

# Advancing Water-Energy Information and Analytics

Presented by Dr. Edward Spang





© Copyright 2015 OSIsoft, LLC



- CWEE Background
- CA water-energy
- Energy efficient water utilities
- Energy efficient water users
- Advancing IT solutions
- The pathway forward





# Presentation Outline



- Part of UC Davis Energy "U-Hub":
  - Institute for Transportation Studies (ITS)
  - Energy Efficiency Center (EEC)
  - Western Cooling Efficiency Center (WCEC)
  - Plug-in Hybrid Electric Vehicle Center (PHEV)
  - CA Lighting Technology Center (CLTC)
- Established 2011
- Mission:
  - "to research, develop, and disseminate efficient technologies and effective policy for integrated water and energy conservation."



# Center for Water-Energy Efficiency





# Life-Cycle Energy Consumption



- Energy Use for Water in CA:
  - 20% of electricity (7% infrastructure)
  - 30% of natural gas
  - 2.1M bbl/yr of diesel
  - 100M t. CO2-eq.
- Motivation
  - Joint conservation of water & energy
  - DROUGHT



# Energy for Water in California



- California leading state in waterenergy activity
  - Water conservation act (2009)
    - 20% reduction by 2020
  - CPUC energy efficiency
  - Carbon cap & trade: AB 32
  - Coordinated government agencies
    - WET-CAT



### Water-Energy Policy



- But...progress limited by availability of actionable information
  - Fragmented data
  - Need for systems approach
  - Improved customer communication
- Need better information flows
  - Improved data integration and visibility
  - Dynamic and cross-cutting analytics



# The Information Bottleneck



#### Energy Efficiency of Water System



**Energy Savings through Water Efficiency** 



### Component vs. System Efficiency



- Measure energy benefits of water conservation
- Create water and energy utility cost-share partnerships
- Challenges
  - Integrating data
  - Mapping system



### Water Utility as Energy Consumer



2009 Dailypage & Usage	) 🖻		April	₽	n	April 01, 2009.xls
2009-10 Monthly Reports	⊳		Aug 16, 2009.xls			April 02, 2009.xls
2010 Dailypage & Usage	⊳		August	⊳		April 03, 2009.xls
2010-11 Monthly Reports	₽		December	⊳	m	April 04, 2009.xls
2011 Dailypage & Usage	⊳		February	⊳	n	April 05, 2009.xls
2011–12 Monthly Reports	₽	D	Four points14, 2009.xls			April 06, 2009.xls
2012 Dailypage & Usage	⊳		January	⊳		April 07, 2009.xls
2012–13 Monthly Reports	⊳		July	⊳		April 08, 2009.xls
2013 Dailypage & Usage	₽		June	⊳	D	April 09, 2009.xls
2013-14 Monthly Reports	⊳		March	⊳		April 10, 2009.xls
2014 Dailypage & Usage	₽		May	⊳		April 11, 2009.xls
2014-15 Monthly Reports	⊳		November	⊳	n	April 12, 2009.xls
Power – North 2009.xls			October	⊳	D	April 13, 2009.xls
Power – North 2010.xls			SCADA data4.currate.xls			April 14, 2009.xls
Power – North 2011.xls			September	⊳		April 15, 2009.xls
Power – North 2012.xlsx					D	April 16, 2009.xls
Power – North 2013.xlsx						April 17, 2009.xls
Power – North 2014.xlsx						April 18, 2009.xls
Power – South 2009.xls						April 19, 2009.xls
Power – South 2010.xls						April 20, 2009.xls
Power – South 2011.xls					m	April 21, 2009.xls
Power – South 2012.xlsx					n	April 22, 2009.xls
Power – South 2013.xlsx					m	April 23, 2009.xls
Power – South 2014.xlsx					n	April 24, 2009.xls
Power Usage	⊳				m	April 25, 2009.xls
					n	April 26, 2009.xls
					n	April 27, 2009.xls
					n	April 28, 2009.xls
					m	April 29, 2009.xls
					m	April 30, 2009.xls



### Aligning Energy and Water Data





- Energy intensity is based on network design
- Sequencing and location matter

# Sequencing Energy Flows

 $\bigcirc$ 

Ο

Raw Water Pumps

**Distribution Pumps** 

Treatment Plants

Pressure Zones

Lift Station



- Understanding the energy flows in high resolution
- Variability of infrastructure energy intensity:
  - Temporal: 10-12% monthly variation around the annual mean
  - Spatial: >12X difference across the distribution network



Case Study: East Bay MUD









#### OPERATIONAL ANALYTICS Water Benefits

- Water Use Benchmarking
- Targeted Conservation
- Leak Loss Detection
- Monitoring and Verification
  Energy Benefits
- Energy Savings
- Demand Response
- Peak Shaving/Shifting
- Energy Storage
- Monitoring and Verification

Integration, analysis, and communication of water and energy data

# An Advanced IT Platform





### Pump Flow, Energy, and Energy Intensity



# Comparing Multiple Pumps



# Energy Intensity (kWh/MG)



### Water Consumption (MG)



# Embedded Energy (kWh)





### Seasonal Load Curves for a Pump





### Checking Response to Summer TOU Pricing



#### Application View

#### Full Year View



### Hourly Energy Consumption Heat Map (8760)



- Improved visibility of end use consumption
- Non-price factors to influence behavior-change
- Linked water and energy savings
- Challenges
  - Data integration and communication
  - Data security and privacy



### Water and Energy End Users



- Behavior-based hot water conservation
  - Messaging for water use savings
  - Estimation of hot water savings
  - Associated energy and GHG savings









### Household as Water/Energy Consumer



- Measuring the Impact:
  - Randomized control trial
  - High-resolution data
  - AMI data for water, gas, electricity
  - 19,000 single family homes













- Wexus Energy & Water Management Mobile Software Project
  - Energy Intensity Mapping
  - Peak Load Analysis
  - Predictive Irrigation
  - Ag Water-Energy Benchmarking
  - Monitoring and Verification
- Developing Pump Efficiency Modeling





### Farmer as Water/Energy Consumer



- Aligning water and energy data
  - Common data platform
  - Dynamic and accessible
  - Security and privacy provisions
  - Evolving suite of analytics
  - Diverse funding sources
  - Multiple stakeholders
- To drive innovation in policy, technology, and business models



--- Data & Information --

# Moving Forward



#### Affiliate Sponsors

- Los Angeles Department of Water and Power
- Microsoft Corporation
- Pacific Gas & Electric
- Southern CA Edison
- Southern CA Gas Company
- San Diego Gas & Electric





**Pacific Gas and** 







#### **Research Partners**

- Austin Water
- Burbank Water & Power
- CA Department of Water Resources (DWR)
- CA Energy Commission (CEC)
- CA Institute for Energy and the Environment
- CA Public Utilities Commission (CPUC)
- CA State Water Resources Control Board
- Cynthia and George Mitchell Foundation
- East Bay Municipal Utility District (EBMUD)
- Glendale Water & Power
- IBM
- Metropolitan Water District
- Otay Water District
- OSIsoft
- San Diego County Water Authority
- WaterSmart Software
- Wexus Technologies

# CWEE Network

# Thank You

