Ensure Effective Water Delivery and Optimize Energy Use:

Enabling data driven choices with smart software

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Agenda

- California's changing energy sector
- Energy demand-side management
- How water distribution utilities can shift energy load
- CWEE's energy demand management system software

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Let's take a poll!

Increased Renewable Integration

Primarily Solar

Operational Challenges

Intermittent	Non-Dispatchable

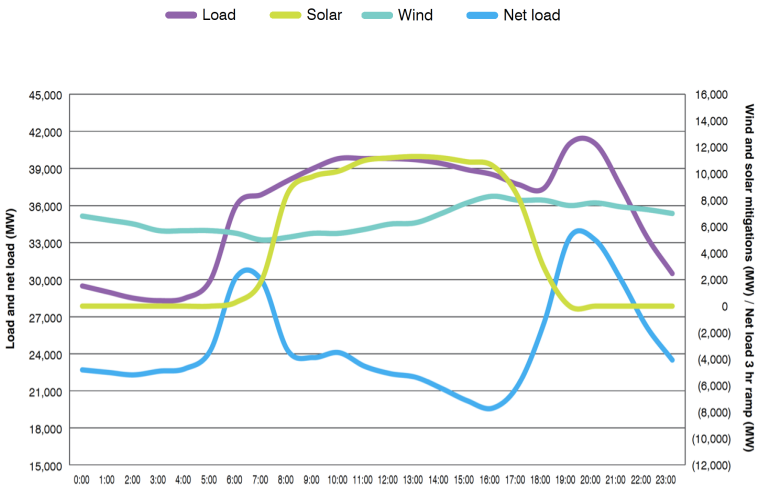

Figure from Clean Coalition 2013

Changing Energy Sector

Pursued Energy Sector Solution:

Energy Demand-Side Management

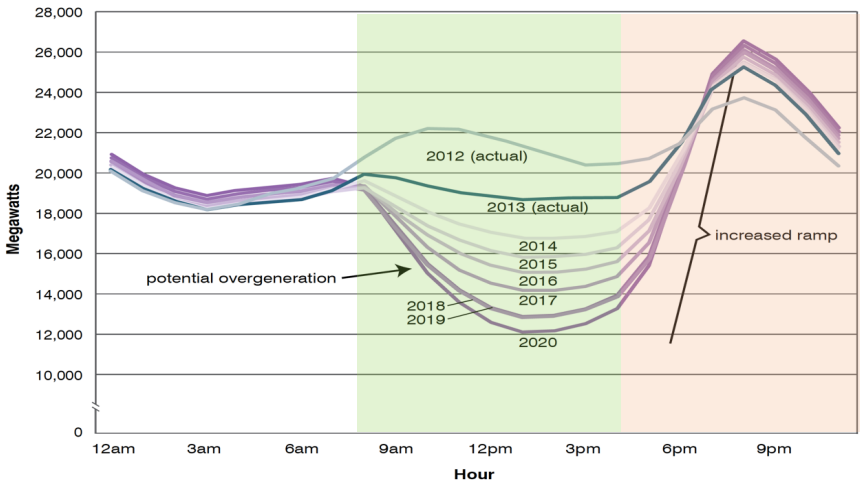

Figure from CAISO 2013

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Shifting Energy Loads

Energy Load Shaping

- ***Long-term*** behavior change
- Energy market incentive:
  - Static Time-of-Use (TOU) Energy Rates

Energy Load Shifting

- More ***immediate*** response to market request
- Energy market incentive:
  - Energy Demand Response
  - Dynamic Energy Pricing

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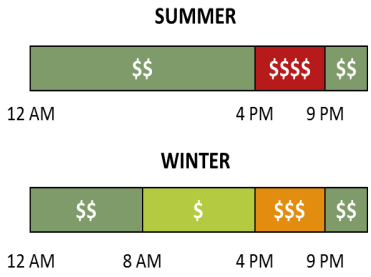
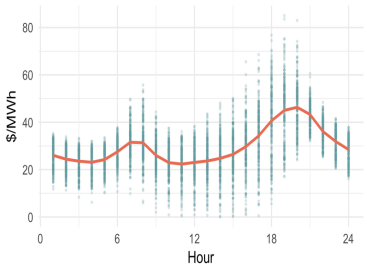
Shape vs. Shift Energy Loads



Static TOU Energy Rate Structures

- IOU Specific TOU Rate Schedules

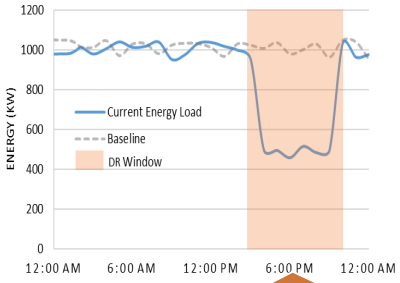
Figure Adapted from SCE



Dynamic Energy Rate Structures or Markets

- CAISO Wholesale Market

Figure from Oasis data 2017



Energy Demand Response (DR) Programs

- CAISO's Proxy Demand Resource Program
- IOU Specific DR Programs

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California Energy Market Mechanisms

- Water utilities can **manage energy** load by changing pump operations
- Water utilities with water storage can further **shift operations** and energy load
- This is an expansion on previous research Energy/Cost/Water Quality pump operation optimization schemes

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Opportunities

When performing **Energy Demand Management,** water distribution systems must take into account:

- Water quality
- Minimum system pressures
- Hydraulic limitations
- Operational limitations

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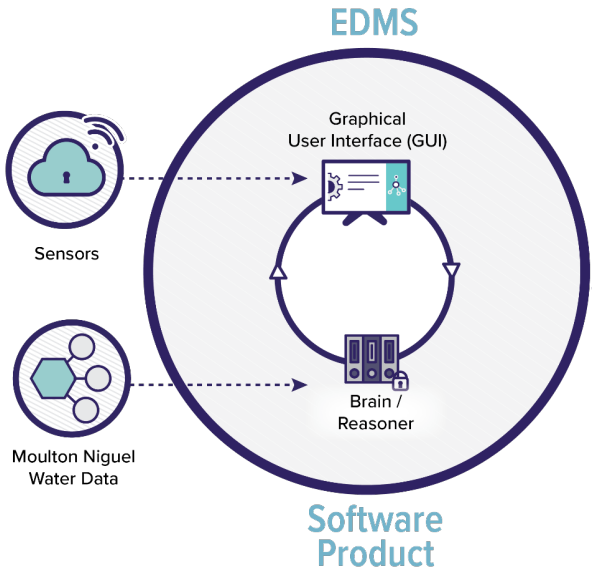
Barriers

Decision Support Tool for Water Utility Operators that assists in Energy Demand Management



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Energy Demand Management System

- Water utility management and optimization software
- **Forecasts** future hydraulic simulations to evaluate a variety of water network operation scenarios
- **Recommends** or tests the necessary **operating controls** to help operators make daily decisions based on user-defined objectives.

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EDMS in a Nut Shell

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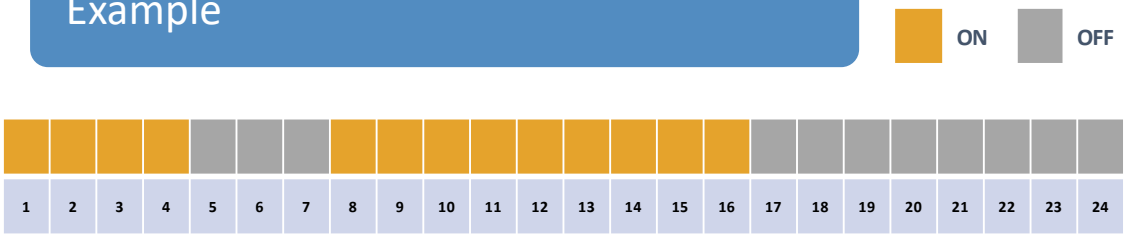
The EDMS Provides

Previous research focused on optimizing **pump schedules**

Example



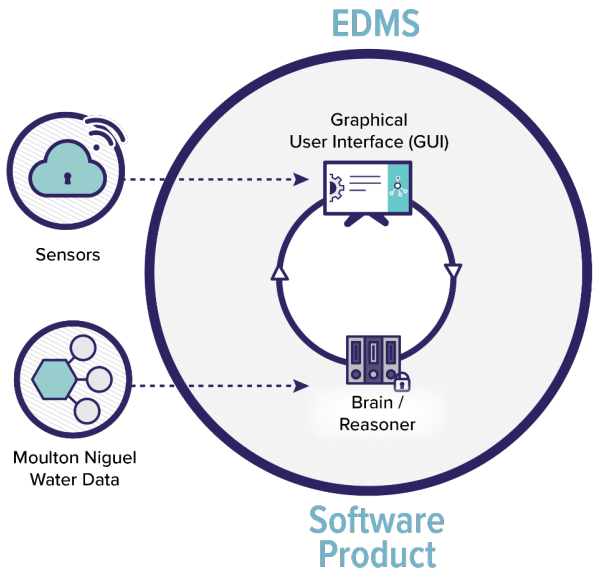
UCDAVIS Center for Water-Energy Efficiency **Previous Water Operation Optimization Tools**

EDMS will optimize **Rule-Based** Controls

Example

- Pump **on** if tank level **is less than** **10 feet**
- Pump **off** if tank level **is greater** than **25 feet** or time is between **4 and 8 pm**

UCDAVIS Center for Water-Energy Efficiency **Rule-Based Controls**



Rule-Based operating recommendations based on:

- SCADA system data
- A hydraulic model (EPANET)
- Energy rate program participation

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Key Inputs into the EDMS

Quality EPA Hydraulic Model

- Built as an extended period simulation
- Can run without crashing
- Calibrated to ensure the results are accurate

Excess Water Storage

- For energy load shifting
- Not necessarily for energy load shaping

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Energy DMS Minimum Requirements

1 Build Scenarios

2

3

Scenario Choices

- Base (how utility currently operate)
- Optimized for various objectives
- Operator designed

1

2 Compare Scenarios

3

For each scenario the EDMS provides

- Full hydraulic simulation for a given time period
- Operating policies, and
- Energy, energy cost, and estimated GHGs

Select a Scenario to operate to.

1

2

3 Real-Time Analysis

For the selected scenario the EDMS provides

- A week ahead forecast of the full hydraulic model simulation and
- Operation policies/controls to implement

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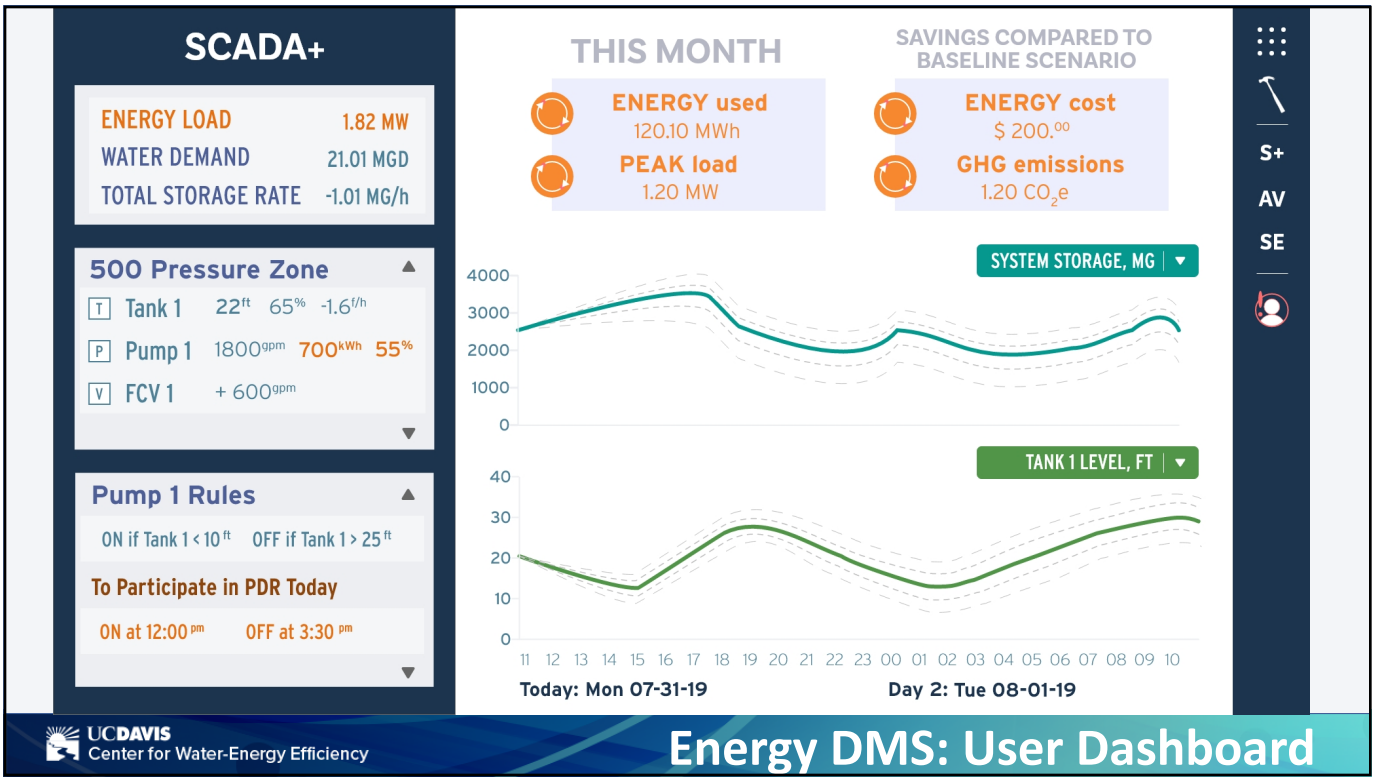
Energy DMS: How Does it Work?



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Energy DMS: User Dashboard

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Water-Energy Efficiency Project

Lindsey Stuvick, Water Efficiency Manager
August 29, 2019

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About Moulton Niguel

- Water, Recycled Water & Wastewater Services
- Serve 6 Cities in South Orange County
- Population Served: 172,000
- 7 Board Members
- 158 Employees
- Water Budget Based Rate Structure
- AAA Rated by Fitch and S&P
- Data-Driven Utility

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Energy Efficiency Project

- Partnered with UC Davis Center for Water-Energy Efficiency (CWEE)
- $3 million grant funded by California Energy Commission
- Explore opportunities for demand response in the water sector to take advantage of Time-Of-Use (TOU) Rates
  - Evaluate if MNWD can participate in the wholesale grid's load-shifting scheme to obtain incentives to shift energy use
- Develop and implement Energy Demand Management System (EDMS)

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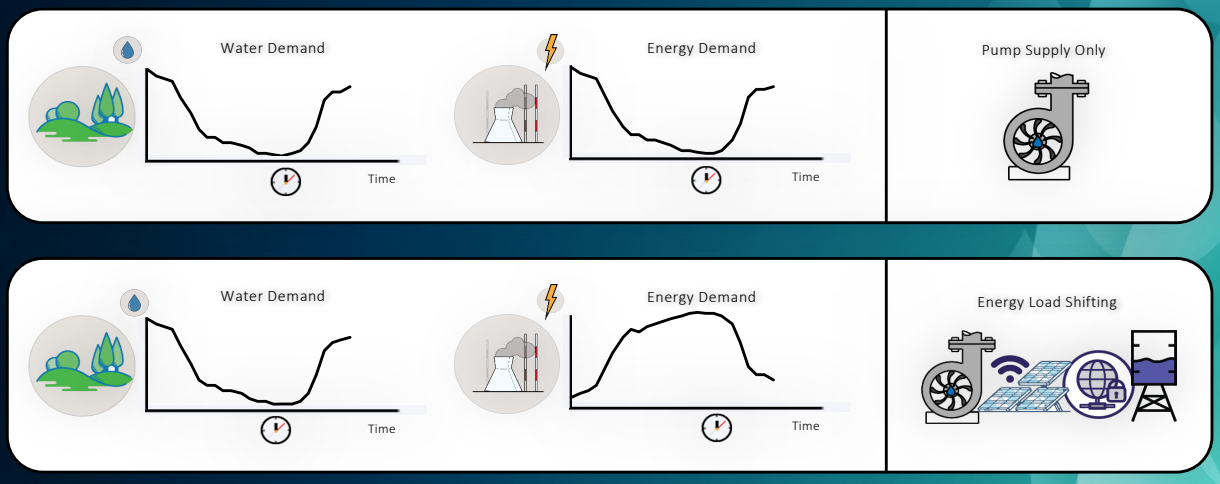
Opportunity for Load Shifting



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Project Objectives

- Quantify energy intensity of PW & RW systems
- Explore operational changes to manage energy loads differently
  - Ramp up & shift energy use
  - Respond to different energy rate programs
  - Maintain safe water system
- Reduce energy costs & generate revenue
- Reduce GHG intensity of energy use

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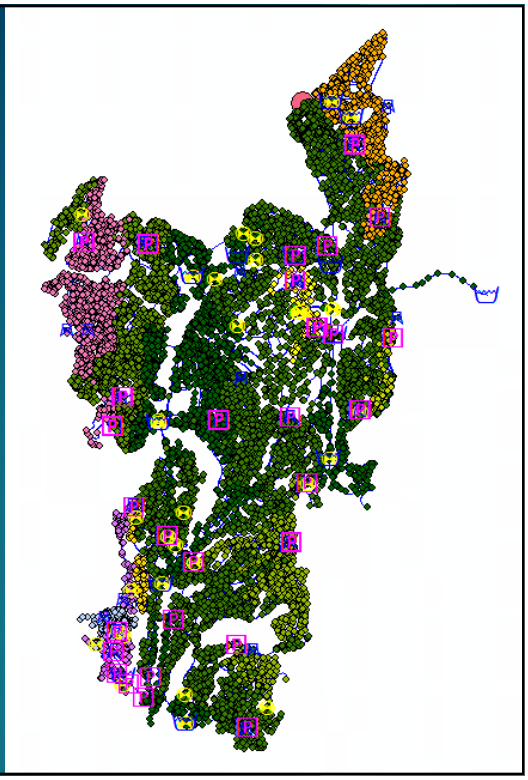
Project Status

- Completed energy intensity analyses
  - Potable and recycled water systems
- Refining potable hydraulic model
- Installing energy meters at active pump stations
- Utilizing existing communication infrastructure
- UC Davis developing water utility specific EDMS technology



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Next Steps:
EDMS Development and Testing

- Configure EDMS technology to MNWD systems
- Develop Operation Guide for using EDMS technology
- Pilot the EDMS technology for 12 months

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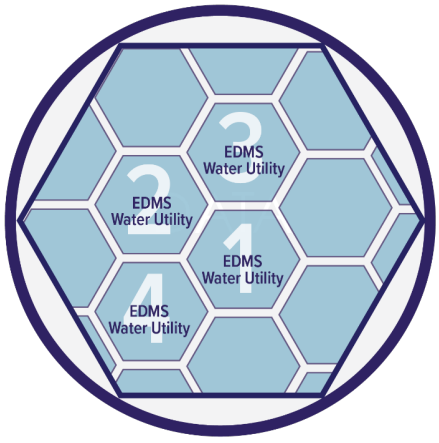
The California Water Efficiency Partnership (**CalWEP**) and CWEE will build, maintain and support an EDMS user group.

CALIFORNIA WATER EFFICIENCY PARTNERSHIP
A Chapter of the Alliance *for* Water Efficiency

EDMS User Support Group
Managed by CalWEP



Outreach and Widespread Adoption

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Long Term User Support

Project

Utilities interested in joining Energy DMS user group

Partnerships

Utilities interested in using the Energy DMS and piloting water specific energy rates

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Continuing to Build the User Group

Questions?

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Q&A Session

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Thank You

Alstone, P., Potter, J., Piette, M. A., Schwartz, P., Berger, M. A., Dunn, L. N., Smith, S. J., Sohn, M. D., Aghajanzadeh, A., Stensson, S., Szinai, J., Walter, T., McKenzie, L., Lavin, L., Schneiderman, B., Mileva, A., Cutter, E., Olson, A., Bode, J., Ciccone, A. and Jain, A. (2017) 2025 California Demand Response Potential Study, Final Report and Appendices on Phase 2 Results: Charting California's Demand Response Future. Lawrence Berkeley National Laboratory. Prepared for California Public Utilities Commission. April, 2017. http://www.cpuc.ca.gov/General.aspx?id=10622

California Independent System Operator (CAISO), "What the duck curve tells us about managing a green grid," October 2013.

Cherchi, C., Badruzzaman, M., Oppenheimer, J., Bros, C. M., & Jacangelo, J. G. (2015). Energy and water quality management systems for water utility's operations: A review. Journal of Environmental Management, 153, 108–120. https://doi.org/10.1016/j.jenvman.2015.01.051

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References