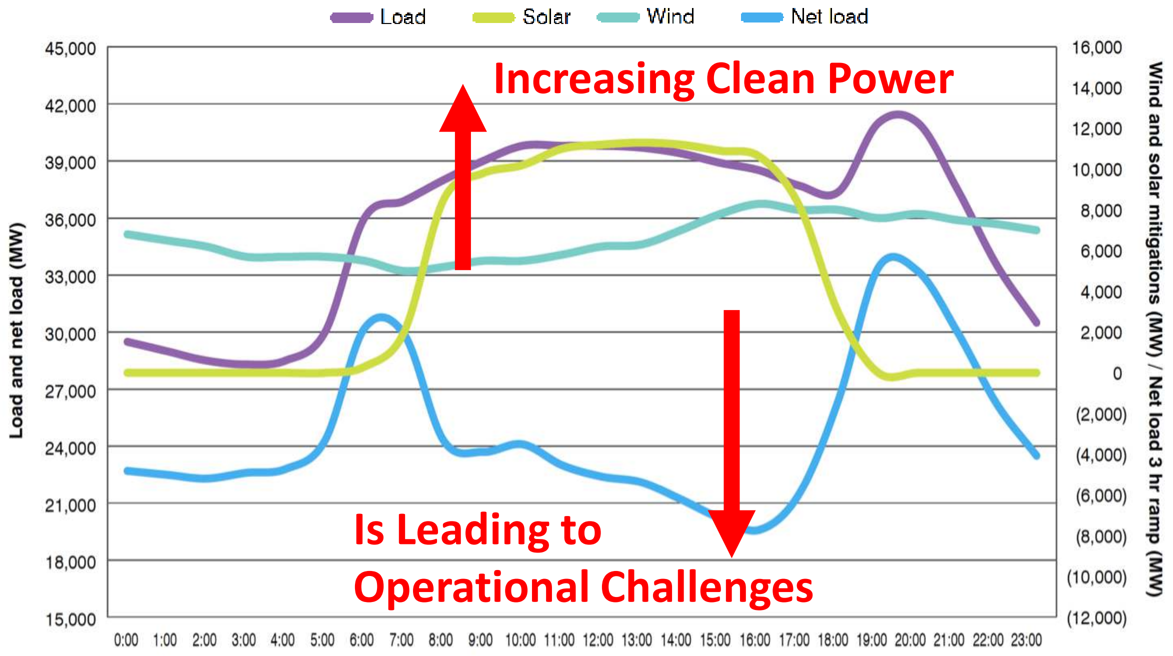
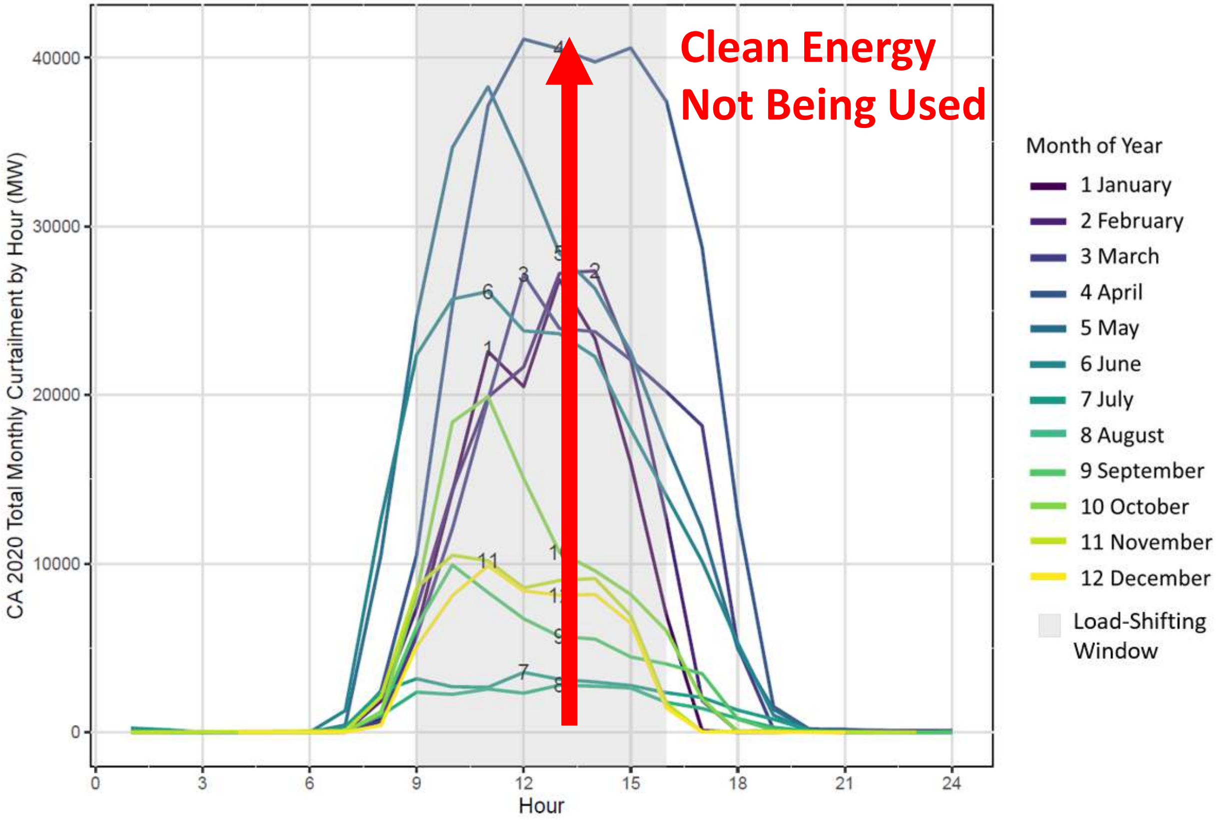
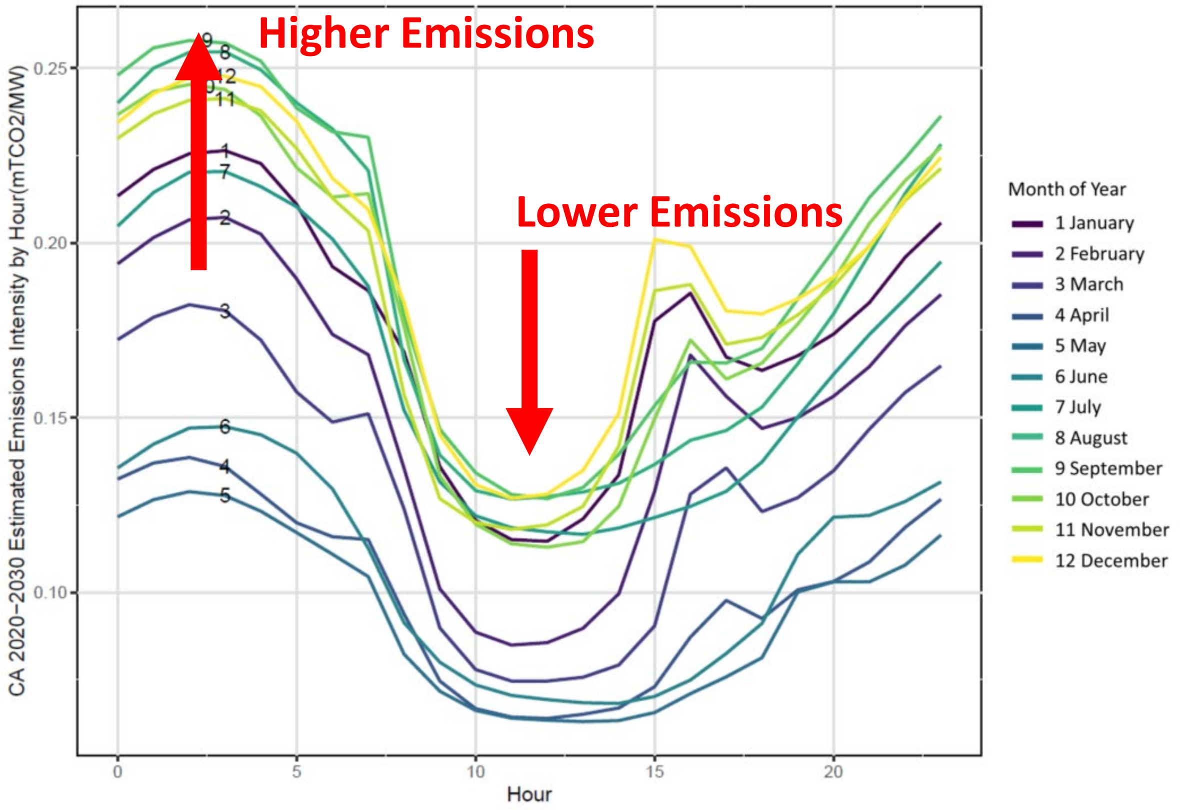


Figure from Clean Coalition 2013

Electricity that goes unused is often “curtailed” outside of California for cheap or *for a price*.

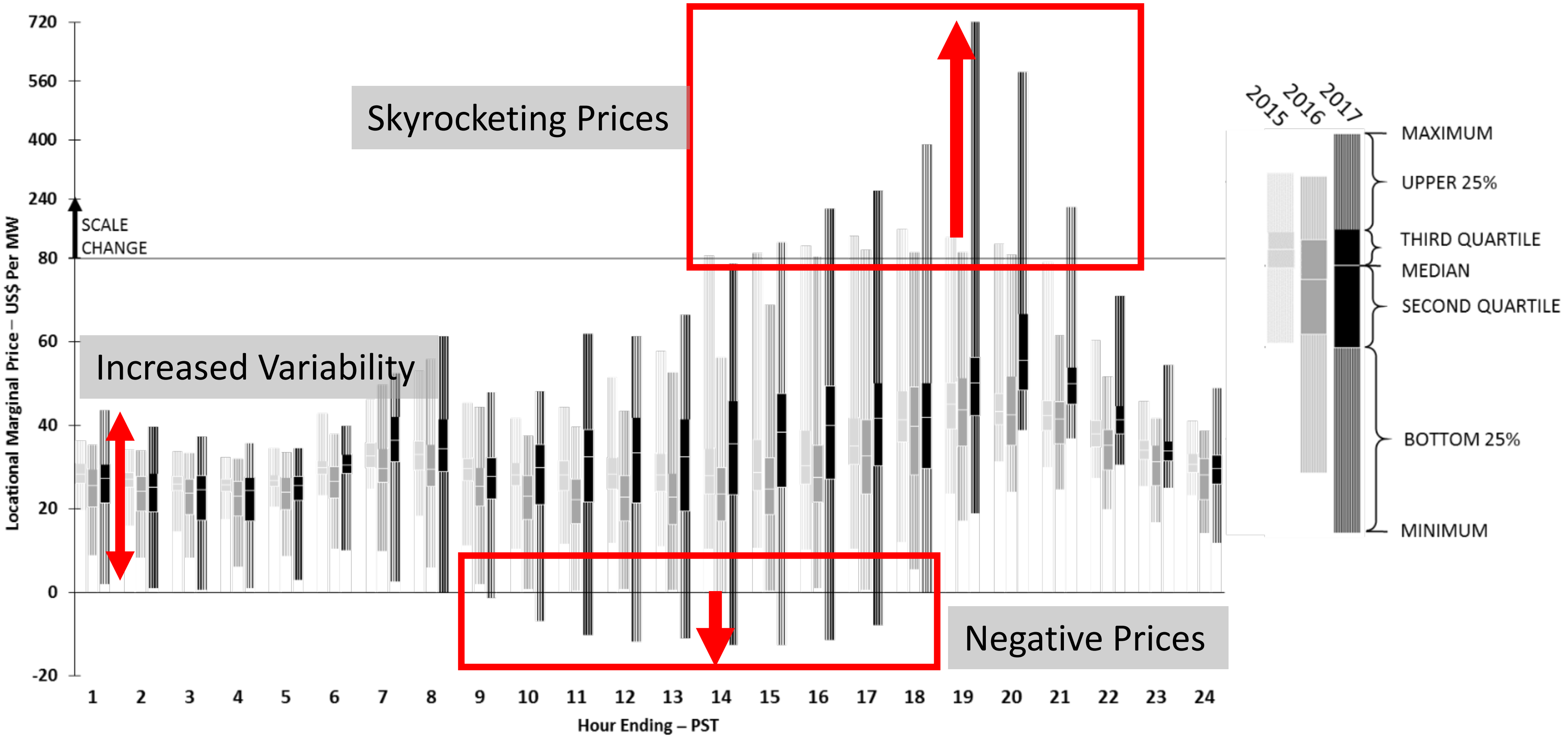


Energy Curtailed Outside of California in 2020, by Month



Average Hourly Emission Intensity to Supply Electricity

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy



Curtailment and solar generation have a direct – and large – impact on operating costs

Figure From: Good, R. (2018). "Reducing Electricity Grid Imbalances through Energy Demand Management of Water Delivery Infrastructure." Master's Thesis. March 9th 2018, University of California, Davis.

The U.S. Department of Energy predicts:

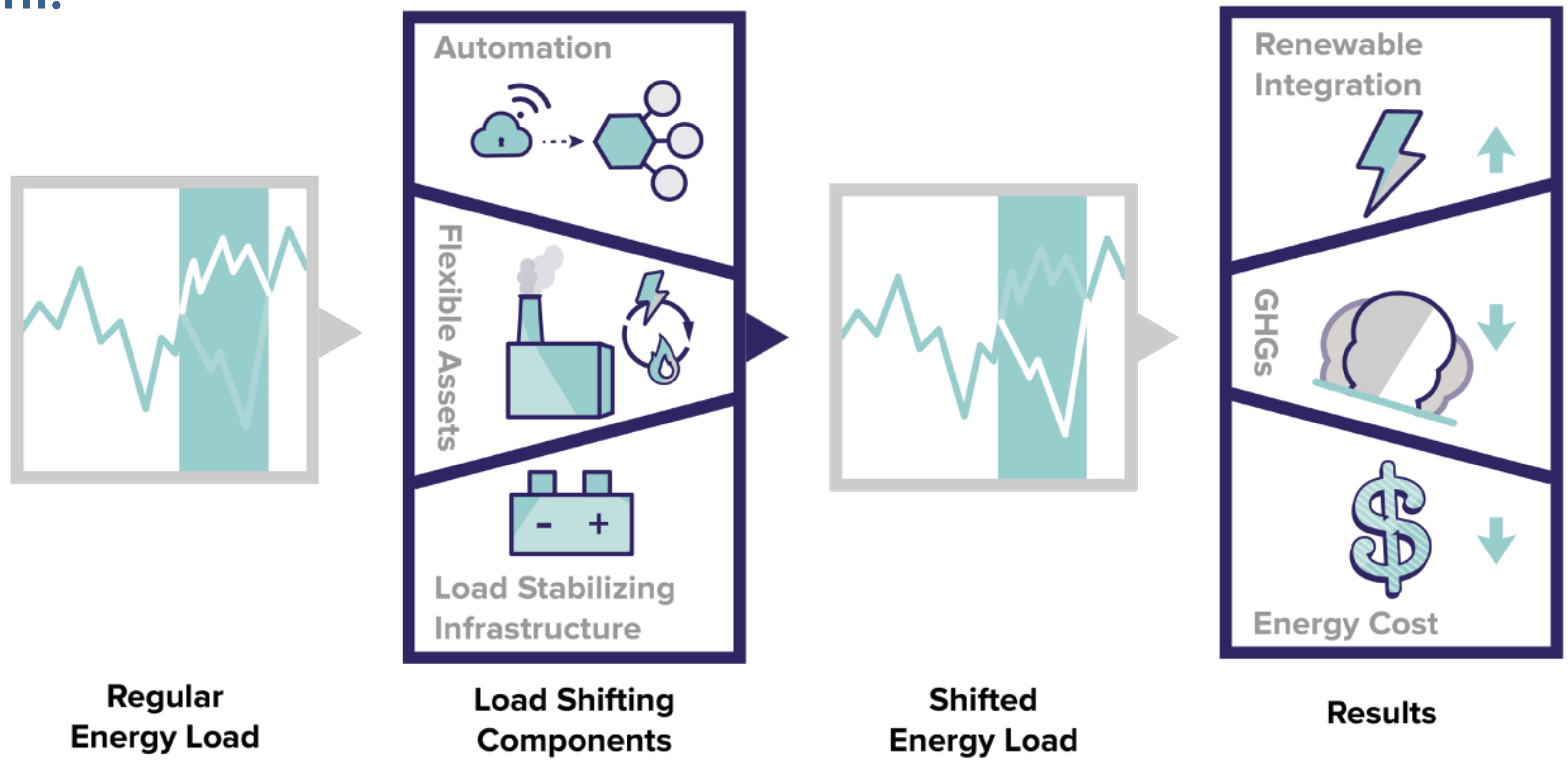
"… no [new] hydropower development will take place at previously undeveloped sites without innovative – even transformational – advances in technologies and designs to reduce costs and meet environmental performance objectives."

Yet, even with rapid innovation:

"Hydroelectric generation accounts for roughly 6% of United States electricity consumption, [or] … 80 Gigawatt (GW) of cumulative installed capacity … [and] approximately 16 GW of hydropower growth at new stream-reaches could be possible with the development of technology solutions that balance efficiency, economics, and environmental sustainability."

- Department of Energy Funding Opportunity Announcement DE-FOA-0001836

UC Davis sought to answer if the Water Sector could assist without significant investment in new equipment:

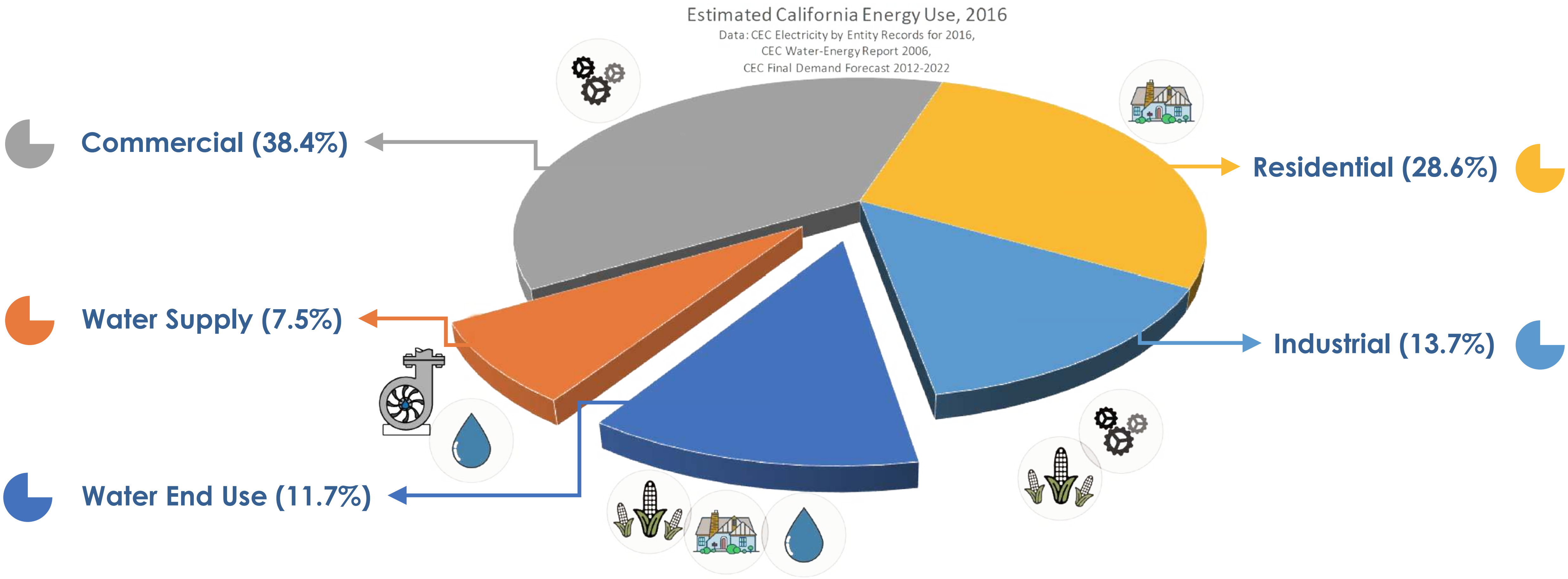


Could the water sector shift when they consume energy with their existing assets?

Figure From: Musabandesu, E., Loge, F. (2021). Load shifting at wastewater treatment plants: A case study for participating as an energy demand resource. Journal of Cleaner Production, Volume 282, 2021, 123354

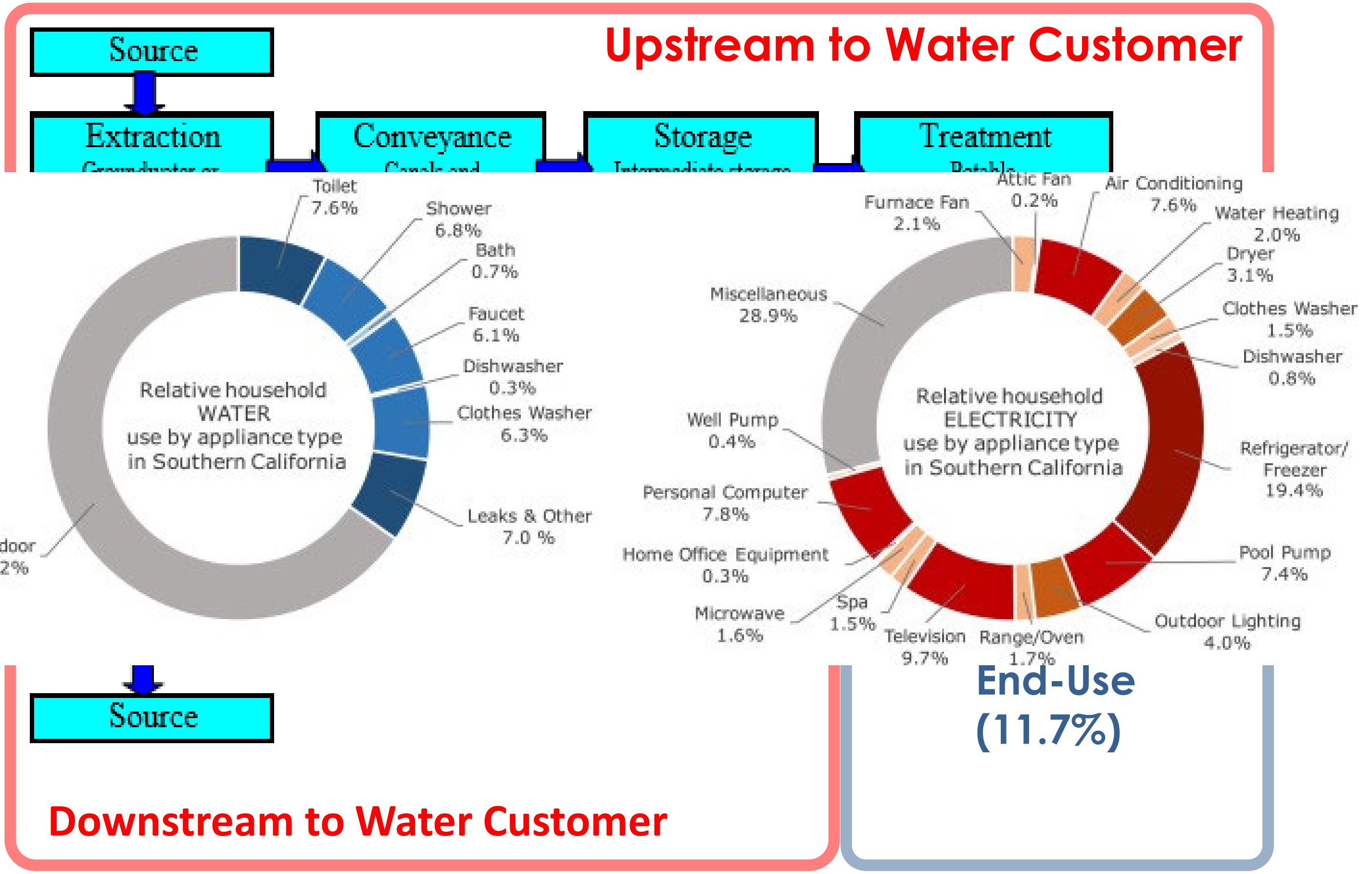
How Does Electricity Relate to Water?

- What is the size of the Water Sector that could load shift?
- Do changes in the Water Sector impact the Energy Sector?
- What are some examples of Energy Load Shifting?

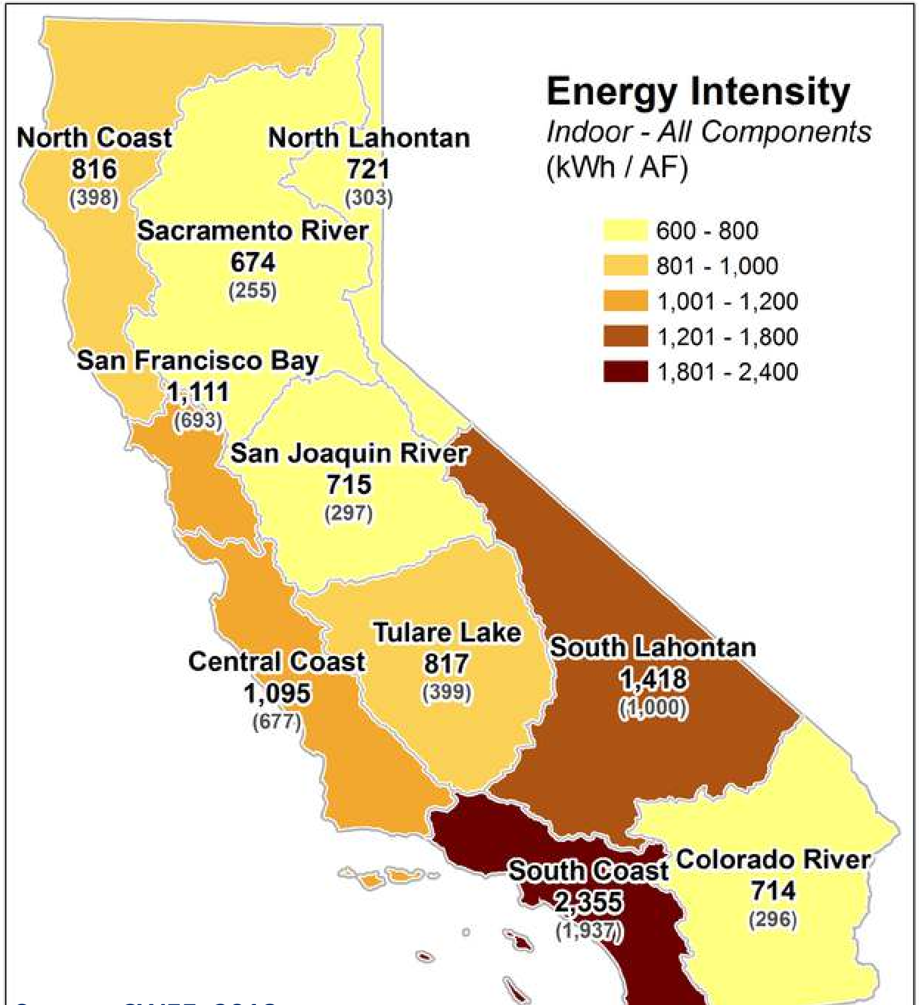


The Water Sector consumes nearly 20% of all electricity in California.

Water Supply (7.5%)



Source: Wilkinson, 2007

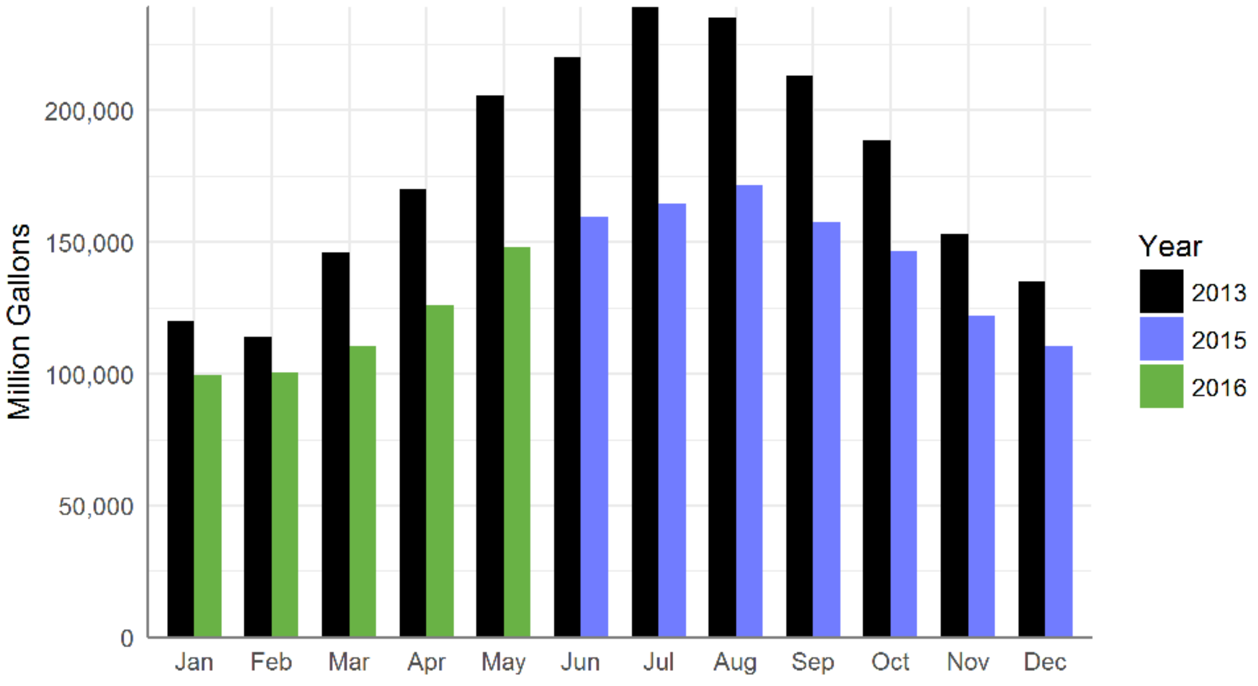


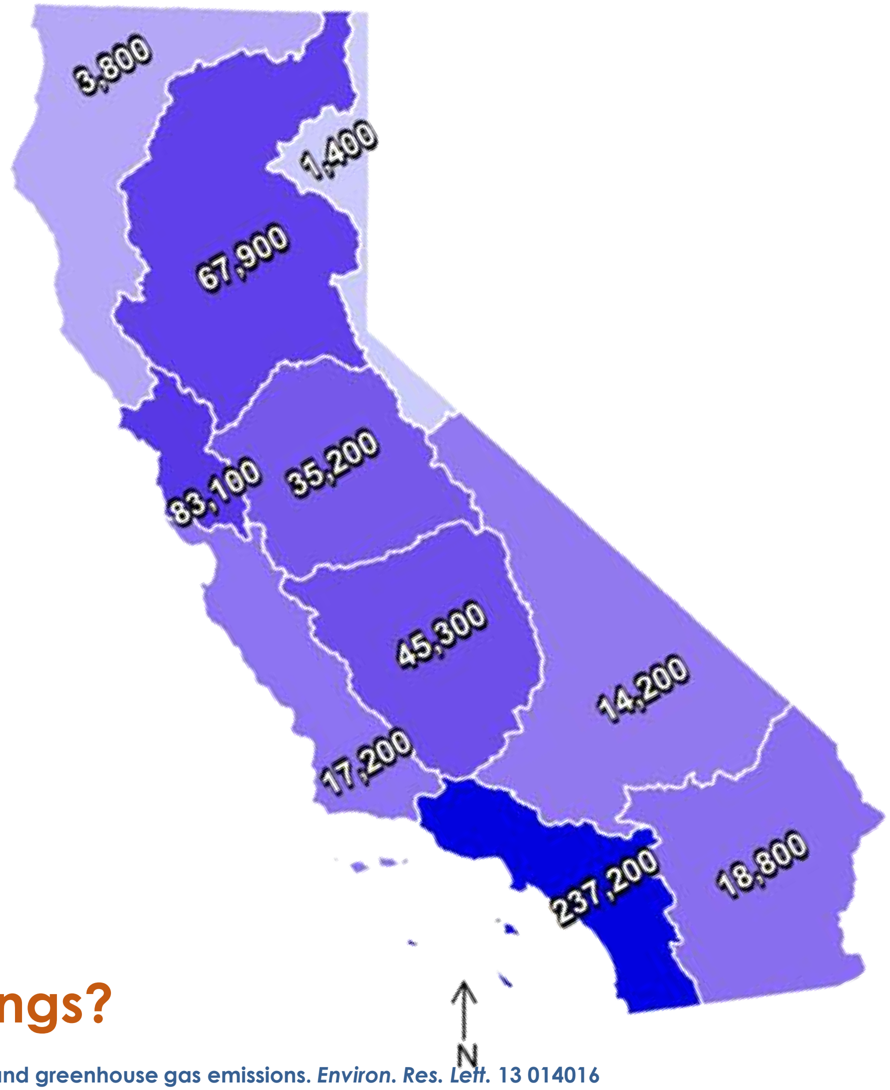
Source: CWEE, 2018

Figure From: Spang, E., Holguin, A., Loge, F. (2018) The estimated impact of California's urban water conservation mandate on electricity consumption and greenhouse gas emissions. *Environ. Res. Lett.* 13 014016

Figure From: Wilkinson, R., Wolff, G., Kost, W., Shwom, R. (2007). An Analysis of the Energy Intensity in California: Providing a Basis for Quantification of Energy Savings from Water System Improvements. ACEEE Summer Study on Energy Efficiency in Buildings

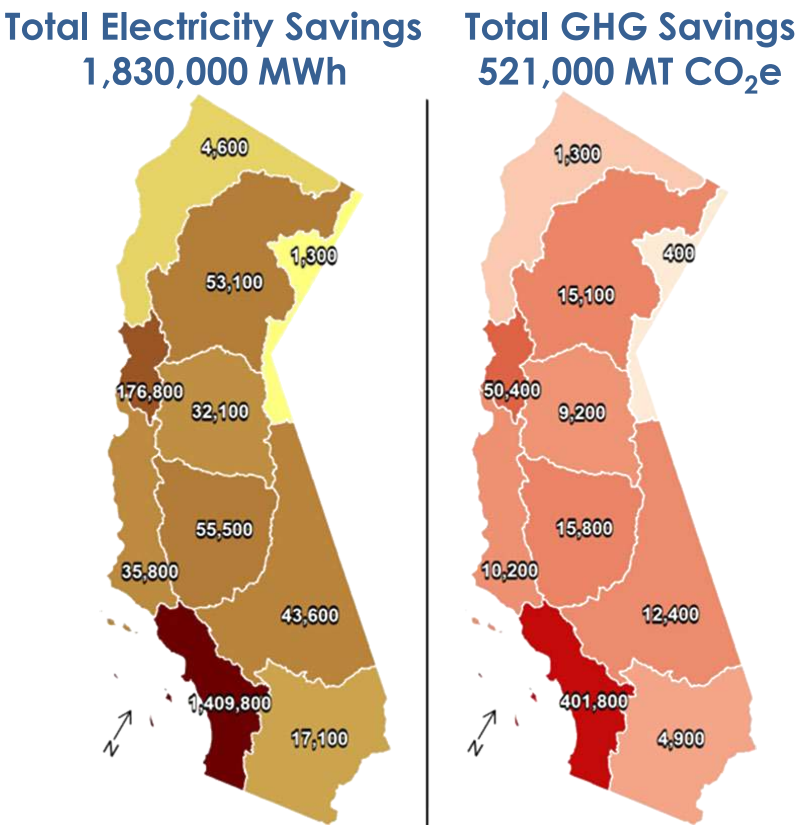
2015-2016 Water Conservation Mandate
524,000 MG, 24.5% Water Use Reductions

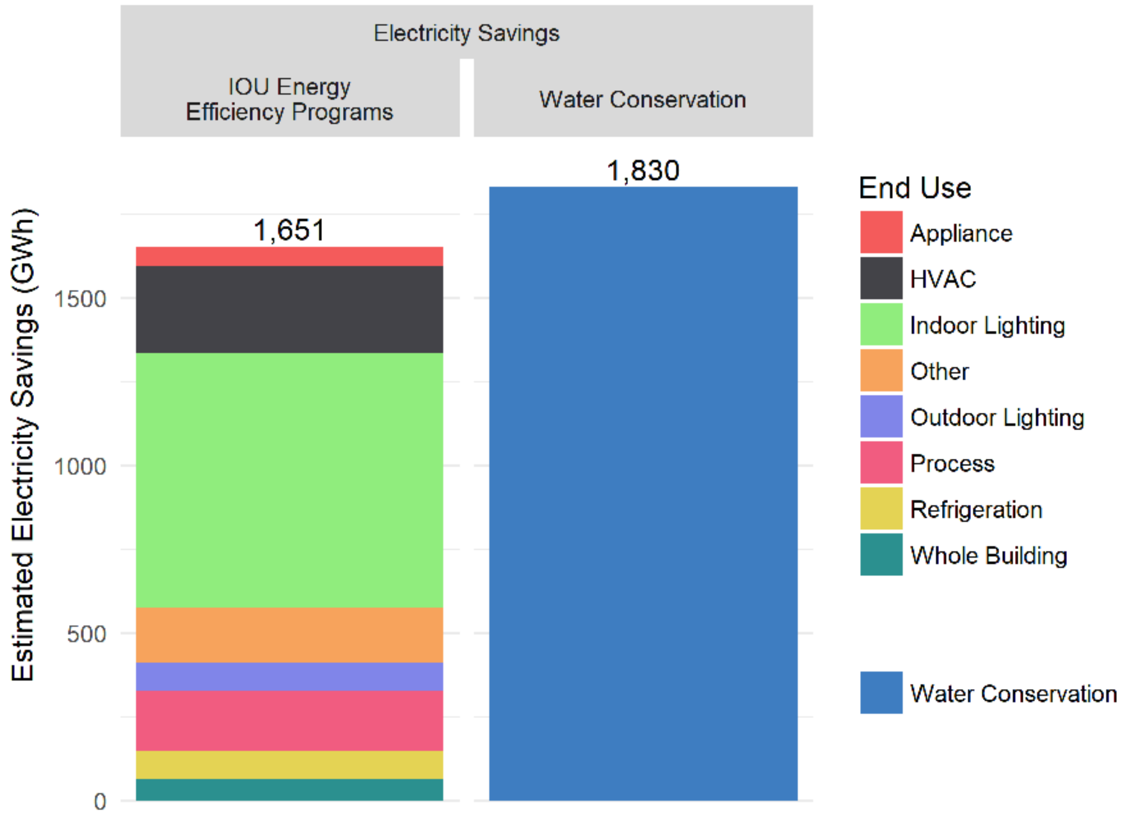




Water conservation mandate during previous CA drought:
Was there electricity savings from these water savings?

Figure From: Spang, E., Holguin, A., Loge, F. (2018) The estimated impact of California's urban water conservation mandate on electricity consumption and greenhouse gas emissions. *Environ. Res. Lett.* 13 014016





More electricity savings were achieved than with all major energy utility programs combined

Figure From: Spang, E., Holguin, A., Loge, F. (2018) The estimated impact of California's urban water conservation mandate on electricity consumption and greenhouse gas emissions. *Environ. Res. Lett.* 13 014016

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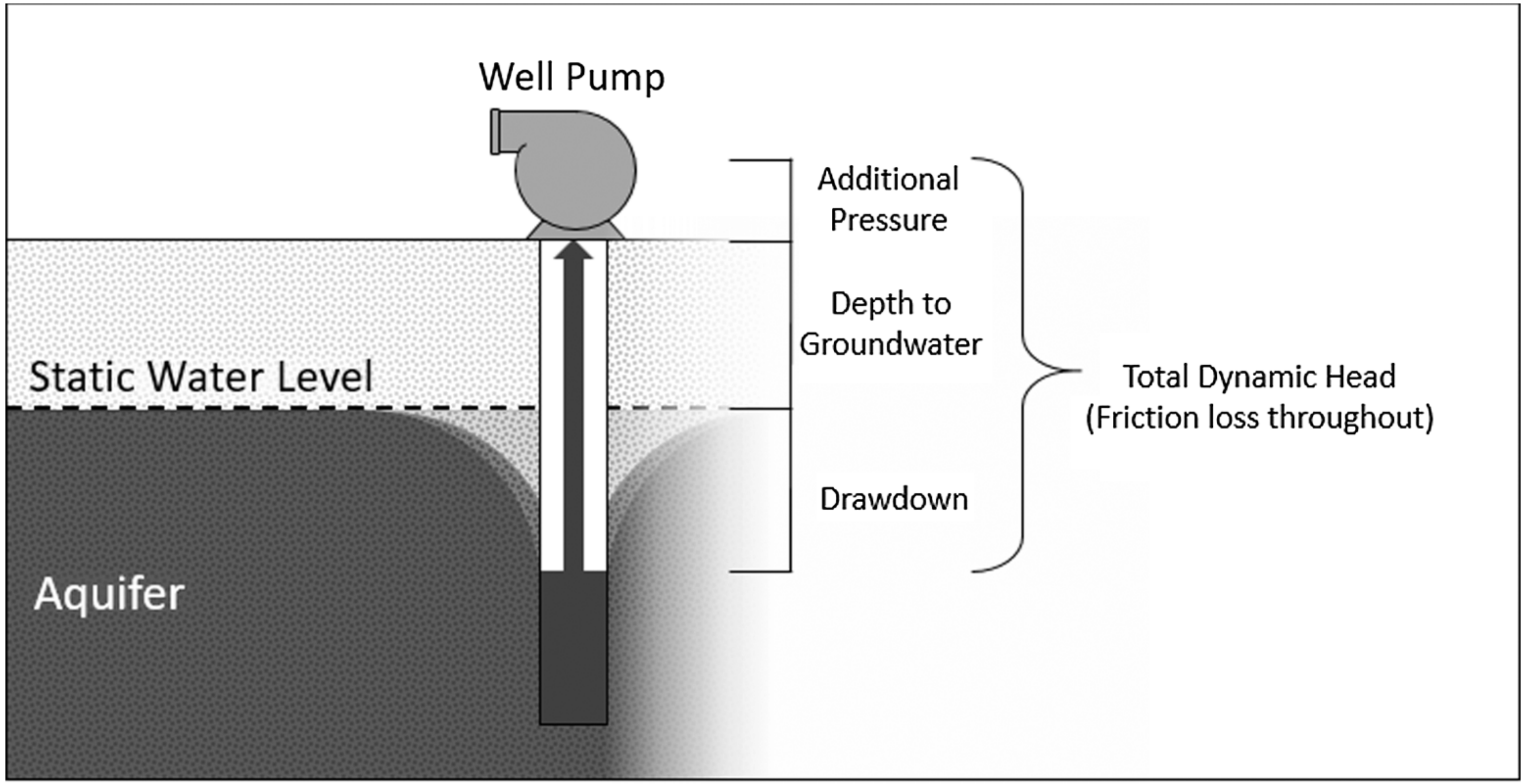
    - ~~How large is the end-use component?~~
    - How large is water pumping?

- ~~Do changes in the Water Sector impact the Energy Sector?~~

- What are some examples of Energy Load Shifting?



Efficiency-Lift Method:

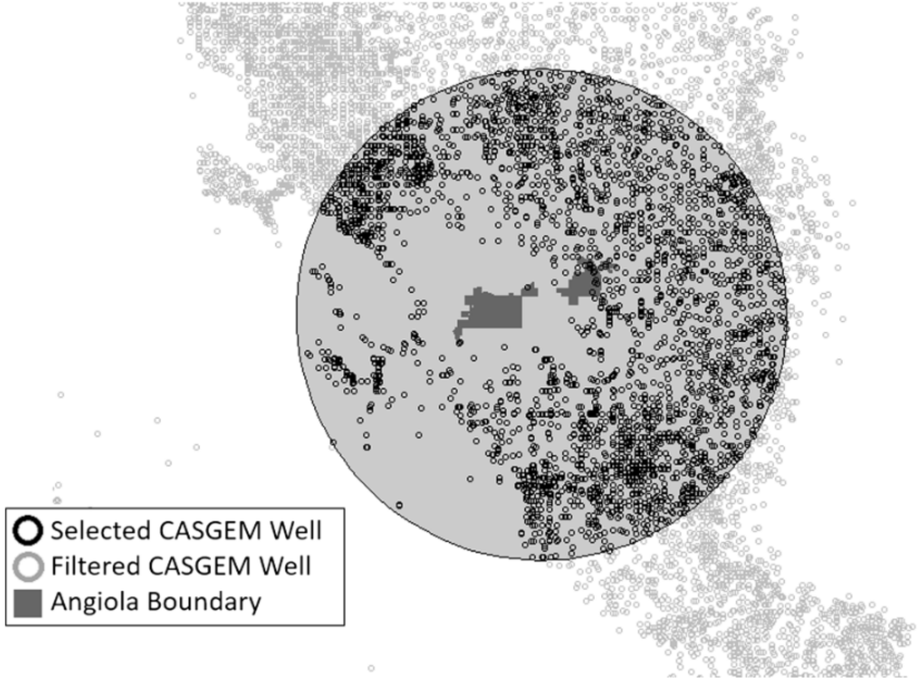
$$V = \frac{E \ * \ \eta}{27.2285 \ * H}$$

where:
V = volume of groundwater pumped (ha-m); (1 ha-m = 8.107 ac-ft)
E = pump energy consumption (kWh);
η = overall pumping plant efficiency (%),
H = total dynamic head (m)

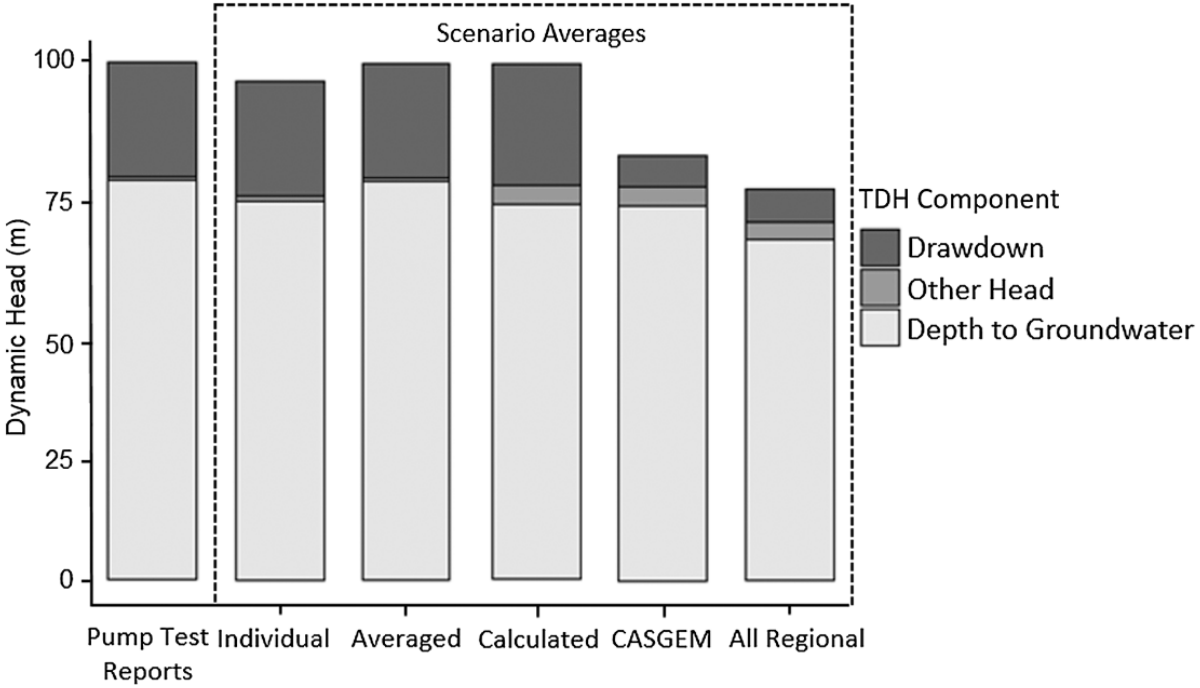
Groundwater accounts for 40% of California's water supply – and 100% of irrigation water in some areas. Could we accurately estimate their pumping activities and energy use?

Figure From: Martindill, J., Good, R., Loge, F. (2020). Estimating Agricultural Groundwater Withdrawals with Energy Data. Journal of Water Resources and Management, Vol. 147, Issue 5 (May 2021)

Region Overview



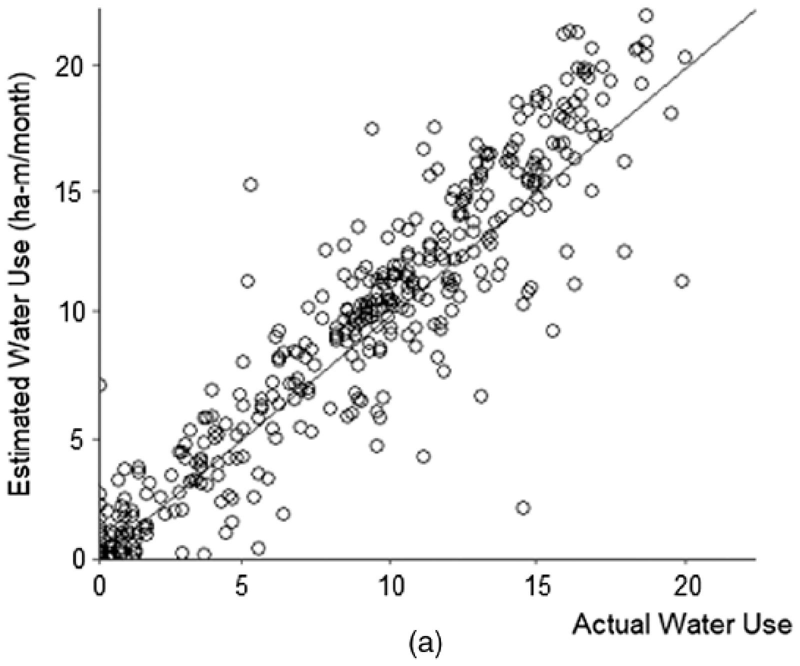
Total Dynamic Head Approaches



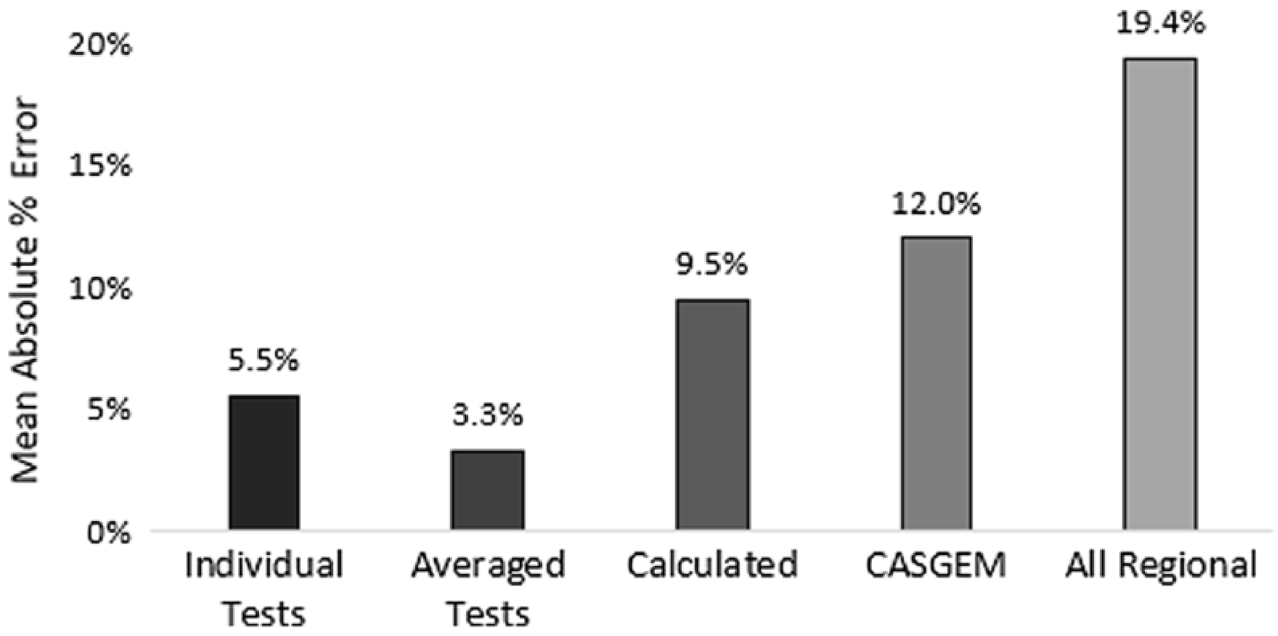
At the Angiola Water District in California, we calibrated and tested the method using retrieved pump test reports and actual energy bills.

Figure From: Martindill, J., Good, R., Loge, F. (2020). Estimating Agricultural Groundwater Withdrawals with Energy Data. Journal of Water Resources and Management, Vol. 147, Issue 5 (May 2021)

Per-Well Performance



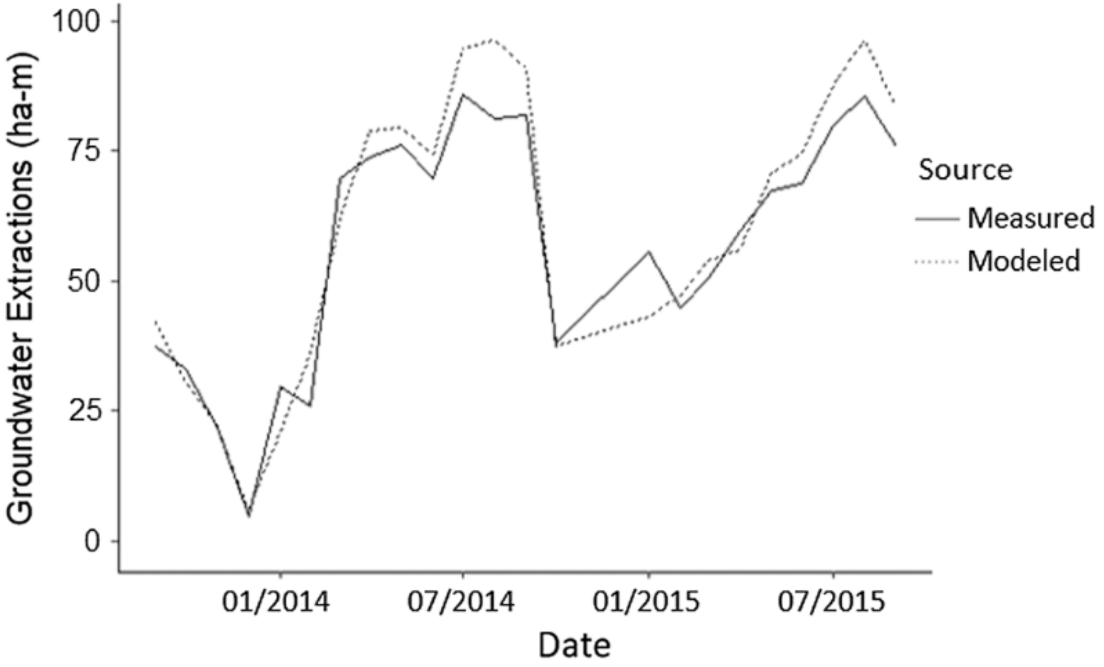
Annual Performance



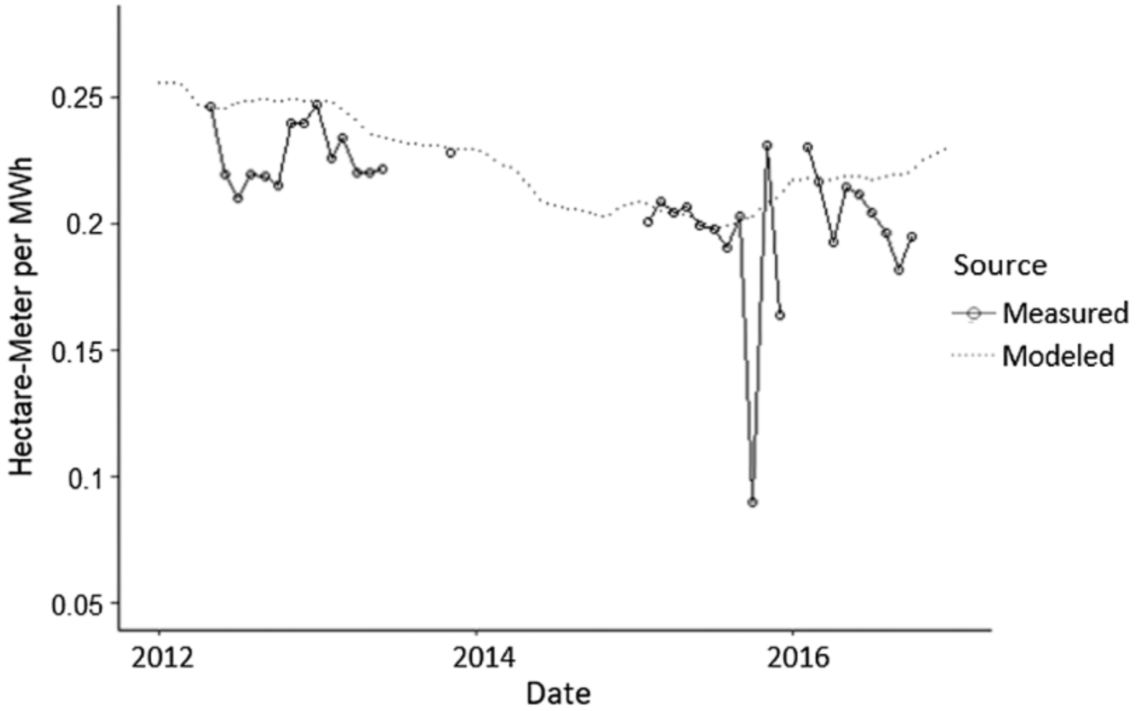
We identified that with unique pump test reports for the region or individual pumps, we could achieve high accuracy. Even without, the "calculated" approach performed well.

Figure From: Martindill, J., Good, R., Loge, F. (2020). Estimating Agricultural Groundwater Withdrawals with Energy Data. Journal of Water Resources and Management, Vol. 147, Issue 5 (May 2021)

Measured vs. Modeled Groundwater Extraction For Select Well



Measured vs. Modeled Energy Intensity For Select Well



In the end we developed a method that performs well at equating energy use to water flows.

Currently performs best with regional pump test reports, though not required to use the method.

Figure From: Martindill, J., Good, R., Loge, F. (2020). Estimating Agricultural Groundwater Withdrawals with Energy Data. Journal of Water Resources and Management, Vol. 147, Issue 5 (May 2021)

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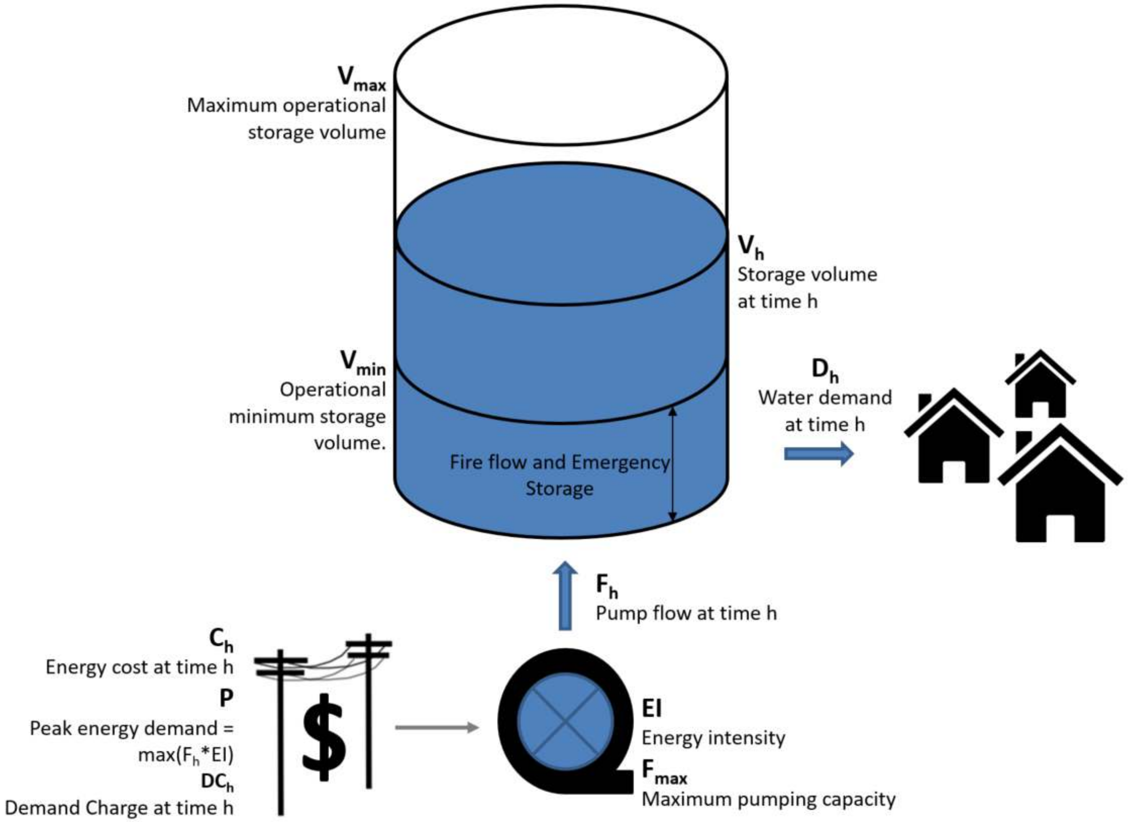


Step 1. Assume the Final Water Storage Level In the Future

Step 2. Working Backwards, Evaluate Every Possible Decision

Step 3. With Each Best Future Decision, Evaluate Every Possible Past Decision…

Step 4. When the "Start" of the Simulation is Found, Select the Best, Final Decision

$$\min \left[\left(\sum_{h=1}^{H} (F_h * EI * C_h) + (X * \mathbb{1}_A) \right) + max_{h=1}^{H} \left[(F_h * EI * DC_h) + (X * \mathbb{1}_B) \right] \right]$$

$$\mathbb{1}_A(F_h) = \begin{cases} 0 & if\ 0 \le F_h \le F_{max} \\ 1 & if\ F_h < 0\ or\ F_h > F_{max} \end{cases}$$

$$\mathbb{1}_A(V_h) = \begin{cases} 0 & if\ V_{min} \le V_h \le V_{max} \\ 1 & if\ V_h < V_{min}\ or\ V_h > V_{max} \end{cases}$$

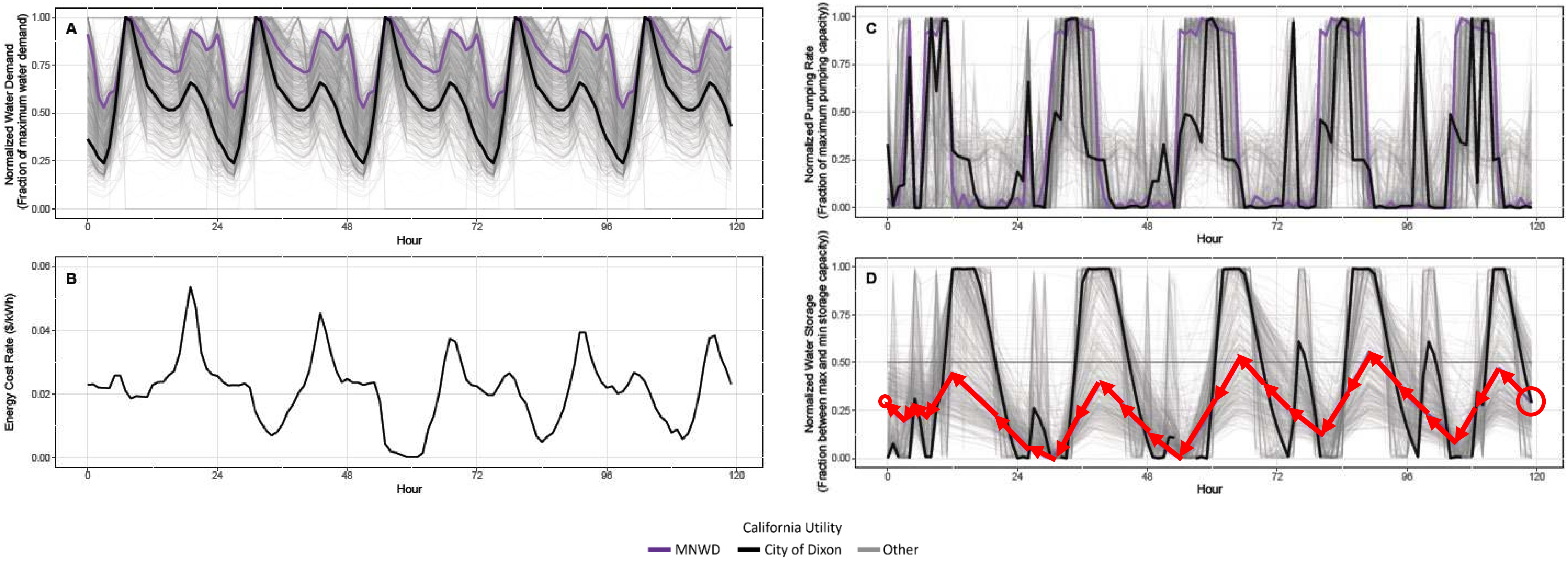
$$\mathbb{1}_B(V_h) = \begin{cases} 0 & if\ V_{h=H} \ge V_{h=1} \\ 1 & if\ V_{h=H} < V_{h=1} \end{cases}$$

Where:
EI = Pump energy intensity (MWh/MG)
C_h = Energy cost ($/MWh) during hour h
E_h = Emission Intensity ($mTCO_{2e}$/MWh) during hour h

There are few estimates for the energy used for water distribution at utilities in California.

We chose to take a mass-balance modeling approach.

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy



The approach solves for a unique hour-by-hour pumping solution for every water system – taking their specific water sales, storage, pump capacity, and fire requirements into account.

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy

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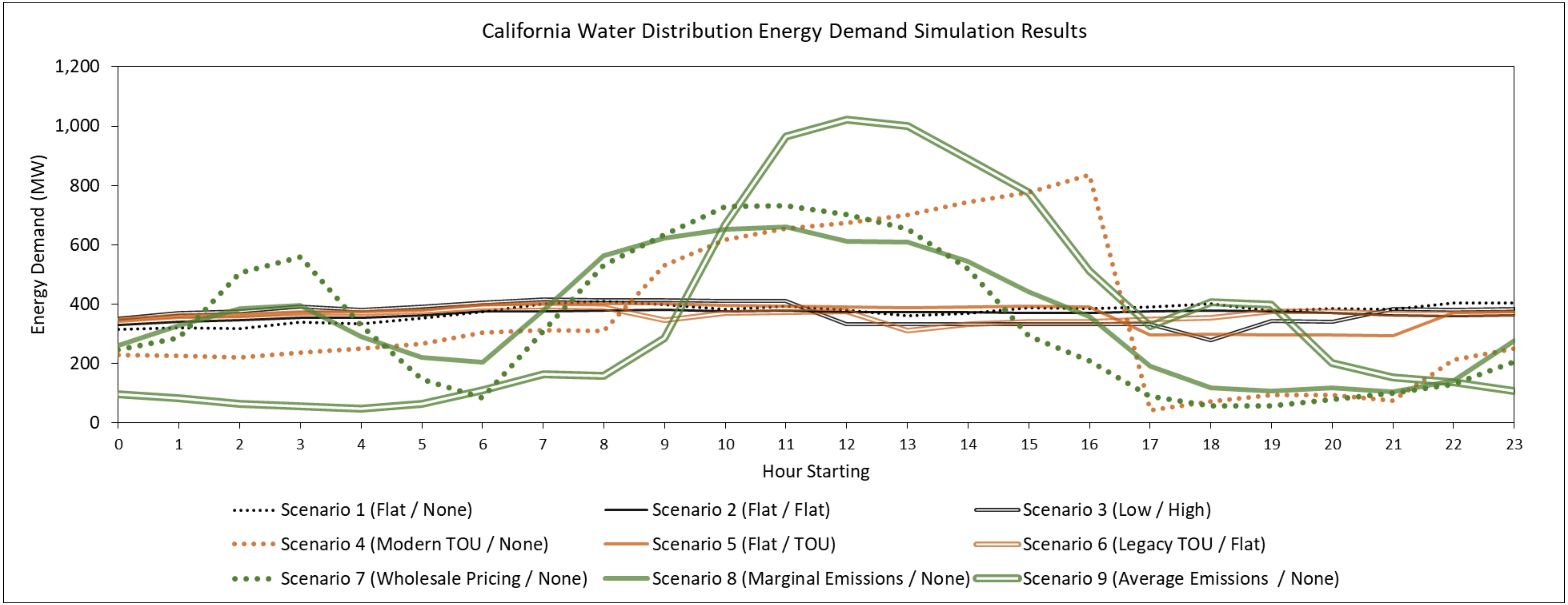

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy

Table: Annual total energy consumed, shifted, emissions, and emission intensity under eight different optimization scenarios.

Scenario (Consumption / Demand)	Annual Total Energy Consumed (MWh)[1]	Annual Net Load Shifted (MWh)[2]	Annual Total GHG Emissions (mTCO2e)	GHG Emission Intensity (mTCO2e/MWh)
1 (Flat/None)	3,273,163	0.0	508,045	0.1552
2 (Flat/Flat)	3,214,285	-16,660	501,495	0.1560
3 (Low/High)	3,228,971	-37,354	509,544	0.1578
4 (TOU/None)	3,189,280	740,900	451,651	0.1416
5 (Flat/TOU)	3,202,021	30,195	499,092	0.1559
6 (TOU/Flat)	3,183,231	-80,584	502,773	0.1579
7 (RTP/None)	2,989,939	578,158	454,042	0.1518
8 (Emissions/None)	3,134,091	535,682	466,440	0.1488

1. Total energy consumption under all scenarios should be identical given identical water demands. Small variations exist because each optimization scenario may have resulted in slightly different final water storage levels each month resulting in slightly more or less total energy being demanded for pumping. The total energy consumed for pumping under all scenarios equates to approximately **1.2% of the total energy consumed in CA in 2020.**
2. Net load shifted is relative to scenario 1 as the baseline considering the energy consumed between the hours of 9am and 4pm. Negative values indicate that a greater load was shifted into the load shift window than out.

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy

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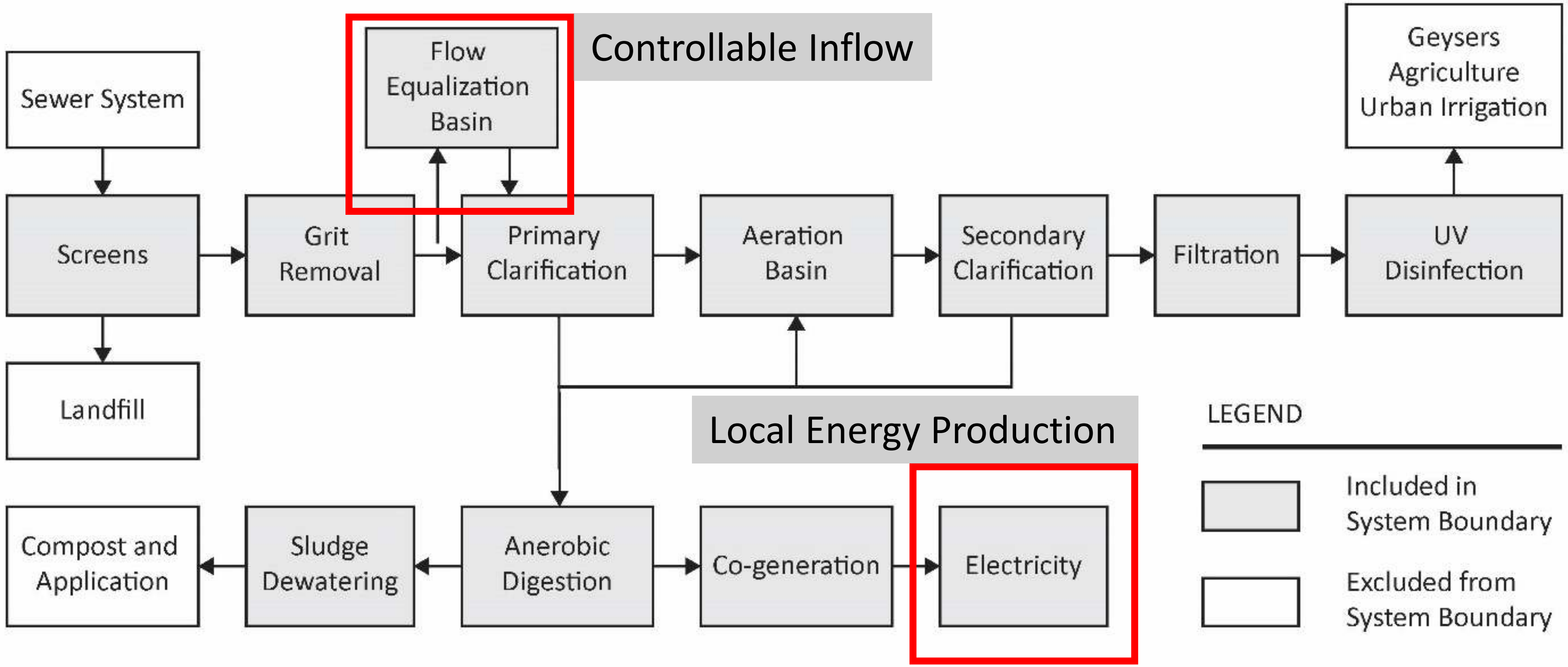
- What are some practical examples of Energy Load Shifting?
  - Wholesale, Proxy Demand Response Program at a Treatment Plant
  - Real-time Decision Support at a Water Distribution System
  - Reducing Peak Irrigation Customer Water Demand

We partnered with a Wastewater Treatment Plant to pilot shifting their energy loads based on price incentives from a wholesale demand response program.

Photos by Robert Good. Related Research: Musabandesu, E., Loge, F. (2021). Load shifting at wastewater treatment plants: A case study for participating as an energy demand resource. Journal of Cleaner Production, Volume 282, 2021, 123354



For this pilot, we took advantage of batteries as well as existing flow-equalization basins to ramp up or down energy loads on a price schedule.

Figure From: Musabandesu, E., Loge, F. (2021). Load shifting at wastewater treatment plants: A case study for participating as an energy demand resource. Journal of Cleaner Production, Volume 282, 2021, 123354

Flow Equalization Basins

1-2 MWh Shift Capability

Batteries

0.5 MWh Shift Capability

Combined Heat & Power

1 MWh Shift Capability

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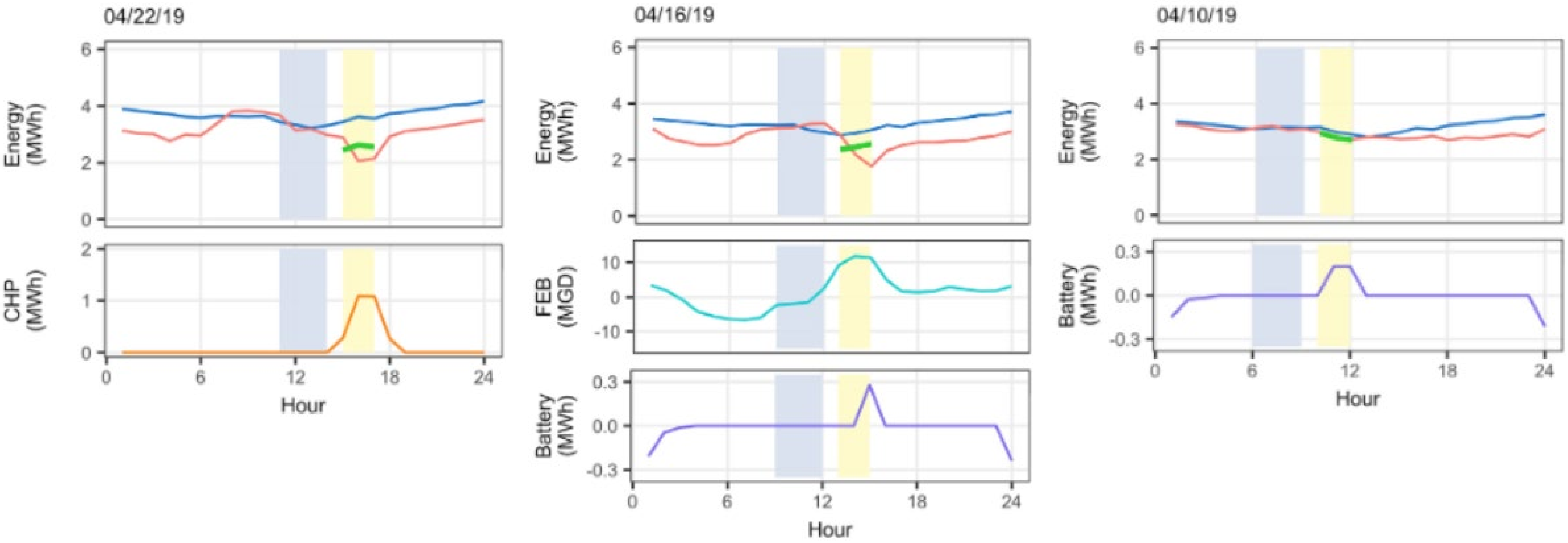
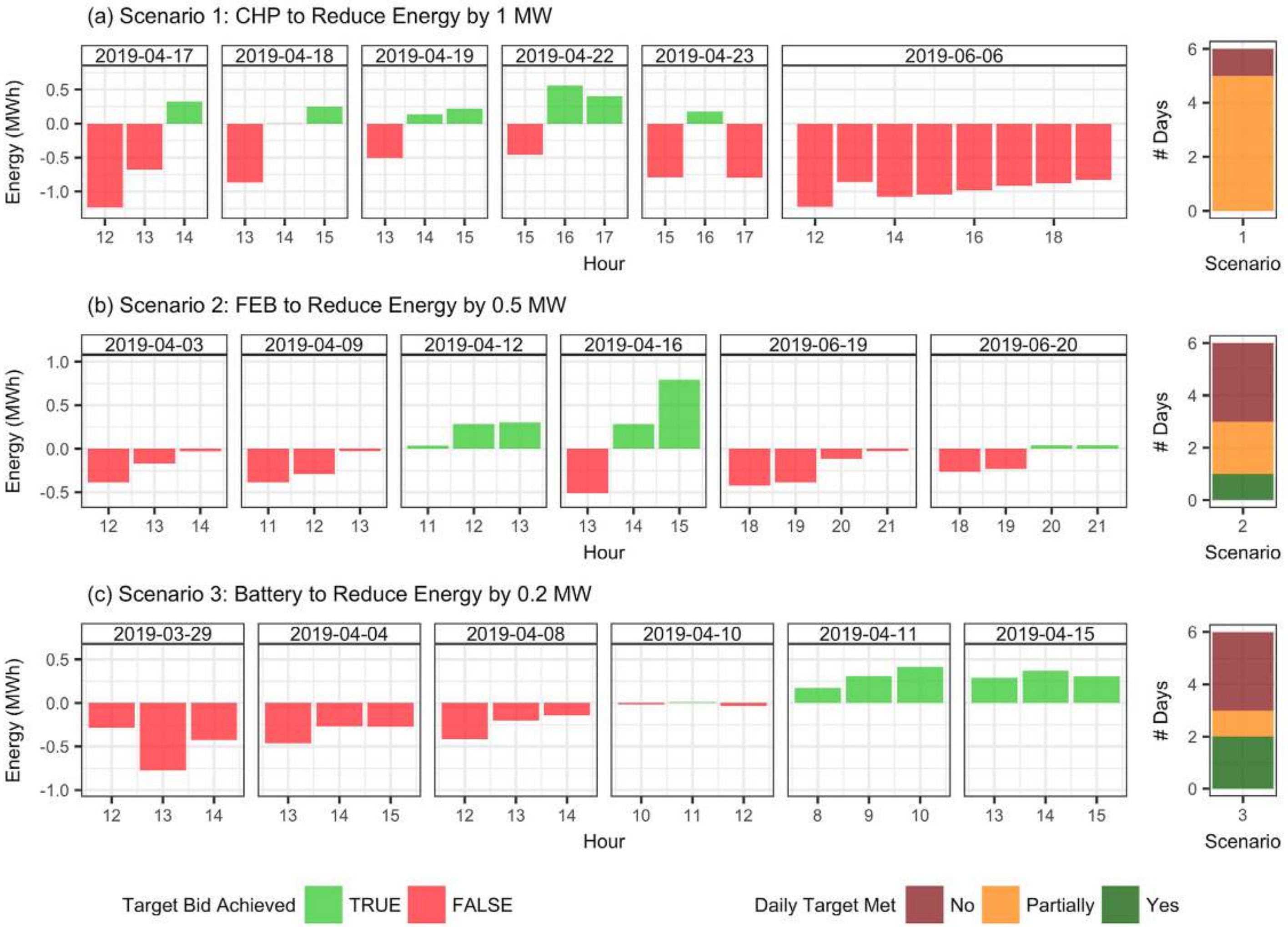


We learned that short-term load-shifting at the facility was difficult. It required precise scheduling of complex equipment, without adjusting too soon or too late.

Figure From: Musabandesu, E., Loge, F. (2021). Load shifting at wastewater treatment plants: A case study for participating as an energy demand resource. Journal of Cleaner Production, Volume 282, 2021, 123354



After 18 load-shifting events, **only 3 were successfully accepted** into the wholesale market.

We estimated that with additional practice, **this facility could generate up to $68,344 annually** through this wholesale market.

Figure From: Musabandesu, E., Loge, F. (2021). Load shifting at wastewater treatment plants: A case study for participating as an energy demand resource. Journal of Cleaner Production, Volume 282, 2021, 123354

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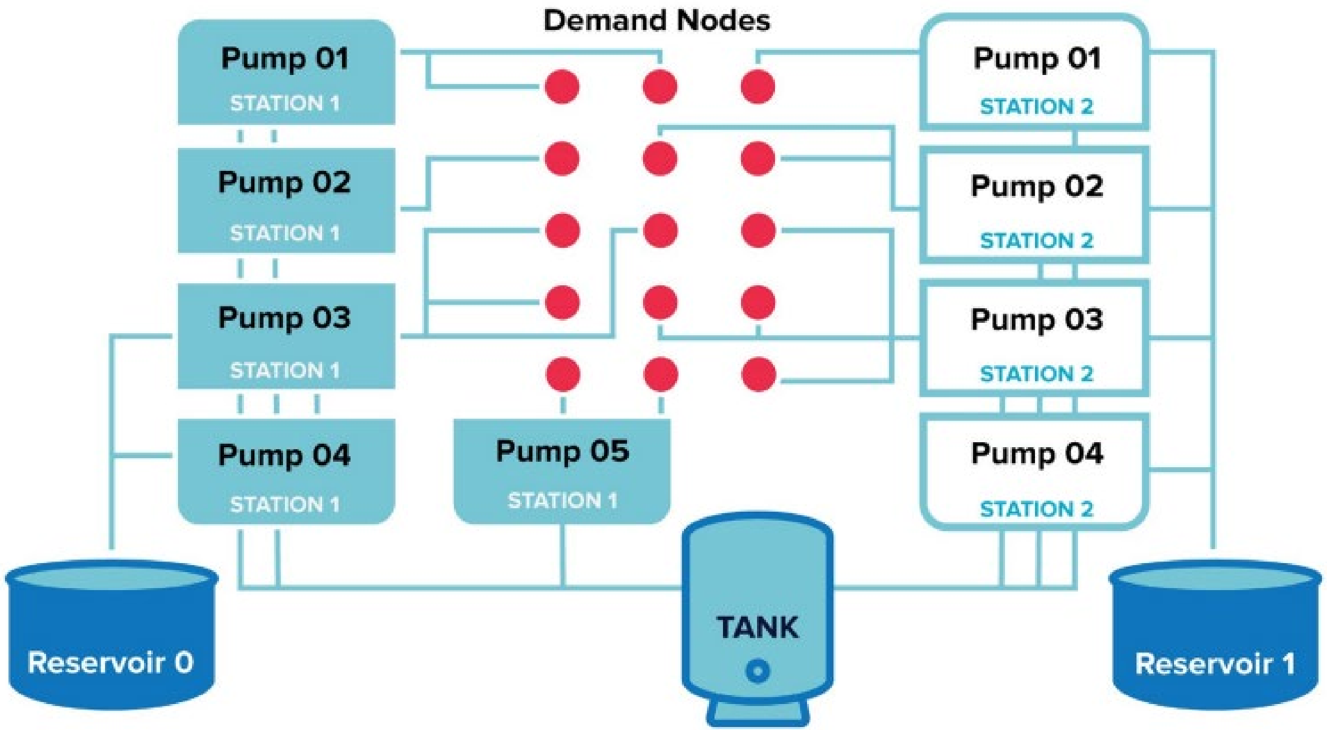
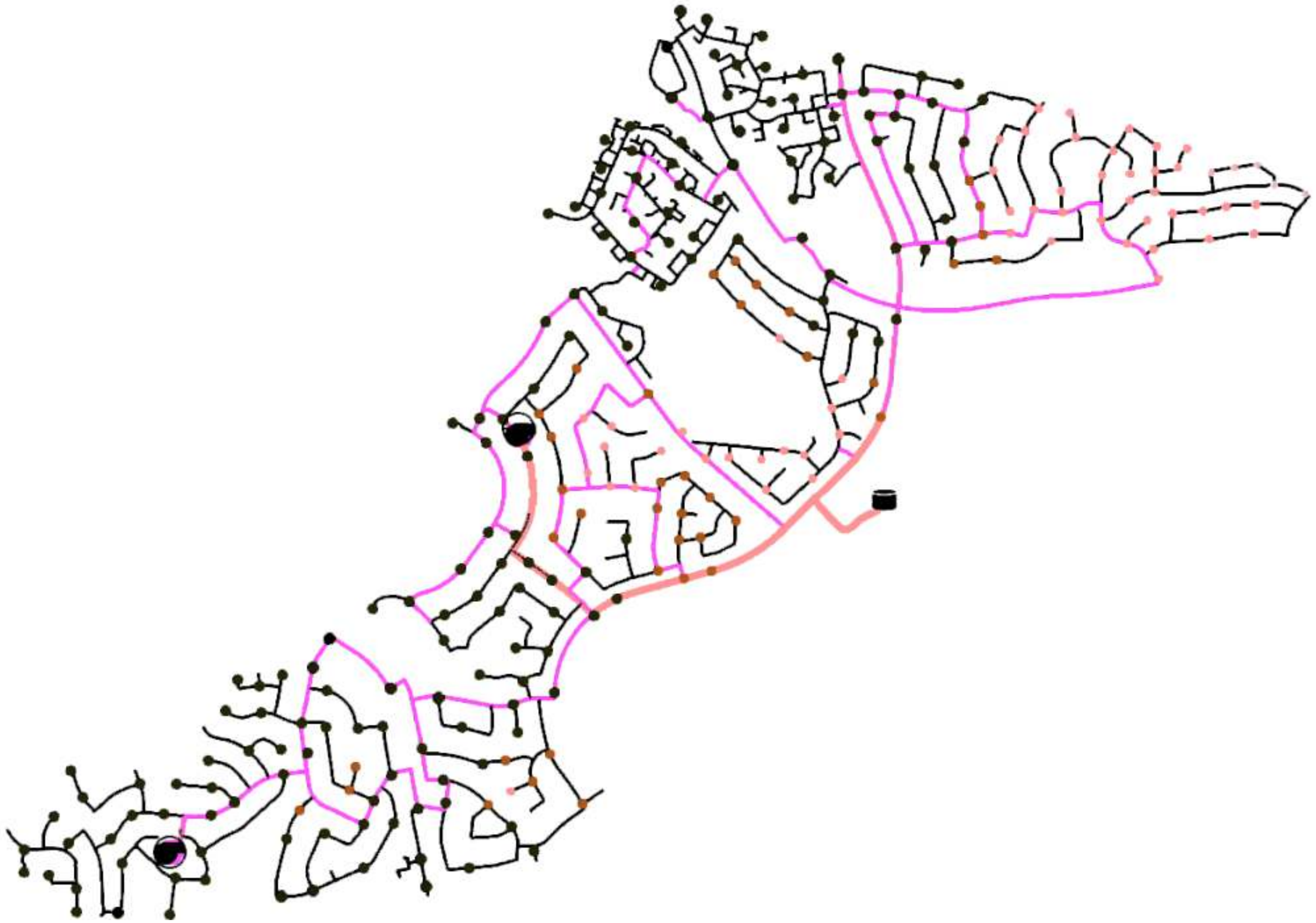


Water systems are complex systems that require balancing mass, momentum, and energy to accurately estimate how the system will react to changes.

This is often solved with hydraulic models.

Figure From: D. Linz, B. Ahmadi, R. Good, E. Musabandesu and F. Loge, "Multi-Threaded Simulation Optimization Platform for Reducing Energy Use in Large-Scale Water Distribution Networks with High Dimensions," 2020 Winter Simulation Conference (WSC), 2020, pp. 704-714, doi: 10.1109/WSC48552.2020.9383920.



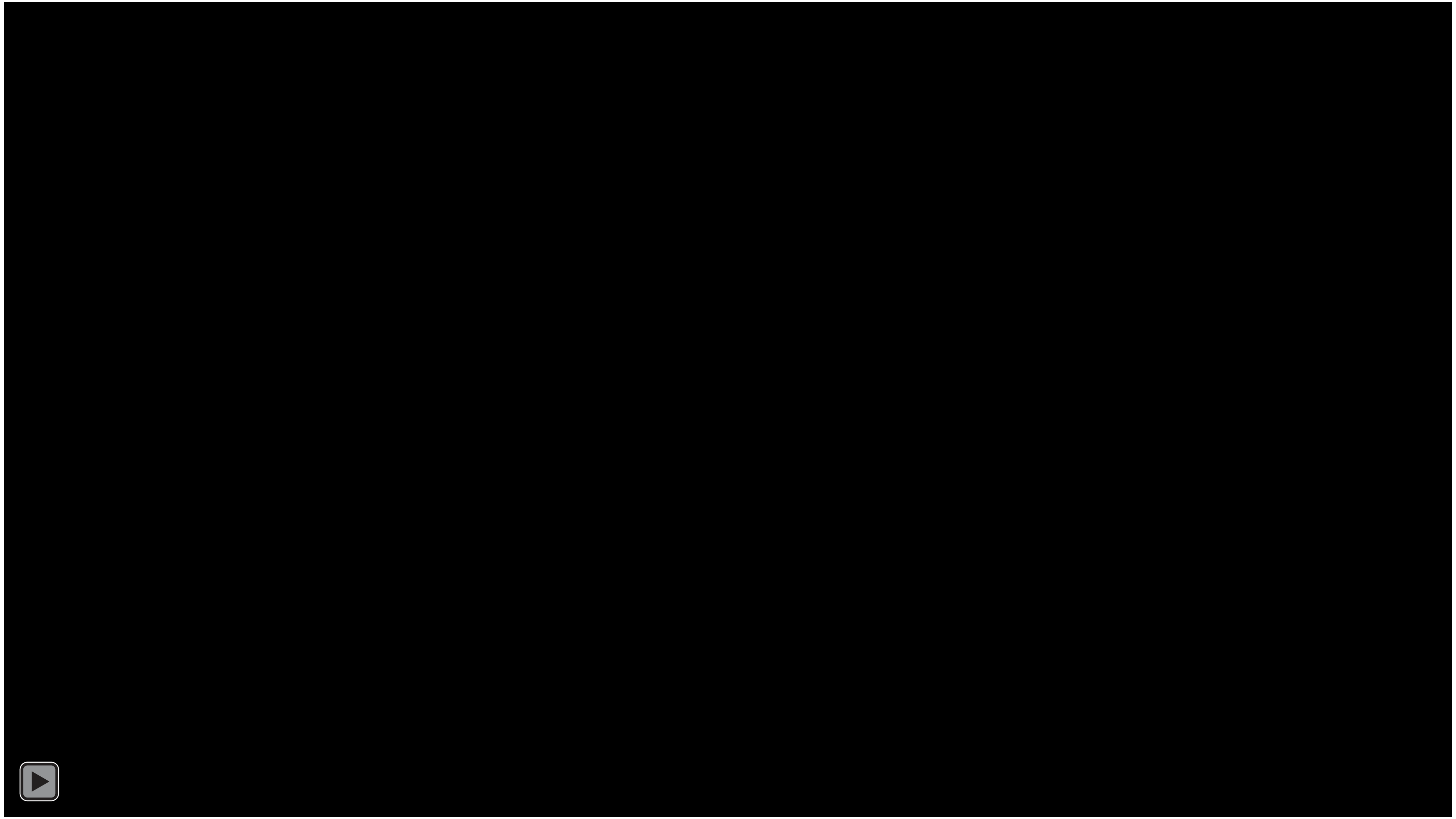
Even after these models are built, utilizing them to make operational decisions has proven difficult. Historically, these are used as engineering tools, not as operational tools.

- Optimizations only produce schedules
- Running simulations requires expertise and debugging
- Lack of Real-time Data Sharing

Figure From: Good, Robert. November 9 (2021). WaterWatch Software: A Planning and Management Tool for the Whole Team. Webinar. University of California Davis. https://cwee.ucdavis.edu/waterwatch/

From there, we developed *WaterWatch*: a stand-alone software for Windows 10 & 11 devices that allows for real-time simulations of water systems in an operator-friendly environment.

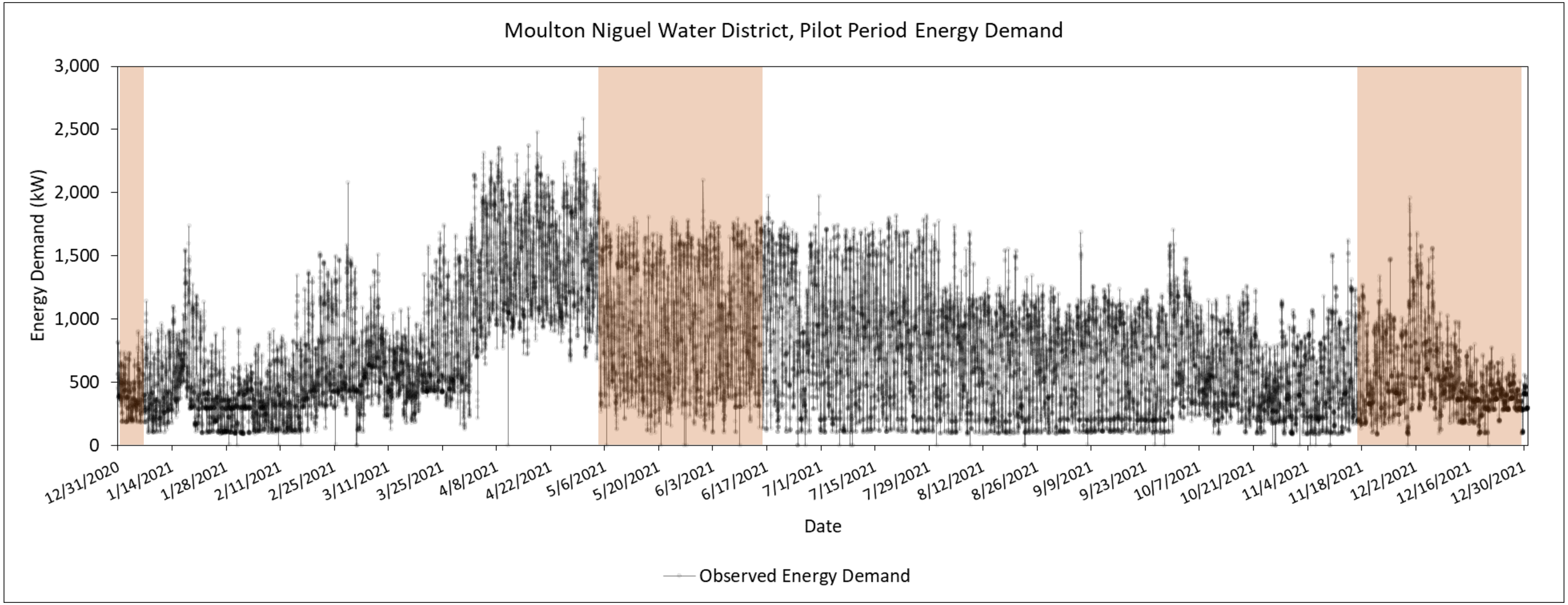
Figure From: Good, Robert. November 9 (2021). WaterWatch Software: A Planning and Management Tool for the Whole Team. Webinar. University of California Davis. https://cwee.ucdavis.edu/waterwatch/



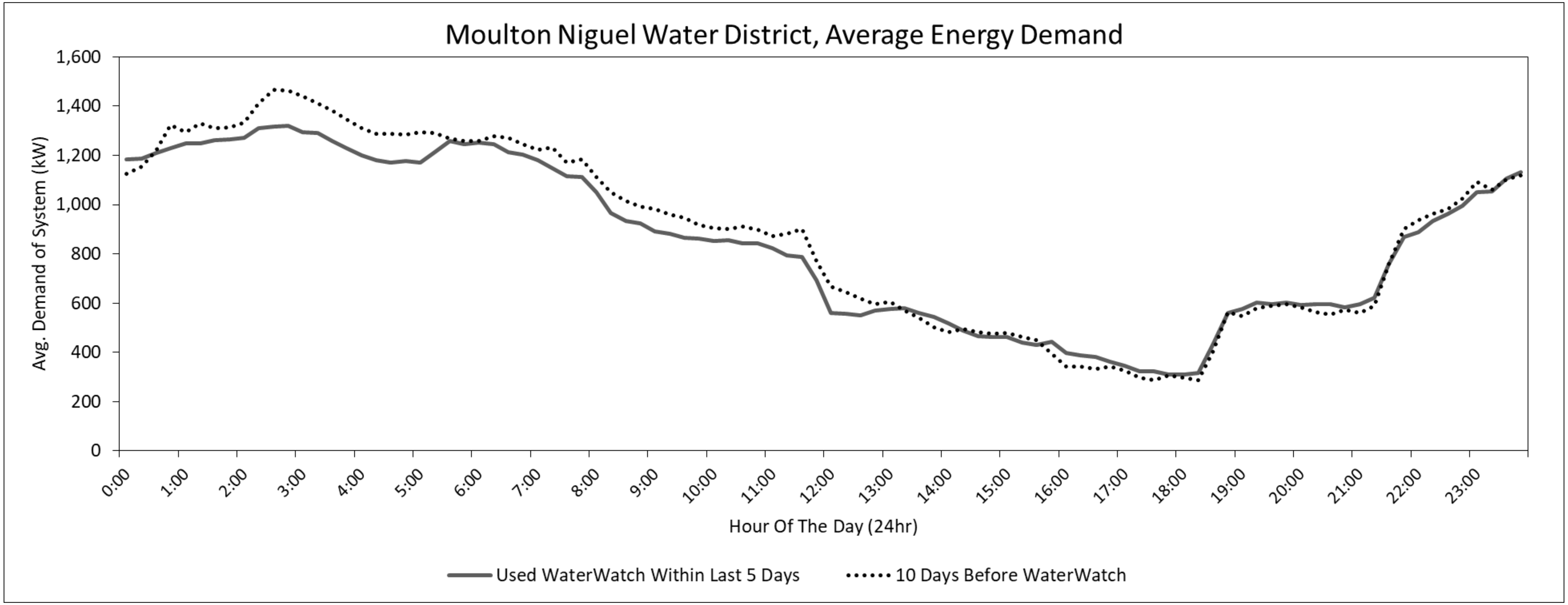
This tool enabled operators to test changes to their system and see immediate feedback.

We piloted the software initially as an educational tool.

Figure From: Good, Robert. November 9 (2021). WaterWatch Software: A Planning and Management Tool for the Whole Team. Webinar. University of California Davis. https://cwee.ucdavis.edu/waterwatch/



We installed high-resolution energy meters at each pump station in the utility. Would the experiments from the tool result in real-world savings at the utility?



We used a discontinuity approach – analyzing the period before and after their interactions with the tool.

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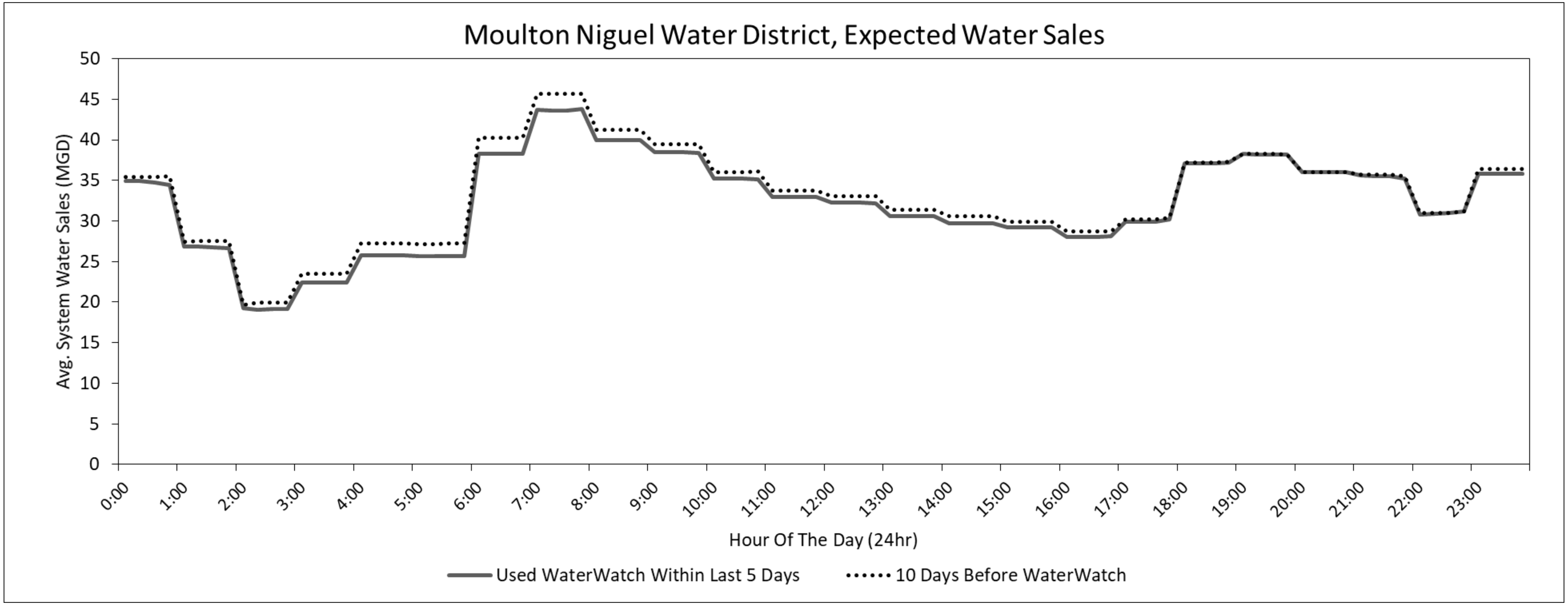


We used a discontinuity approach – analyzing the period before and after their interactions with the tool.

Table: Regression Results for WaterWatch, Controlling for Calendar Date

Dependent Variable (Units)	Power Demand (kW)	Energy Intensity (MWh / MG)	Energy Consumption (kWh / 15 min)
Average	728.5– 883.2	0.673– 0.676	182.1– 220.8
Constant	547.713*** (43.64)	0.664*** (0.03)	136.928*** (10.91)
Utilized WaterWatch Within Previous 5 Days	-145.634*** (26.5)	-0.008 (0.02)	-36.408*** (6.62)
Percent Impact	-16.49%	N/A	-16.49%
Control for Water Sales	-	-	-
Control for Hour of Day	-	-	-
Control for Month of Year	-	-	-
Control for Exact Date	YES	YES	YES

Results of an ordinary least-squares linear regression with the specified controls. Results presented include the coefficient, (standard error), and significance***.

Regressions with increasing "control" narrows in on the likely influence or effect of the tool

Table: Regression Results for WaterWatch, Controlling for Month of the Year

Dependent Variable (Units)	Power Demand (kW)	Energy Intensity (MWh / MG)	Energy Consumption (kWh / 15 min)
Average	728.5– 883.2	0.673– 0.676	182.1– 220.8
Constant	450.091*** (6.79)	0.598*** (0)	112.523*** (1.7)
Utilized WaterWatch Within Previous 5 Days	-39.562*** (6.62)	-0.025*** (0)	-9.891*** (1.65)
Percent Impact	-4.48%	-3.70%	-4.48%
Control for Water Sales	-	-	-
Control for Hour of Day	-	-	-
Control for Month of Year	YES	YES	YES
Control for Exact Date	-	-	-

Results of an ordinary least-squares linear regression with the specified controls. Results presented include the coefficient, (standard error), and significance***.

Regressions with increasing “control” narrows in on the likely influence or effect of the tool

Table: Regression Results for WaterWatch, Controlling for Month and Hour

Dependent Variable (Units)	Power Demand (kW)	Energy Intensity (MWh / MG)	Energy Consumption (kWh / 15 min)
Average	728.5– 883.2	0.673– 0.676	182.1– 220.8
Constant	401.864*** (8.65)	0.591*** (0.01)	100.466*** (2.16)
Utilized WaterWatch Within Previous 5 Days	-35.582*** (4.95)	-0.027*** (0)	-8.896*** (1.24)
Percent Impact	-4.03%	-3.99%	-4.03%
Control for Water Sales	-	-	-
Control for Hour of Day	YES	YES	YES
Control for Month of Year	YES	YES	YES
Control for Exact Date	-	-	-

Results of an ordinary least-squares linear regression with the specified controls. Results presented include the coefficient, (standard error), and significance***.

Regressions with increasing "control" narrows in on the likely influence or effect of the tool

Table: Regression Results for WaterWatch, Controlling for Month, Hour, and Water Sales

Dependent Variable (Units)	Power Demand (kW)	Energy Intensity (MWh / MG)	Energy Consumption (kWh / 15 min)
Average	728.5– 883.2	0.673– 0.676	182.1– 220.8
Constant	405.202*** (14.1)	1.038*** (0.01)	101.301*** (3.53)
Utilized WaterWatch Within Previous 5 Days	-35.570*** (4.95)	-0.025*** (0)	-8.892*** (1.24)
Percent Impact	-4.03%	-3.70%	-4.03%
Control for Water Sales	YES	YES	YES
Control for Hour of Day	YES	YES	YES
Control for Month of Year	YES	YES	YES
Control for Exact Date	-	-	-

Results of an ordinary least-squares linear regression with the specified controls. Results presented include the coefficient, (standard error), and significance***.

Regressions with increasing "control" narrows in on the likely influence or effect of the tool

How Does Electricity Relate to Water?

- ~~What is the size of the Water Sector?~~
  - ~~How large is the end-use component?~~
  - ~~How large is water pumping?~~

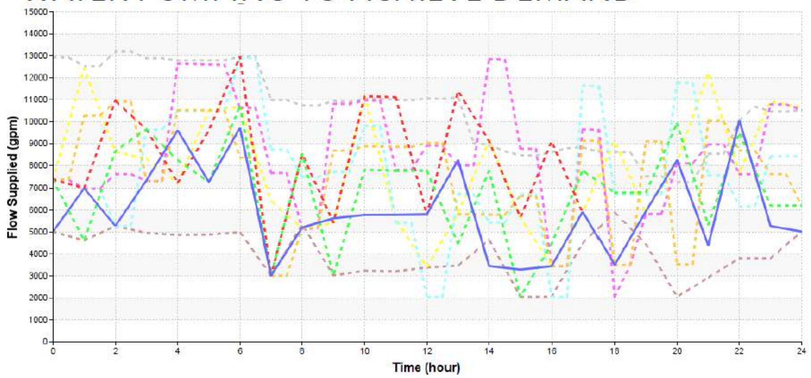
- ~~Do changes in the Water Sector impact the Energy Sector?~~

- What are some practical examples of Energy Load Shifting?
  - ~~Wholesale, Proxy Demand Response Program at a Treatment Plant~~
  - ~~Real-time Decision Support at a Water Distribution System~~
  - Reducing Peak Irrigation Customer Water Demand

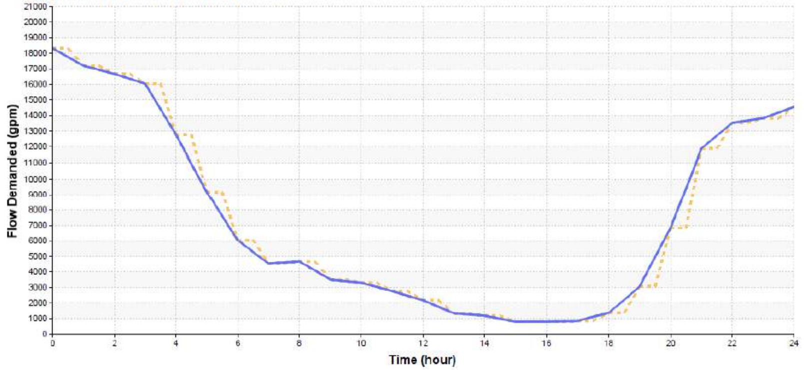
What would be benefit of irrigation shifting at a reclaimed water system?

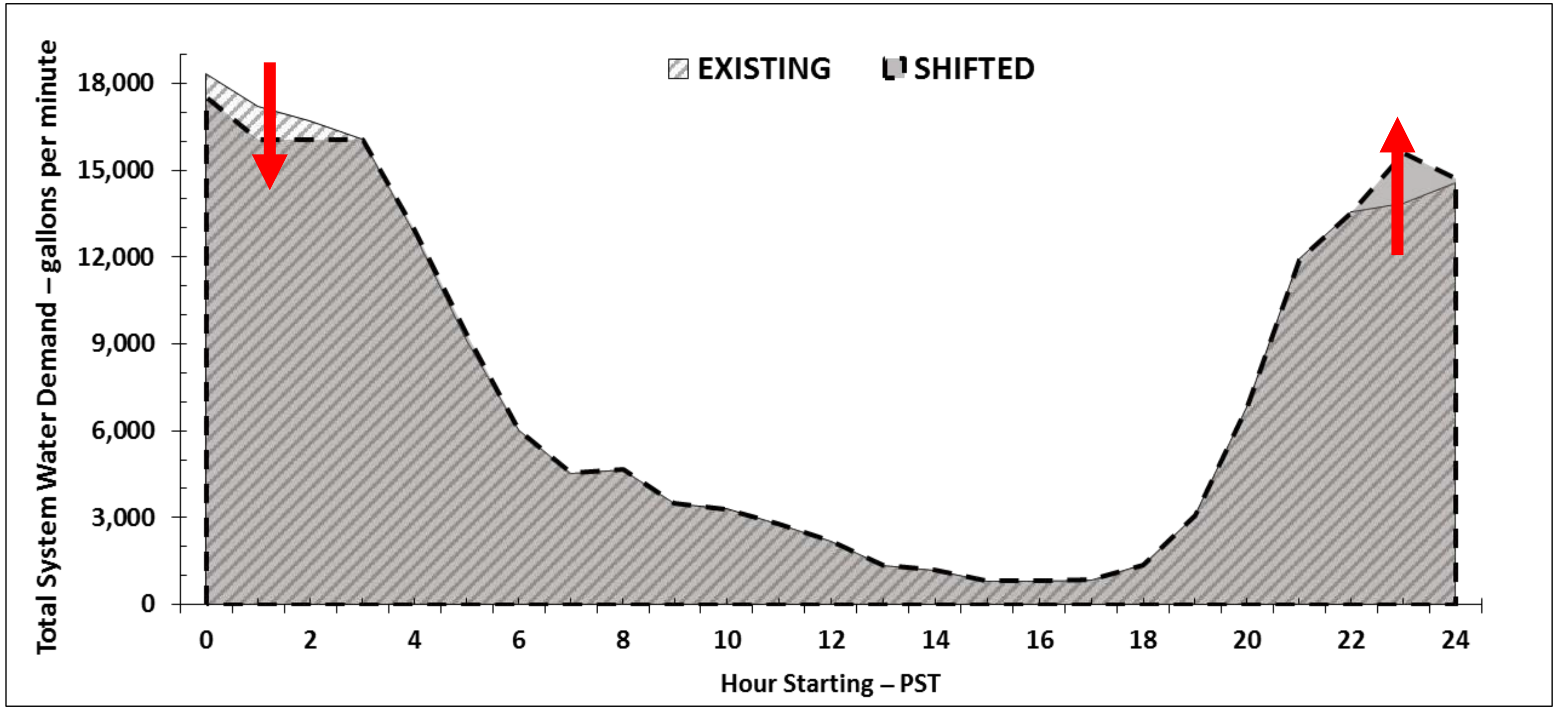
Photos by the Moulton Niguel Water District.

WATER PUMPING TO ACHIEVE DEMAND



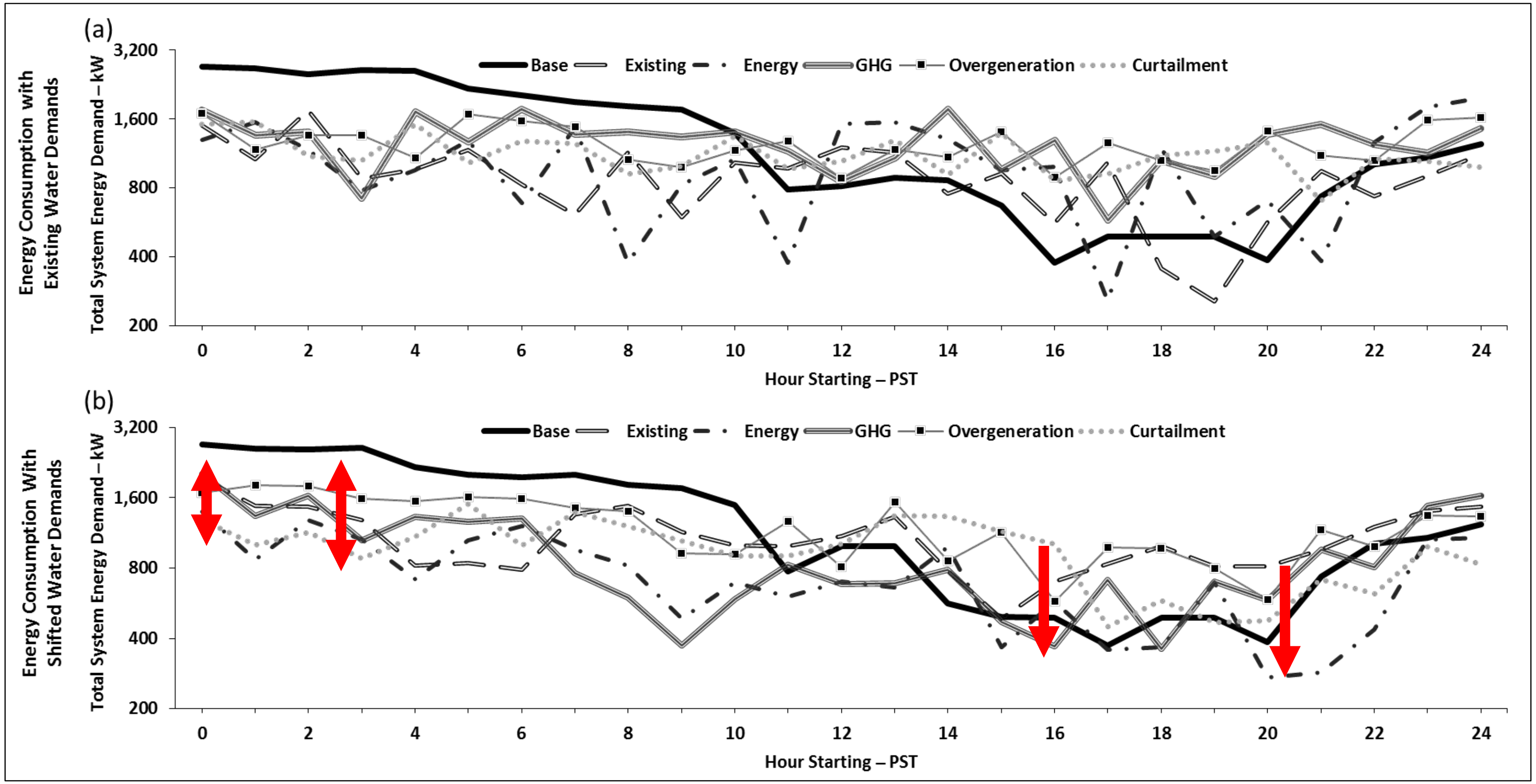
WATER DEMAND





We found that there were hundreds of ways to run a reclaimed system with water storage – and those options grew if you considered shifting irrigation demand.

Figure From: Good, R. (2018). "Reducing Electricity Grid Imbalances through Energy Demand Management of Water Delivery Infrastructure." Master's Thesis. March 9th 2018, University of California, Davis.



We found that there were hundreds of ways to run a reclaimed system with water storage – and those options grew if you considered shifting irrigation demand.

Figure From: Good, R. (2018). "Reducing Electricity Grid Imbalances through Energy Demand Management of Water Delivery Infrastructure." Master's Thesis. March 9th 2018, University of California, Davis.

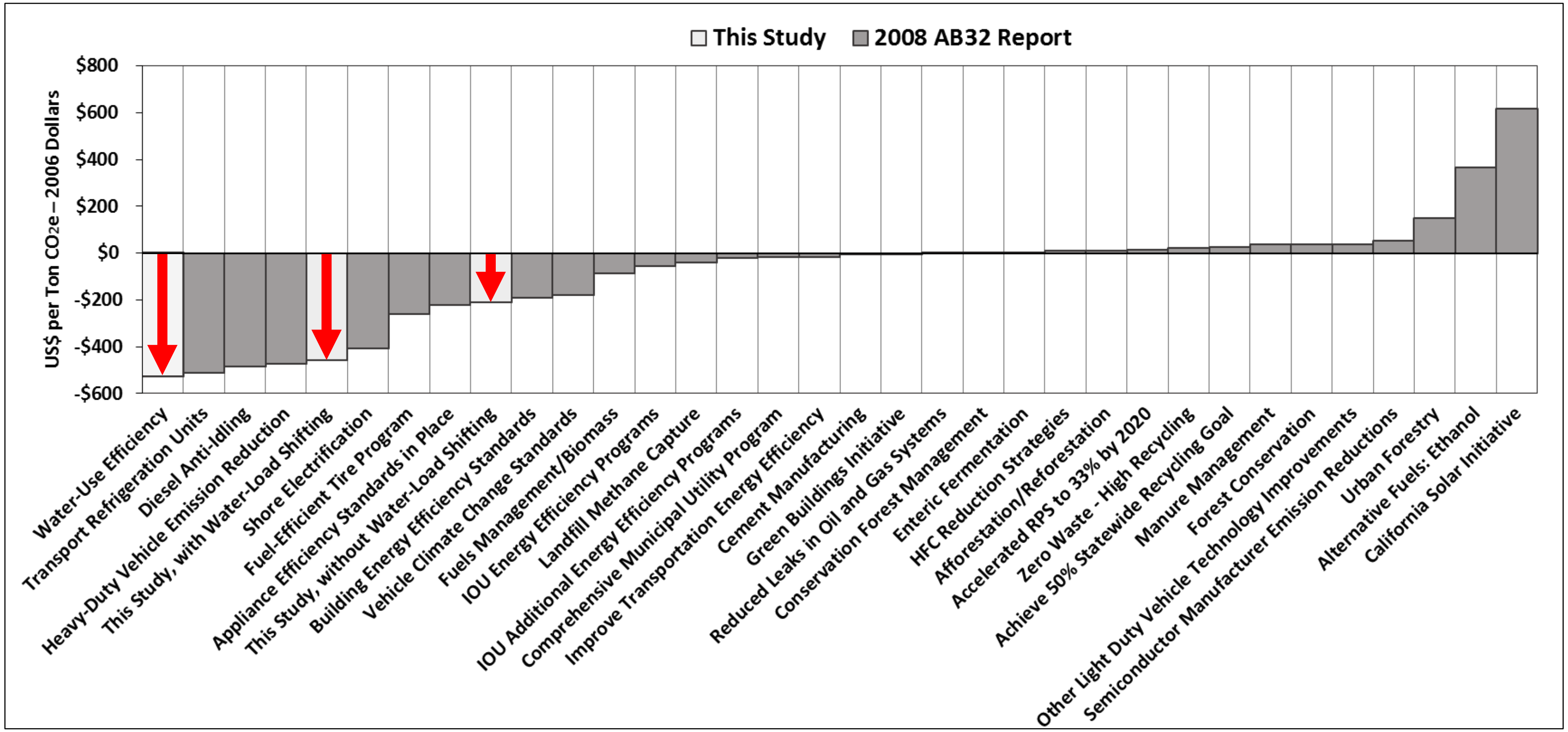
Table: Optimization Results for the Recycled Water Distribution System of the Moulton Niguel Water District

Scenario	% Change to Total Energy Consumed % of MWh	% Change to Total Emissions % of $mTCO_2e$	% Change to Carbon Intensity of Energy Consumed % of $mTCO_2e$ / MWh
Optimized	17.97%	22.23%	5.42%
Optimized With Water Demand Shifted	27.82%	30.55%	3.76%

Results of a pump-schedule optimization over a 48-hour period utilizing a particle swarm optimization.

On average, shifting the irrigation customer demands to reduce the peak increased potential energy savings from 18% to 28%.

Figure From: Good, R. (2018). "Reducing Electricity Grid Imbalances through Energy Demand Management of Water Delivery Infrastructure." Master's Thesis. March 9th 2018, University of California, Davis.



In the context of cost-effective ways to reduce carbon emissions, shifting and conservation in the water sector are some of the most competitive options

Figure From: Good, R. (2018). "Reducing Electricity Grid Imbalances through Energy Demand Management of Water Delivery Infrastructure." Master's Thesis. March 9th 2018, University of California, Davis.

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Questions?

Robert Good

rtgood@ucdavis.edu
https://cwee.ucdavis.edu
https://cwee.ucdavis.edu/waterwatch/

UCDAVIS
Center for Water-Energy Efficiency

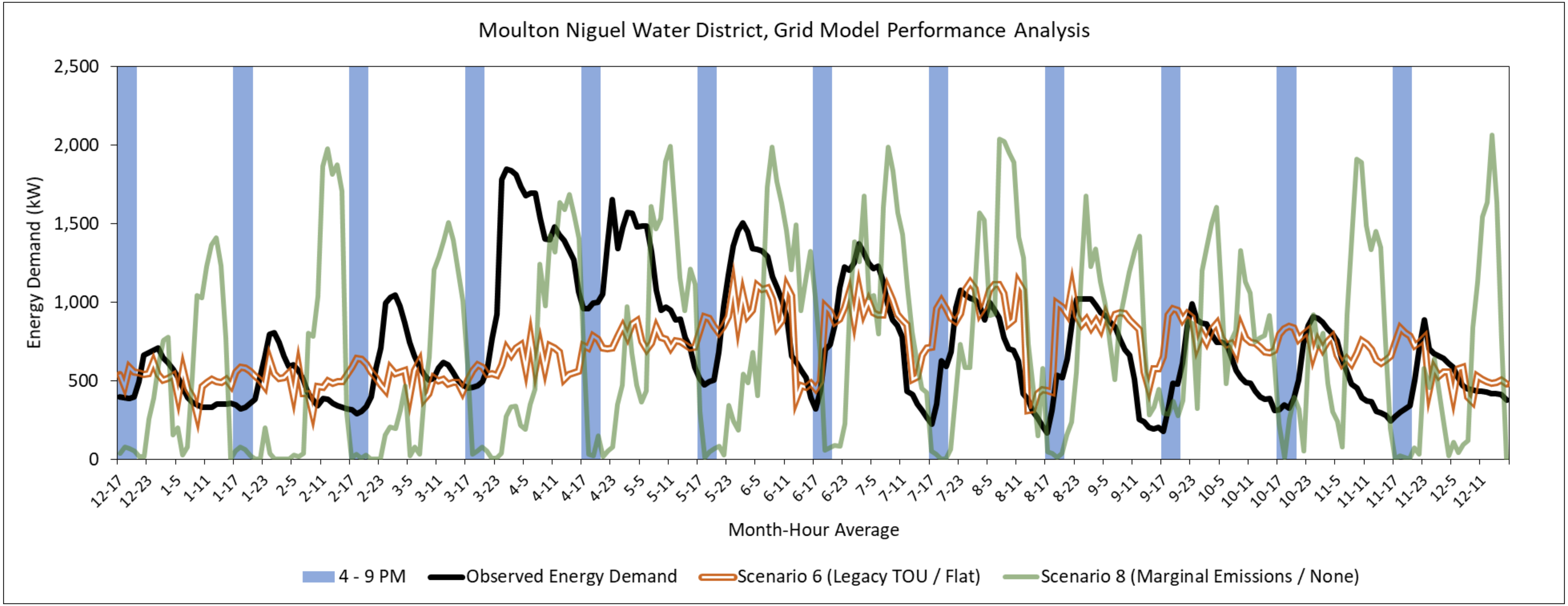
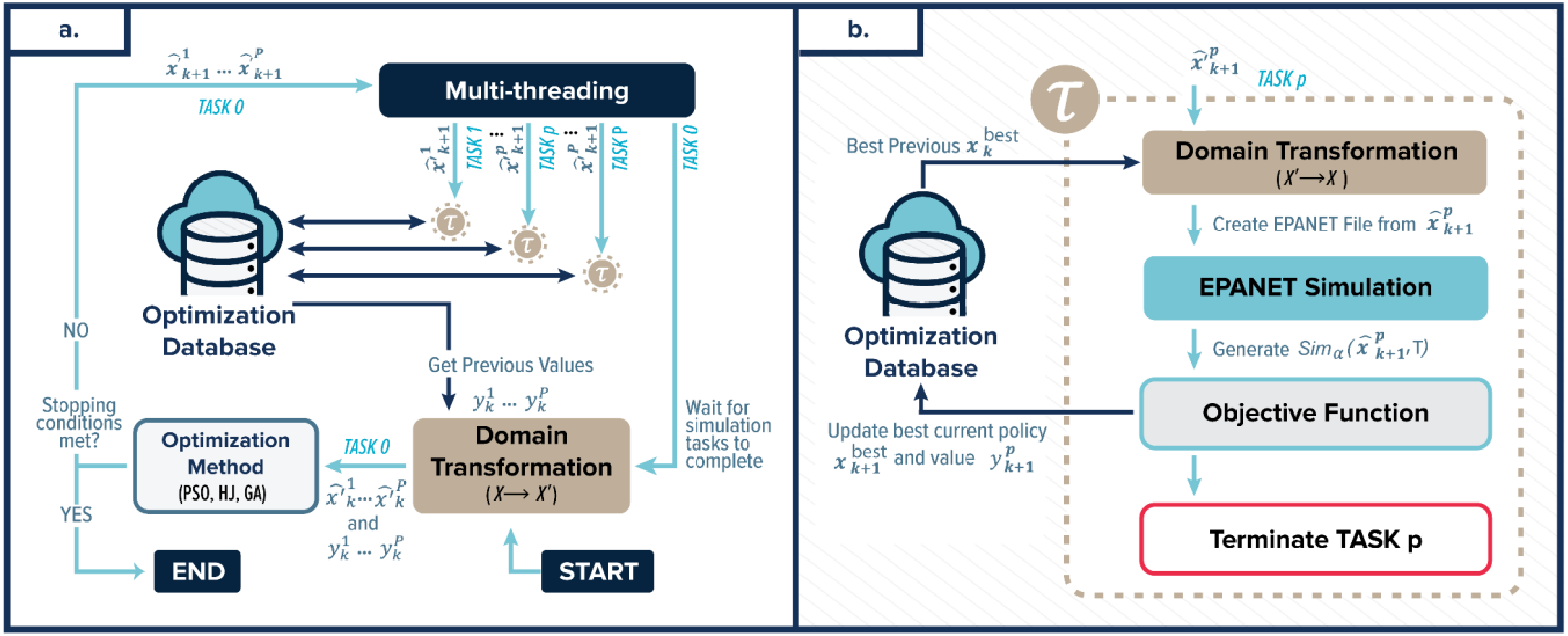
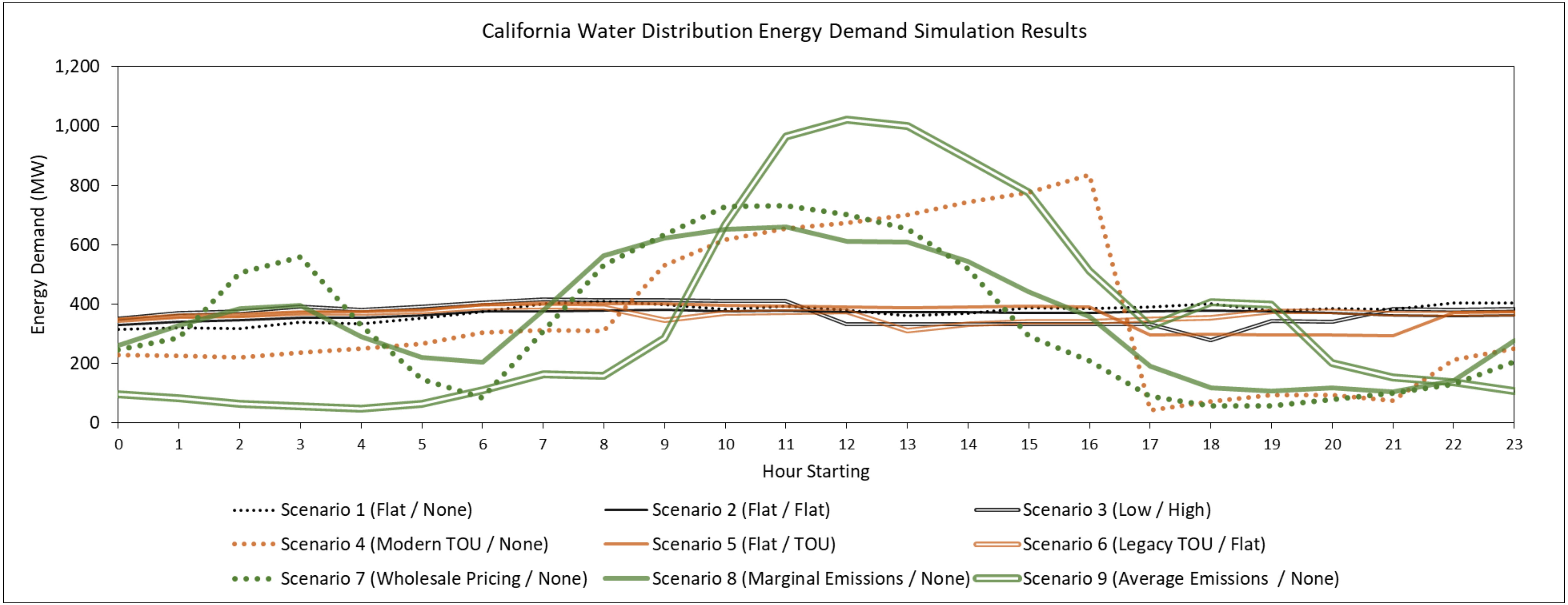


Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy



We started by developing a tool that solves for pump controls (If…then…else) rather than solving for 24-hour schedules. But we needed a tool that could be overridden in real-time.

Figure From: D. Linz, B. Ahmadi, R. Good, E. Musabandesu and F. Loge, "Multi-Threaded Simulation Optimization Platform for Reducing Energy Use in Large-Scale Water Distribution Networks with High Dimensions," 2020 Winter Simulation Conference (WSC), 2020, pp. 704-714, doi: 10.1109/WSC48552.2020.9383920.



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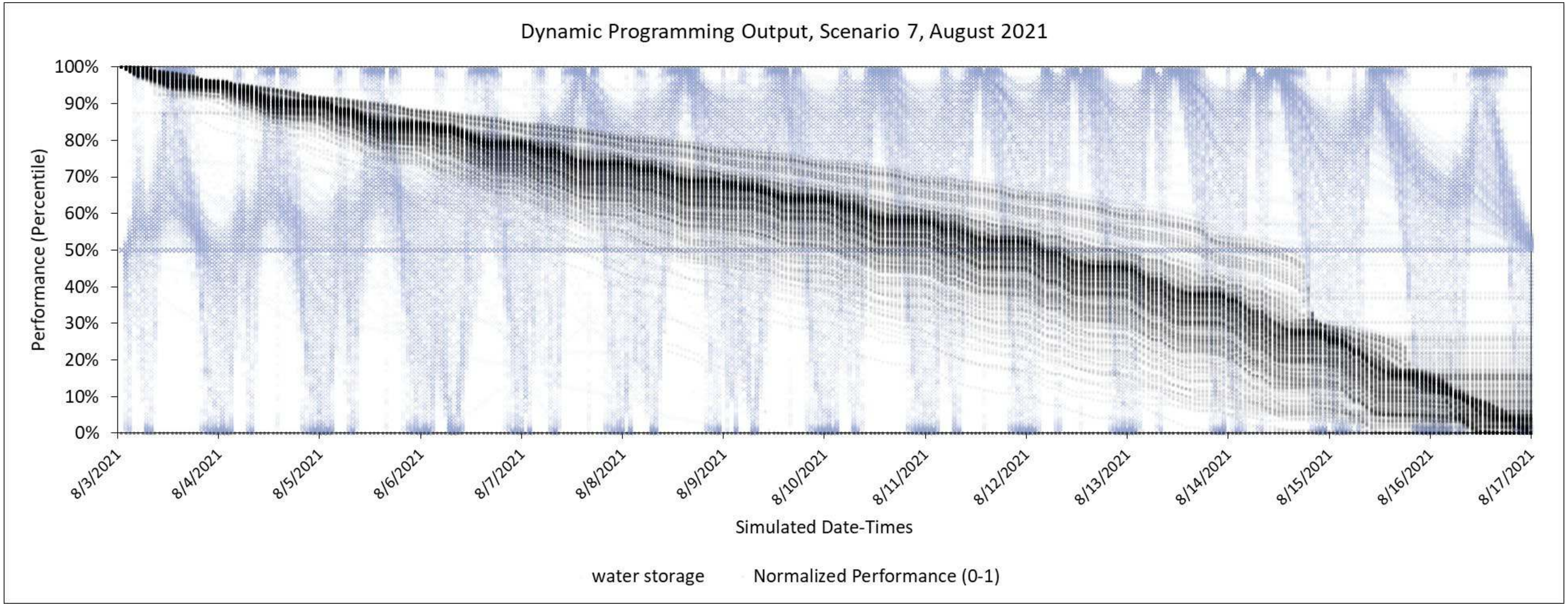


Depending on the ration of storage to pumping capacity to customer demand, the flexibility of operations at each water system can vary widely.

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy

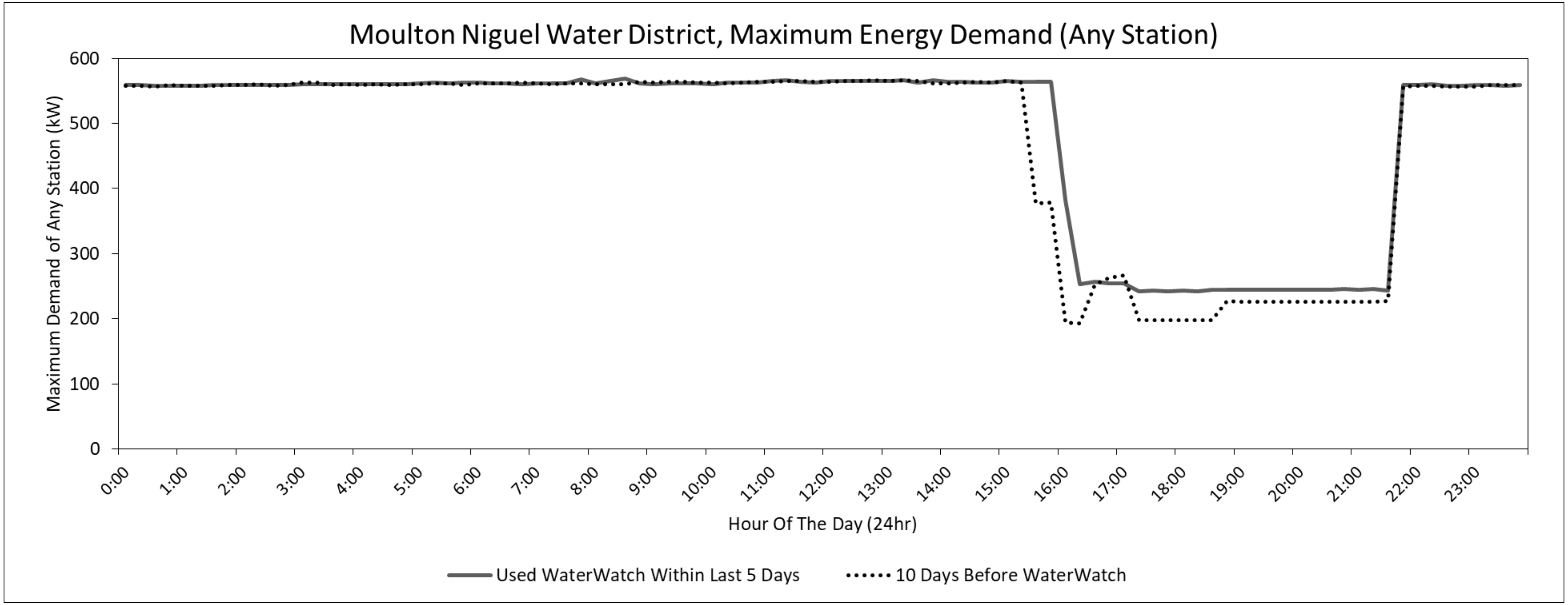
Table: Annual average daily peak net energy demanded from the CA water distribution sector, magnitude and percent reduction in average daily net peak demand relative to scenario one for all eight scenarios.

Scenario (Consumption / Demand)[1]	Annual Average Daily Peak Net Energy Demanded (MW)[1]	Change in Annual Average Daily Peak Net Energy (From Scenario 1) (MW)	Percent Change in Average Daily Peak Net Demand (From Scenario 1) (%)
1 (Flat/None)	378.3	0.0	0.0%
2 (Flat/Flat)	376.1	-2.1	-0.6%
3 (Low/High)	342.5	-37.9	-9.3%
4 (TOU/None)	92.5	-285.7	-75.6%
5 (Flat/TOU)	295.3	-82.7	-21.8%
6 (TOU/Flat)	375.2	-2.6	-0.7%
7 (RTP/None)	56.3	-321.5	-85.1%
8 (Emissions)	105.6	272.1	-72.0%

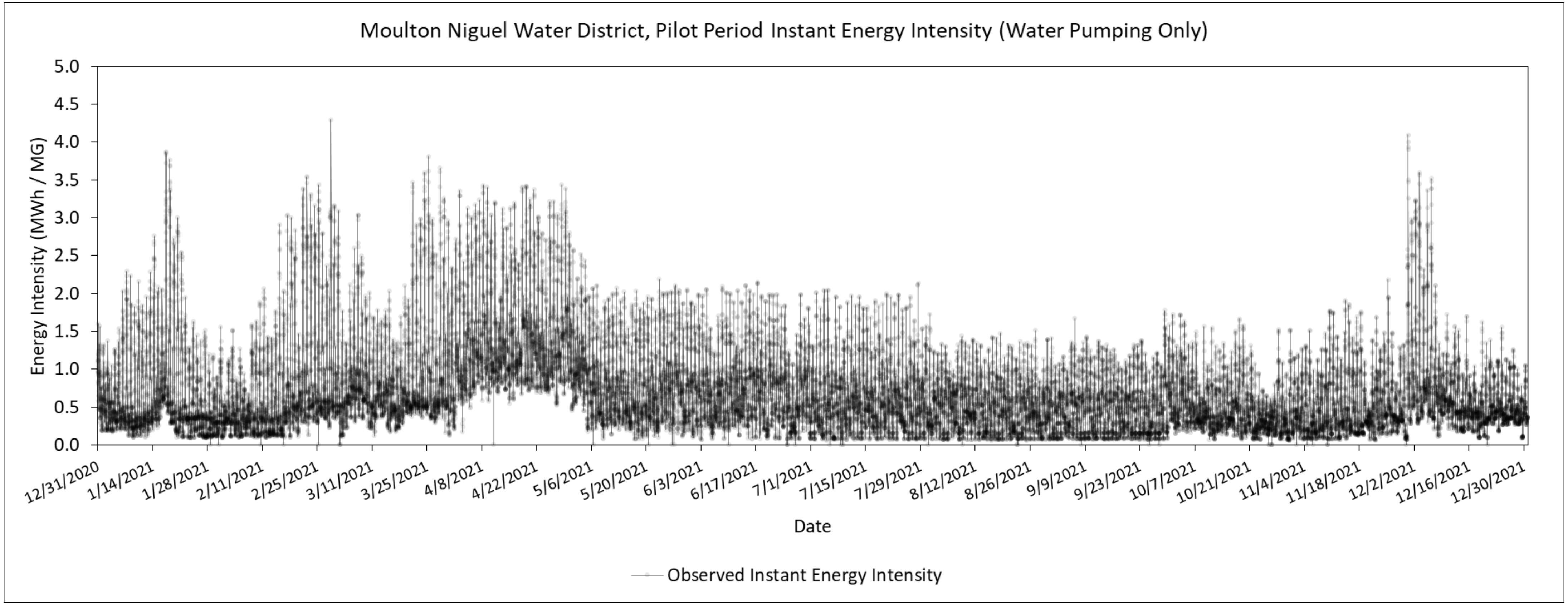
1. Peak energy measured as energy demanded at the 7pm hour (representing the net peak demand on the CA grid in 2020)

Water distribution pumping appears to account for 1.2% of all demand in California – and up to 85% of that demand could be shifted out of the 7pm period with demand charges removed.

Figure From: Rupiper, A., Good, R., Miller, G., & Loge, F. (2022). Mitigating renewables curtailment and carbon emissions in California through water sector demand flexibility. In Review at Applied Energy



We used a discontinuity approach – analyzing the period before and after their interactions with the tool.



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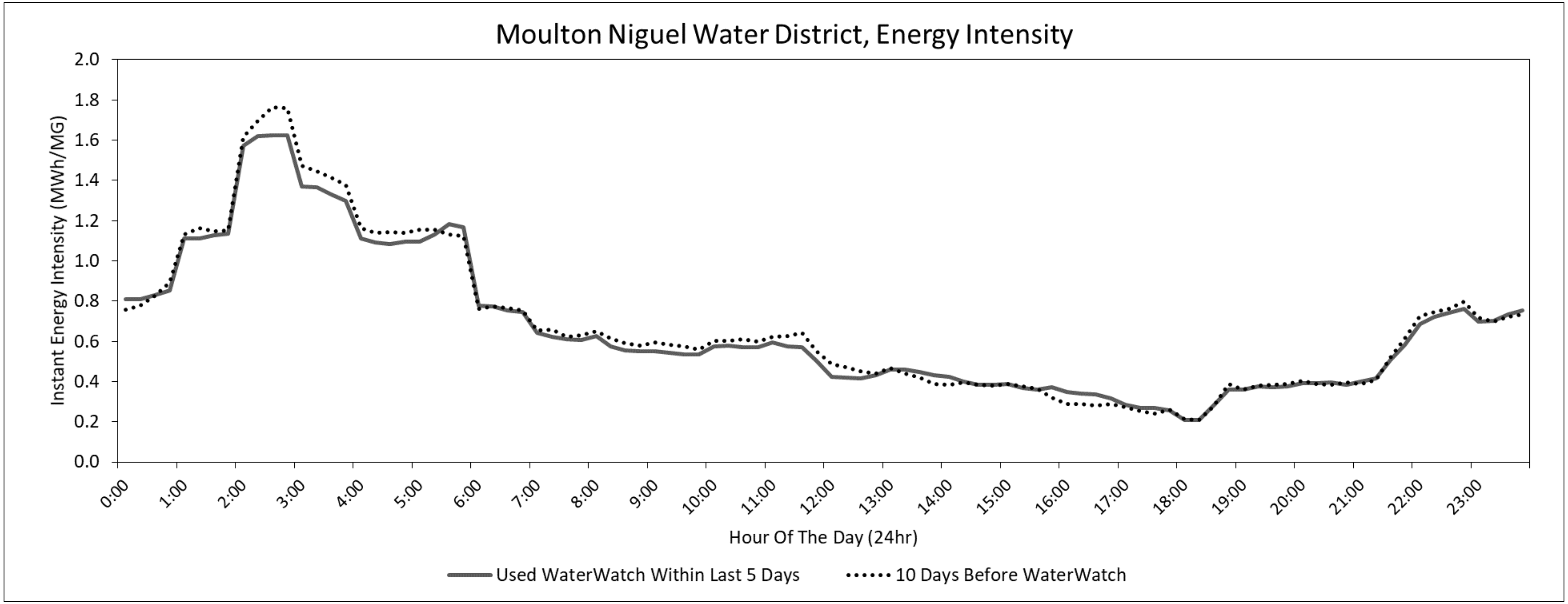

We used a discontinuity approach – analyzing the period before and after their interactions with the tool.

Water Manager and Irrigation Consultant

The inner workings of a necessary relationship

Glenn Kramer, O’Connell Landscape
Steve Hohl, Water Concern

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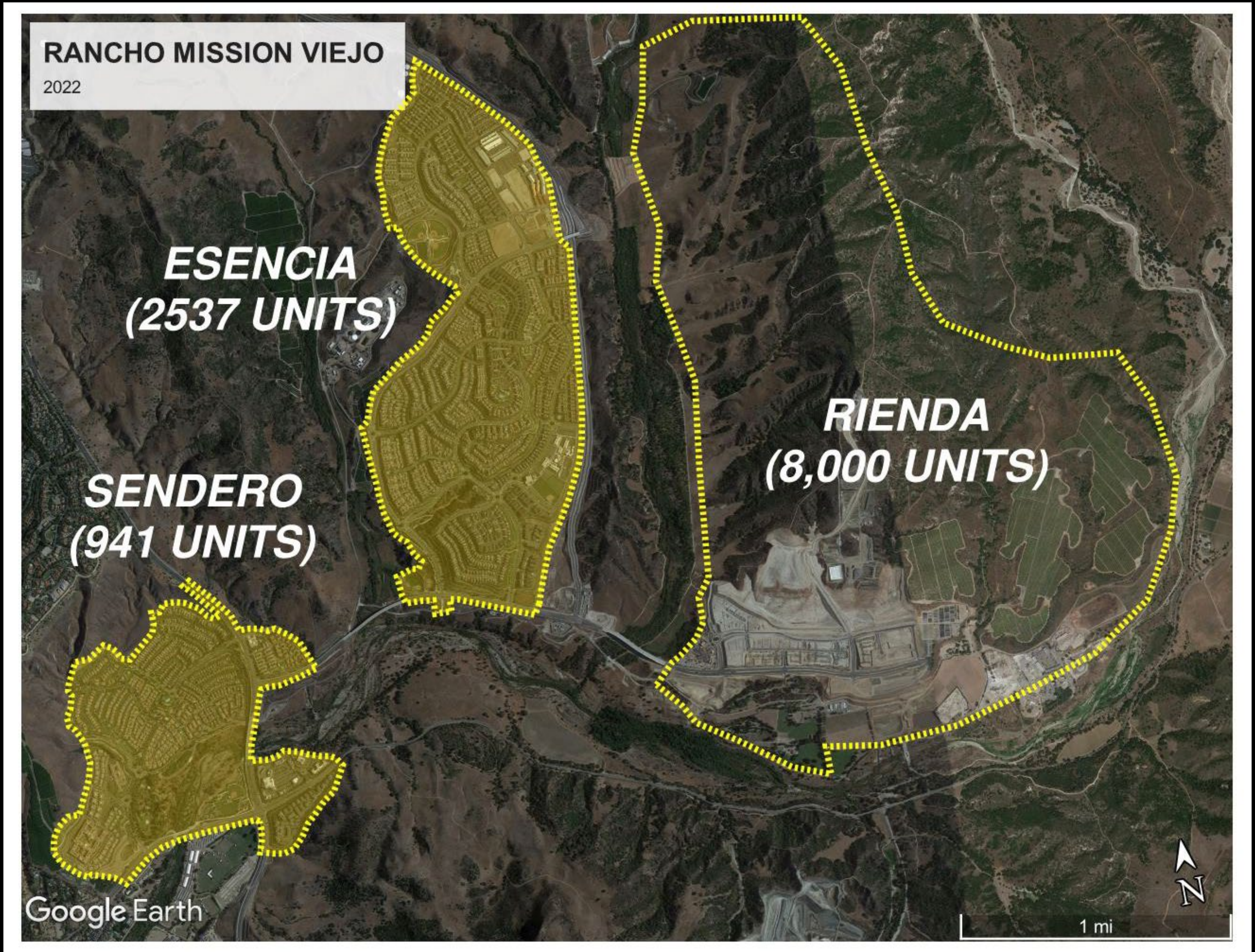
NEW ORLEANS

Rancho Mission Viejo

- Master Planned in 2010
- Broke ground 2012
- Three Villages to date
  - Sendero
  - Esencia
  - Rienda –opened early April 2022
- Ultimate 14,000 homes
- 2,100 acres (59, 30, 11)
- 5,500 AF / year recycled water
- 900 controllers
- Central control with flow management


RANCHO MISSION VIEJO
2022
ESENCIA
(2537 UNITS)
SENDERO
(941 UNITS)
RIENDA
(8,000 UNITS)
Google Earth
N
1 mi

Rancho Mission Viejo



Rancho Mission Viejo

Managing H2O for HOAs

Rene Orta, Mosaic Consulting

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HOA

HOME OWNERS ASSOCIATION

H_2O

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NEW ORLEANS

MOSAIC

Horticulture • Arboriculture • Irrigation • Soils

Presenter: Rene Orta

Horticulture & Water Manager Consultant

Introduction

- Who is Mosaic?
- Who is Rene Orta?
- Case Study: Ladera Ranch, CA
- Stakeholders

Bridging the Gap

- HOA boards
- Water Purveyor
- Irrigation Consultants
- Maintenance

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NEW ORLEANS

MOSAIC
Horticulture • Arboriculture • Irrigation • Soils

Presenter: Rene Orta
Horticulture & Water Manager
Consultant

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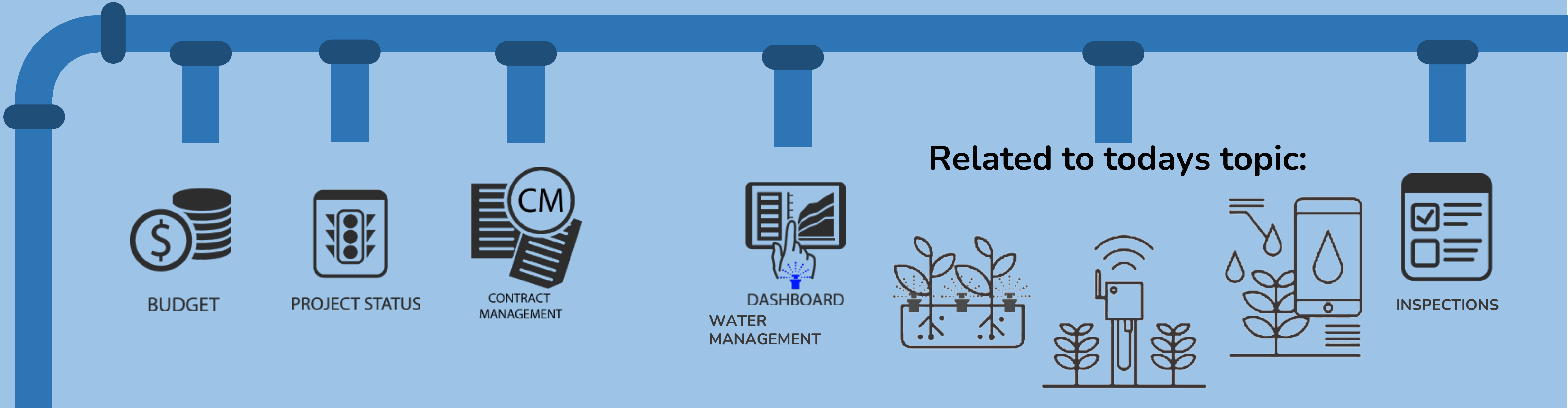
MOSAIC
Horticulture • Arboriculture • Irrigation • Soils

Mosaic Consulting Inc. bridges the gap between **communities** and their **manufactured landscapes**. We challenge deep-rooted industries and **deliver innovative solutions** that meet the needs of all **stakeholders** involved.

Mosaic has been providing **Administrative, Horticulture, Arboriculture, and Water Management services** for over **20 years** in Southern California. We primarily deal with **HOA and HOA boards** providing the following:



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RENE ORTA

I grew up working in the landscape industry. My first full time job was propagating, nursing, and watering at my family owned plant nursery. My love for plants lead me to attain a Bachelors of Science in Landscape architecture with an emphasis in irrigation design. Currently, I manage the central irrigation system and help oversee landscape maintenance contracts for large HOAs. Over the last 5 years I have concentrated on education. I strongly believe education is the key to change and success.

Education

B.S. Landscape Architecture
Minor in Irrigation Design
CalPoly Pomona, CA

MSA – Parks and Recreation
Central Michigan University, MI

Certificates

QAL
CLIA
QWEL
CPSI
CLCA-WM

Why water conservation?

Love 4 H2O

Work Credentials

Landcare (Trugreen landscape)
JMS Design Firm
Ortas Nursery
UCANR
Orange County Regional Parks
MOSAIC

“DO or DO NOT… there is no try”
- Yoda

“There is no life without water”
– Albert Szent-Gyorgyi

Ladera Ranch

750 Irrigated Acres

350 Slopes, 98 Fuel mod, 157 Turf, 126 Shrubs
591 miles of pipe, 1597 miles of irrigation wire

50,000 Trees

Ladera Ranch has more trees than Central Park, NY
Oaks, Sycamore, Tristania, Schinus, Palms, Crape myrtles

5-7 million dollar budget

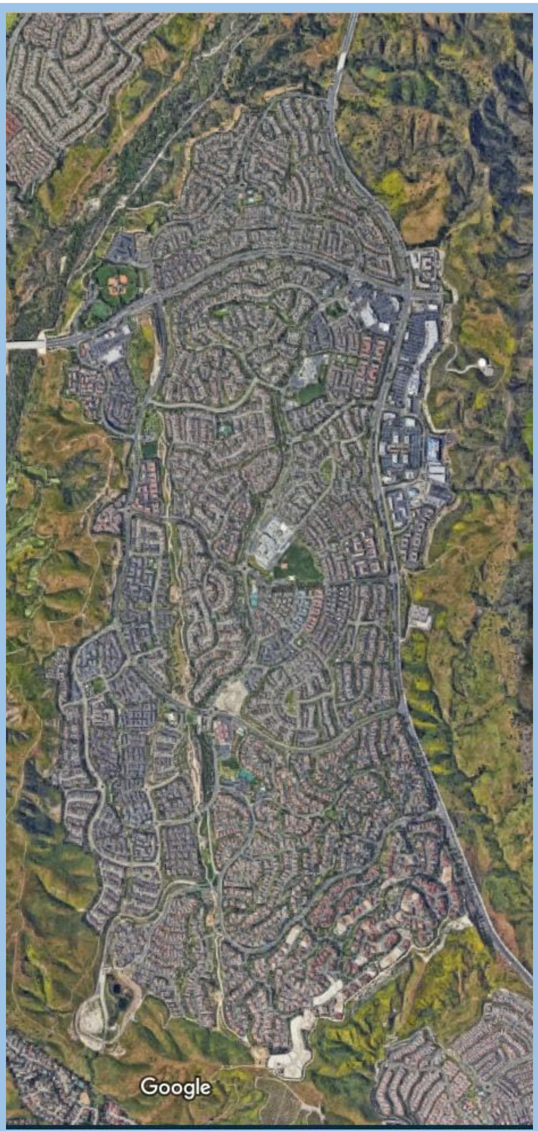
Budget consists of landscape contracts, water budget, irrigation repairs, and capital improvement projects.

12 Sports fields + 2 dog parks

One 5 acre open grass field, 3 soccer fields, 8 Baseball/Soccer fields

276 Central Irrigation Controllers + 50 Battery operated controllers

Mosaic Consulting and Hydropoint Data Systems worked together to develop a new feature for their central control cloud system.



Ladera Ranch

MOSAIC CONSULTING

HOA Boards

- Educate
- Manage Budget
- Provide Solutions
- Oversee Maintenance contracts
- Maintenance prevention

Water Purveyor

- Educate
- Water allocations
- Plant Coefficients
- Reclaimed water compliance walks
- Water availability
- Water window compliance negotiations
- REBATES!

Designers

- Educate
- Field walks
- Collaboration
- Design Revisions

Maintenance Contractors

- Educate
- Project Management
- Direct Oversight
- Specifications Overview
- Landscape Inspections
- Irrigation Inspections

Coffee and Bagel discussions

HOA BOARDS


HOW TO
instructions
"What You Need to Know!"
Educate
HOW CAN WE FIX IT?
Solutions
Manage Budget
PREVENTION

Transparancy

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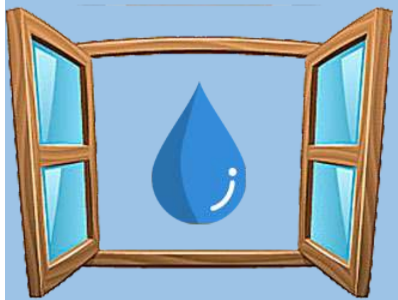
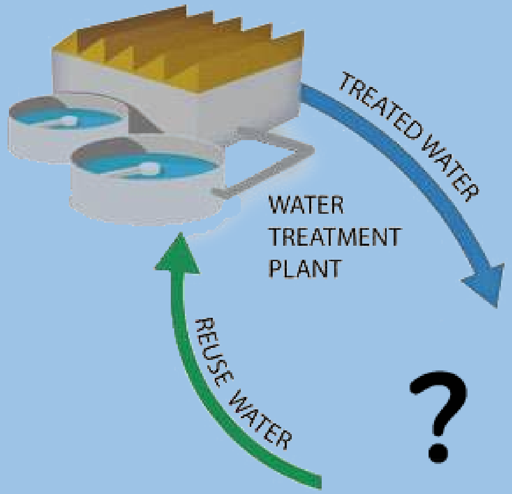
Water Purveyor




INSPECTIONS



OUTDOOR = Irrigable Area SQ. footage x ET monthly evapotranspiration rate x ~~0.8 ET Adjustment Factor~~ 1.0 Et ÷ 1200 Conversion Factor

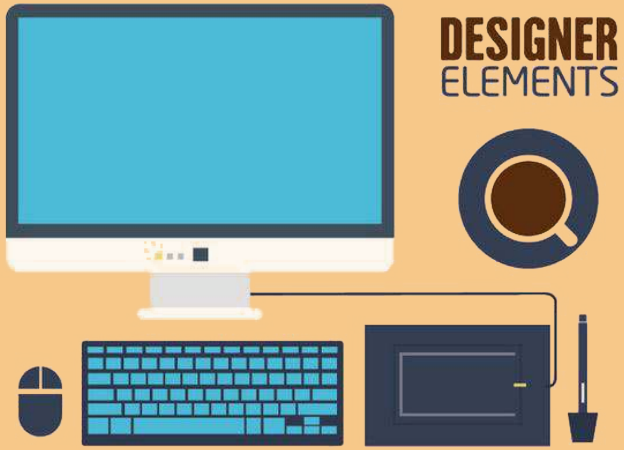
Designers

COLLABORATION

TABLE 1. Plant factors (PF)/crop coefficients (K_c) for established landscape plants in California

Plant type	Plant factor (PF)*/ Crop coefficient (K_c)†
Landscape plants with high water use	0.7–0.9*
Landscape plants with medium/moderate water use	0.4–0.6*
Landscape plants with low water use	0.1–0.3*
Landscape plants with very low water use	< 0.1*
Warm-season turfgrass (Bermudagrass, zoysiagrass, St. Augustinegrass, buffalograss)	0.6†
Cool-season turfgrass (tall fescue, Kentucky bluegrass, ryegrass, bentgrass)	0.8†

UCANR.EDU



Designers

Irrigation Firms – Landscape Architecture Firms

Irrigation Firms – Irrigation firms

Irrigation Firms – Water Managers

Irrigation Firms – Landscape Maintenance

Irrigation Firms – Water purveyors

Water Managers – Landscape Architecture Firms

Water Managers – Landscape Maintenance

Water Managers – Water purveyors

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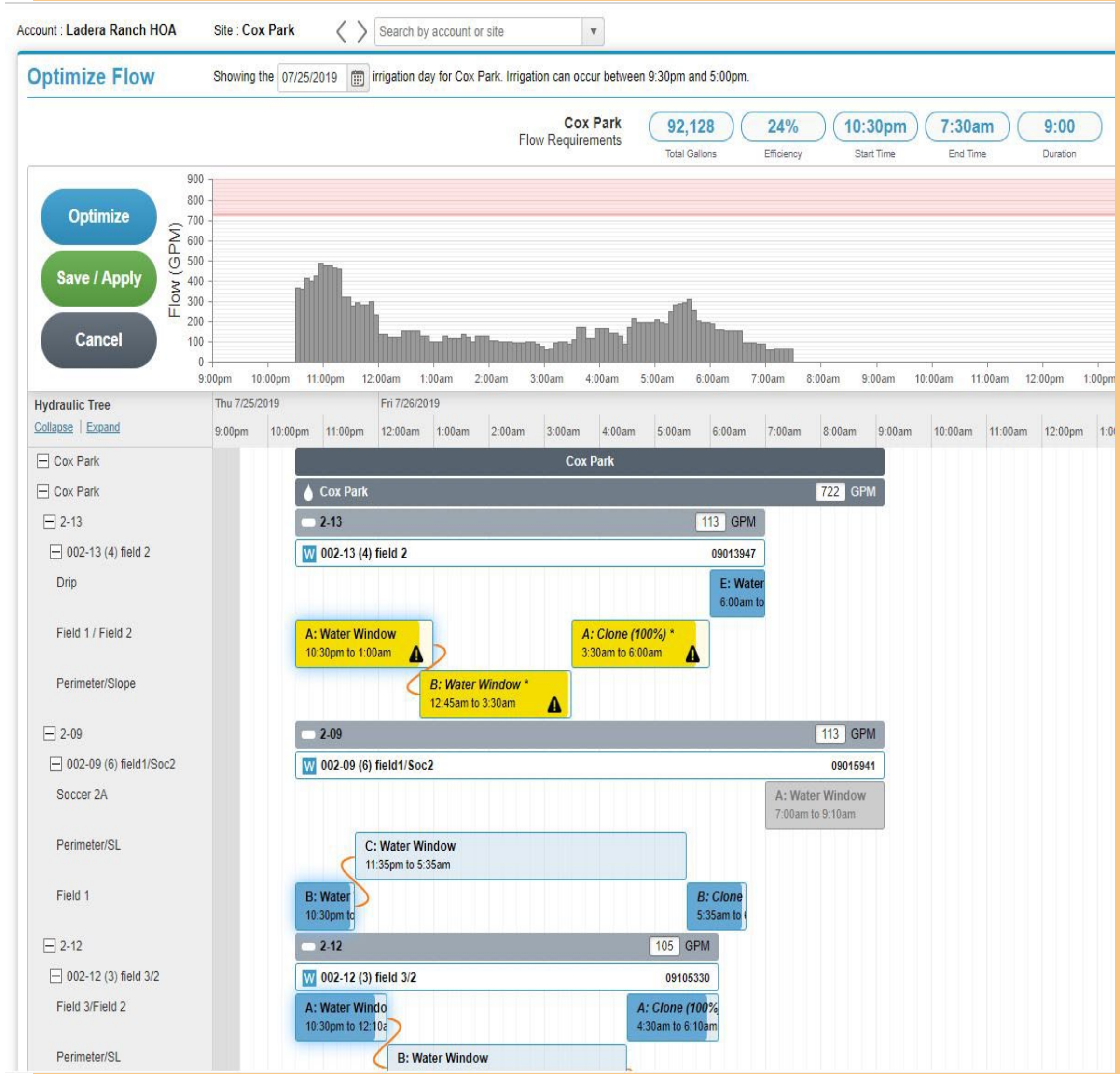
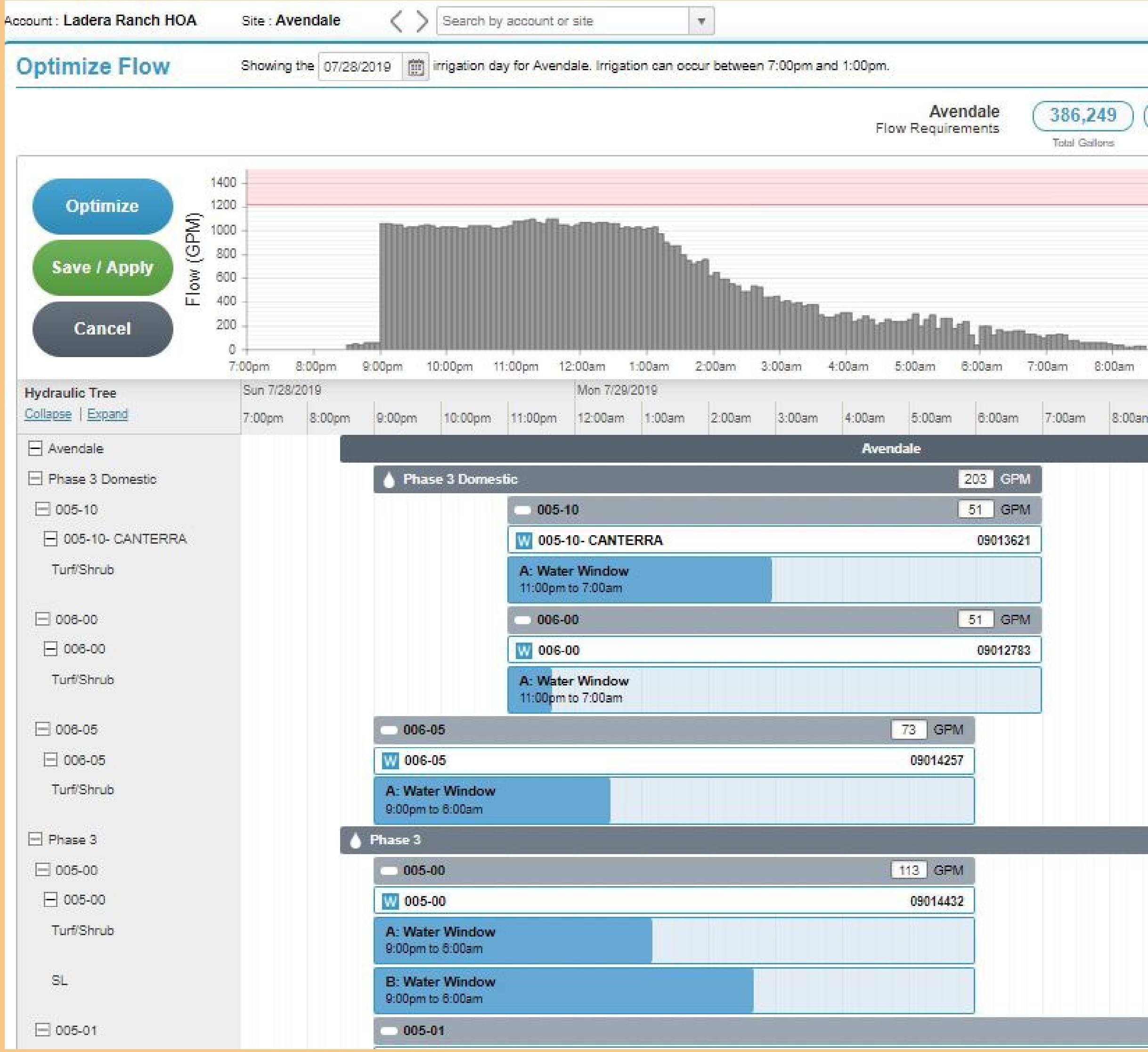




Designers

Educate

Design with rebates in mind

- Know the process and procedures
- Spec appropriately

Local water purveyor & Metropolitan Agency

- Rebates can be combined

Know local water window restrictions and enforcement policies, design appropriately.

- Drip requires long cycle soak times and schedules could surpass water window limitations.

Watering limitations how they impact water windows

- Gallons of water per acre?
- Max GPM per area, street, meter, and hydrozone.
- Zone pressure restrictions

Process order can differ per agency.

- **We took over an account after a turn over walk, and the HOA asked us to attain rebates. This particular agency requested field walks pre and post install of any rebate item. We couldn't get any rebate money, the HOA had budgeted for the cost of the project. HOA had to use reserve funds instead.**

Water window negotiations

- ALLOWED DAY irrigation of Drip Irrigation
- ALLOWED DAY irrigation for interior slopes (away from public)
- ALLOWED DAY irrigation for areas with nightly pressure problems (had water purveyor do inhouse PSI tests)
- ALLOWED staggered water window start times to reduce mass pressure loss

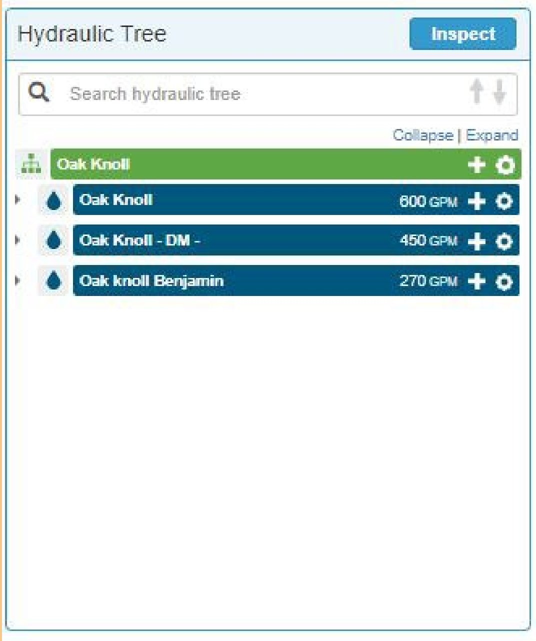
Designers

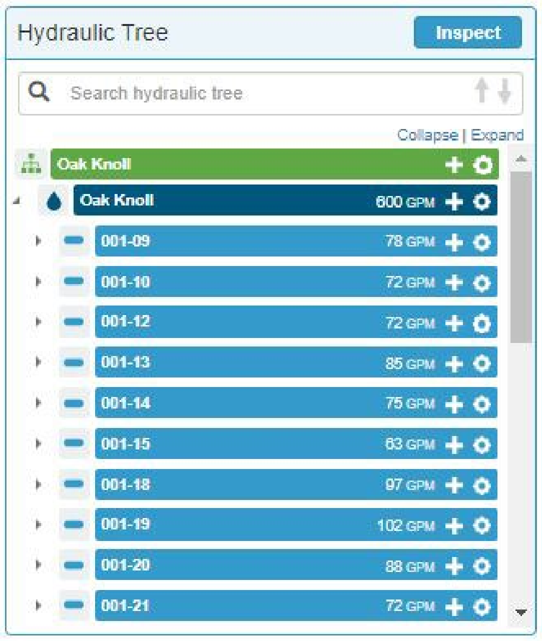
Water limitations

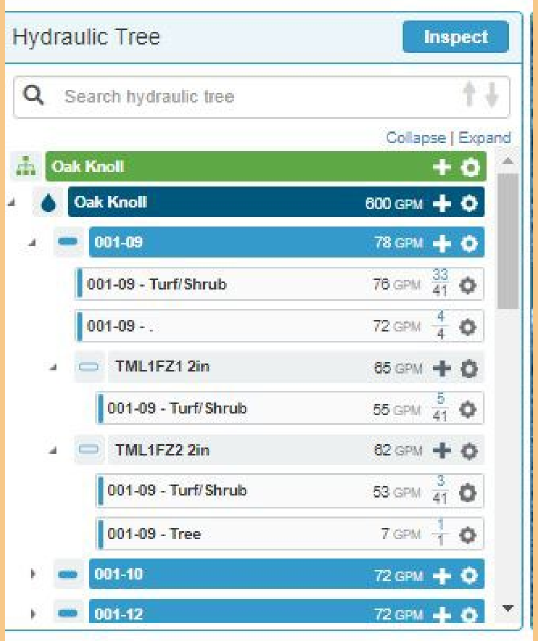
- 5 million gallon tank & 2 million gallon tank
  peak demand exceeds
  7 million & 3 million gallons

a. Worked with water purveyor to gather infrastructure as builds. Knowing max flows allows us to determine how many controllers/valves we can run at the same time.

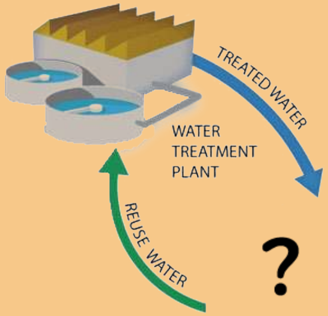
b. Before everything ran at 8pm. Inlet PSI would drop to 30-50 PSI. Specific example: is six – 2” meters on a 6” line. We now have staggered times for two sets of 3 controllers each.







Designers



Understand how reclaimed water damages all aspects of horticulture and specifically irrigation.

- Know your water source!! Simply knowing its reclaimed is not enough. Where is it from? What do the quality reports look like?
- Shorter life expectancy for galvanized pipe, valves, sprinklers, nozzles. Chlorine accelerates corrosion and decomposition of materials
- Hardness of water clogs nozzles quicker.
- Water crystalizes during off months
- Water molds over, grow bacteria during off months

Understand how reclaimed water damages all aspects of horticulture and specifically irrigation.

- We are replacing all galvanized with PCV
- Specifying reclaimed water components. “More durable”
- Exercise all components and allow water flow during off months.
- Flush all drip valves to remove algae growth and slime.
- Treat with chemical for algae and hardness– fertitank

Understand long term affects of reclaimed water on soil and plants. Analyze appropriately, and consider hydrozones encompassing future replanting changes

Designers

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Designers

Sample Id : **Chaparral**

SATURATION EXTRACT - PLANT SUITABILITY

Test	Result	Effect on Plant Growth: Negligible	Sensitive Crops Restricted	Many Crops Restricted	Only Tolerant Crops Satisfactory	Few Crops Survive
Salinity (ECe)	1.8 dS/m					
Sodium Adsorption Ratio (SAR) *	4.61					
Boron (B)	1.01 ppm					
Sodium (Na)	10.0 meq/L					
Chloride (Cl)						
Carbonate (CO3)						
Bicarbonate (HCO3)						
Fluoride (F)						

* Structure and water infiltration of mineral soils potentially adversely affected at SAR values higher than 6.

Test	Result	Strongly Acidic	Moderately Acidic	Slightly Acidic	Neutral	Slightly Alkaline	Moderately Alkaline	Strongly Alkaline	Qualitative Lime
pH	6.9 s.u.								None

EXTRACTABLE NUTRIENTS

Test	Result	Sufficiency Factor	Soil Test Ratings: Very Low	Low	Medium	Optimum	Very High
Available-N	31 ppm	0.6					
Phosphorus (P) - Olsen	13 ppm	0.4					
Potassium (K)	28 ppm	0.2					
Potassium - sat. ext.	1.9 meq/L						
Calcium (Ca)	1230 ppm	0.8					
Calcium - sat. ext.	6.4 meq/L						
Magnesium (Mg)	363 ppm	1.7					
Magnesium - sat. ext.	3.0 meq/L						
Copper (Cu)	0.8 ppm	0.7					
Zinc (Zn)	7 ppm	1.4					
Manganese (Mn)	1 ppm	0.1					
Iron (Fe)	32 ppm	0.7					
Boron (B) - sat. ext.	1.01 ppm	3.4					
Sulfate - sat. ext.	10.0 meq/L	3.3					
Exch Aluminum							

NO3-N	NH4-N	Total Exchangeable Cations(TEC)
16 ppm	15 ppm	94 meq/kg

Sample Id : **Oso Grande Park**

SATURATION EXTRACT - PLANT SUITABILITY

Test	Result	Effect on Plant Growth: Negligible	Sensitive Crops Restricted	Many Crops Restricted	Only Tolerant Crops Satisfactory	Few Crops Survive
Salinity (ECe)	15.6 dS/m					
Sodium Adsorption Ratio (SAR) *	10.14					
Boron (B)	1.70 ppm					
Sodium (Na)	71.4 meq/L					
Chloride (Cl)						
Carbonate (CO3)						
Bicarbonate (HCO3)						
Fluoride (F)						

* Structure and water infiltration of mineral soils potentially adversely affected at SAR values higher than 6.

Test	Result	Strongly Acidic	Moderately Acidic	Slightly Acidic	Neutral	Slightly Alkaline	Moderately Alkaline	Strongly Alkaline	Qualitative Lime
pH	7.6 s.u.								Low

EXTRACTABLE NUTRIENTS

Test	Result	Sufficiency Factor	Soil Test Ratings: Very Low	Low	Medium	Optimum	Very High
Available-N	30 ppm	0.4					
Phosphorus (P) - Olsen	19 ppm	0.4					
Potassium (K)	235 ppm	0.7					
Potassium - sat. ext.	5.2 meq/L						
Calcium (Ca)	3250 ppm	0.7					
Calcium - sat. ext.	42.0 meq/L						
Magnesium (Mg)	1790 ppm	3.0					
Magnesium - sat. ext.	57.1 meq/L						
Copper (Cu)	1.4 ppm	0.4					
Zinc (Zn)	4 ppm	0.3					
Manganese (Mn)	1 ppm	0					
Iron (Fe)	23 ppm	0.2					
Boron (B) - sat. ext.	1.70 ppm	5.7					
Sulfate - sat. ext.	120.0 meq/L	40.0					
Exch Aluminum							

NO3-N	NH4-N	Total Exchangeable Cations(TEC)
12 ppm	18 ppm	277 meq/kg

Designers

How can you create hydrozones if you don't know the plant name, therefore, plant factors??

Landscape Architects can be challenged, double check their work, as it affects your work

TABLE 1. Plant factors (PF)/crop coefficients (K_c) for established landscape plants in California

Plant type	Plant factor (PF)*/ Crop coefficient (K_c)†
Landscape plants with high water use	0.7–0.9*
Landscape plants with medium/moderate water use	0.4–0.6*
Landscape plants with low water use	0.1–0.3*
Landscape plants with very low water use	< 0.1*
Warm-season turfgrass (Bermudagrass, zoysiagrass, St. Augustinegrass, buffalograss)	0.6†
Cool-season turfgrass (tall fescue, Kentucky bluegrass, ryegrass, bentgrass)	0.8†

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Muhlenbergia- Deer grass

Pennisetum – Fountain grass

- Use water needs for naming controller valves
- When we have "programming issues" typically plant type solves the problem.
- Helps with consistency
- Have PLANT ID walks with irrigation consultants

12	SH-LW-SLD-TOP-MSU-R5
13	SH-LW-SLD-MID-MSU-R5
14	SH-LW-SLD-TOE-MSU-R5
15	TR-BU-Crapes
16	TR-BU-
17	SH-HW-SLD-TOP-SUN-R5
18	SH-HW-SLD-TOE-SUN-R5
19	TF-HW-PP-FLT-SUN-SP
20	SH-MW-PP-FLT-MSU-SP
21	TF-HW-PP-FLT-SUN-SP
22	SH-HW-SLD-TOE-MSU-SP

Designers

DESIGN – POC

- Normally open master valve
- Adding quick couplers before and after

POC

- Avoid water hammer or air in the lines We've eliminated mainline breaks on controllers with over 10+ years of historically yearly breaks.
- Helps with maintenance requests for water
- We've made it a standard to add quick couplers before and after the POC.
  - Accurate pressure readings
  - Allows master valve testing
  - Preventative

DESIGN – Sprinkler Design

- Have maintenance in mind
- Practicality not aesthetics
- Design my valve max threshold, not pipe size. Lateral breaks could equal the amount of GPM for the sprinklers by-passing high flow alerts.
- Rotaries have their place and time. (In the testing warehouse!).

Sprinklers

- Surprised to know how many designers have never been a job site!! We encourage designers to attend turn over walks, and visit sites a few years after.
- Do not exceed lateral GPM max threshold, different from valve GPM max threshold.
- With proper maintenance everything works as designed and intended. Reality most of the time that's not the case, therefore do not plan for it. Rotaries need weekly checks.

Designers

Misconception – Drip is not the savior of sustainability and water conservation

- **Drip has a proper time and place**
  - Commercial and Residential still has a lot to learn from Agricultural drip
  - Evaluate: site conditions, plant scheme, soil conditions, foot traffic, water quality
- **Do not use when planting for ground covers**
  - Will not be maintained: inspected, flushed or repaired. Small breaks are difficult to spot.
  - Mass plant die back for repairs
  - Specially in thorn planting. Best to have spray in these circumstances.
- **Knowing your water quality**
  - Hardness will clog
  - Bacteria will create algae and slime, which has to be chemically treated. Need a fertitank
- **Plans**
  - Spec indicators
  - Spec drip location in regards to plant location
  - Do not design drip by plant rootball. We want to encourage growth
  - Drip for turf??? Yeah I'm not touching that subject. NEXT

Designers

- General Design
  - We have the power to shutdown the Landscape architect curve or at least lower the radius!
  - Design Hydrozone/valve order with wet checks in mind.
  - Best location for controllers: toe of the slope, pocket parks, planter after the sidewalk (not adjacent to street)
  - Worst location for controllers: major streets, medians
  - Rotor/Spray 6” from any hardscape surface (not up to it)
  - At least two extra cables for the main bundle, and one extra cable for every large T’off
  - Valves in planters or grass: consistency
- Sport Fields
  - Infield hose connections
- Reclaimed Water
  - Keep valve locations in mind for easy accessibility. All components, specially boxes could be checked yearly for compliance.
- Water management
  - Create Hydraulic trees for different sites based on maximum allowed capacity of mainline

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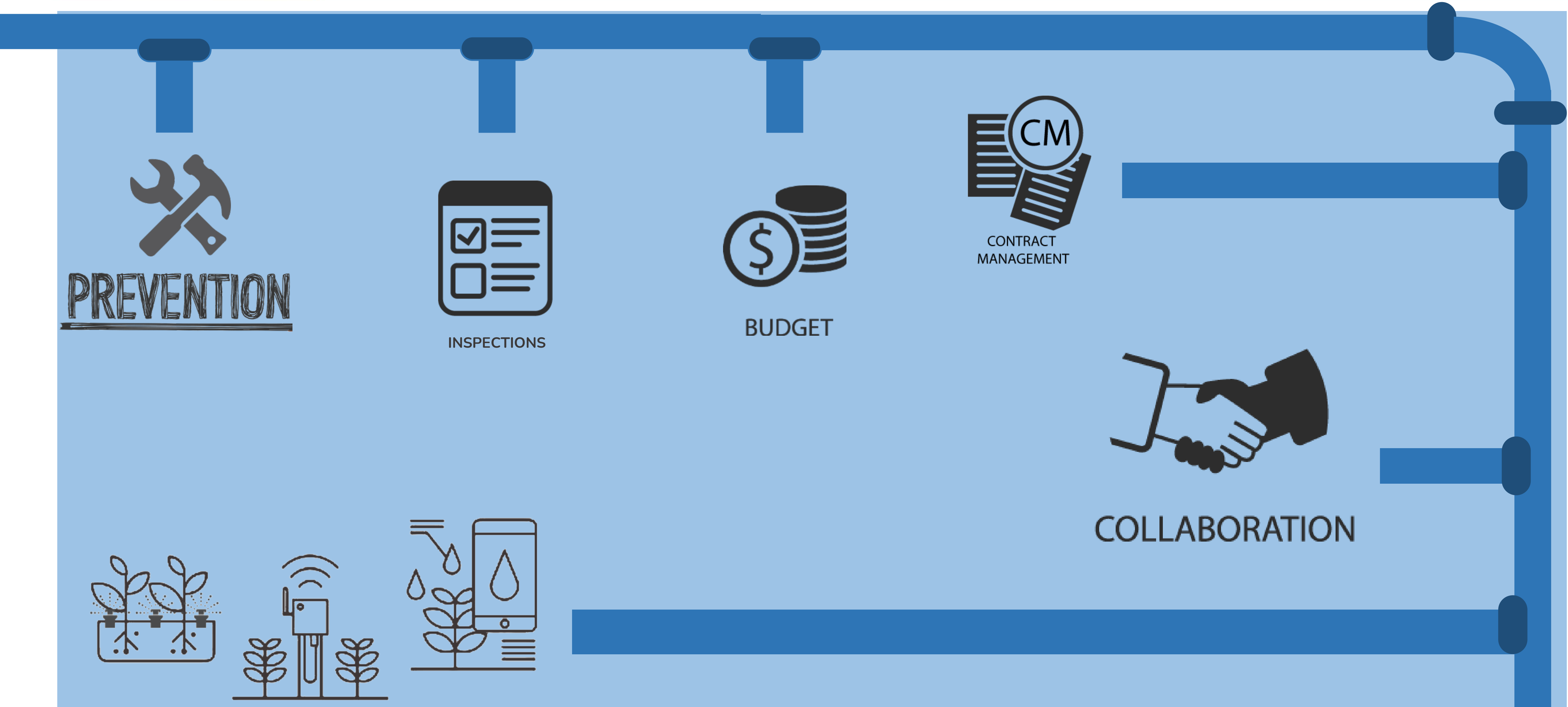
Maintenance



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Presenter: Rene Orta

Horticulture & Water Manager Consultant

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