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WATER VIRTUAL IN-PLANT (VINPLT) TRAINING

Week 1

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Week 1: Introduction, Energy Basics, & Power Company Relationships

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Thank You!

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Today's Trainers

Rob Sowby, Ph.D, P.E.

Wendy Waudby, P.E.

Giulia Pollastri

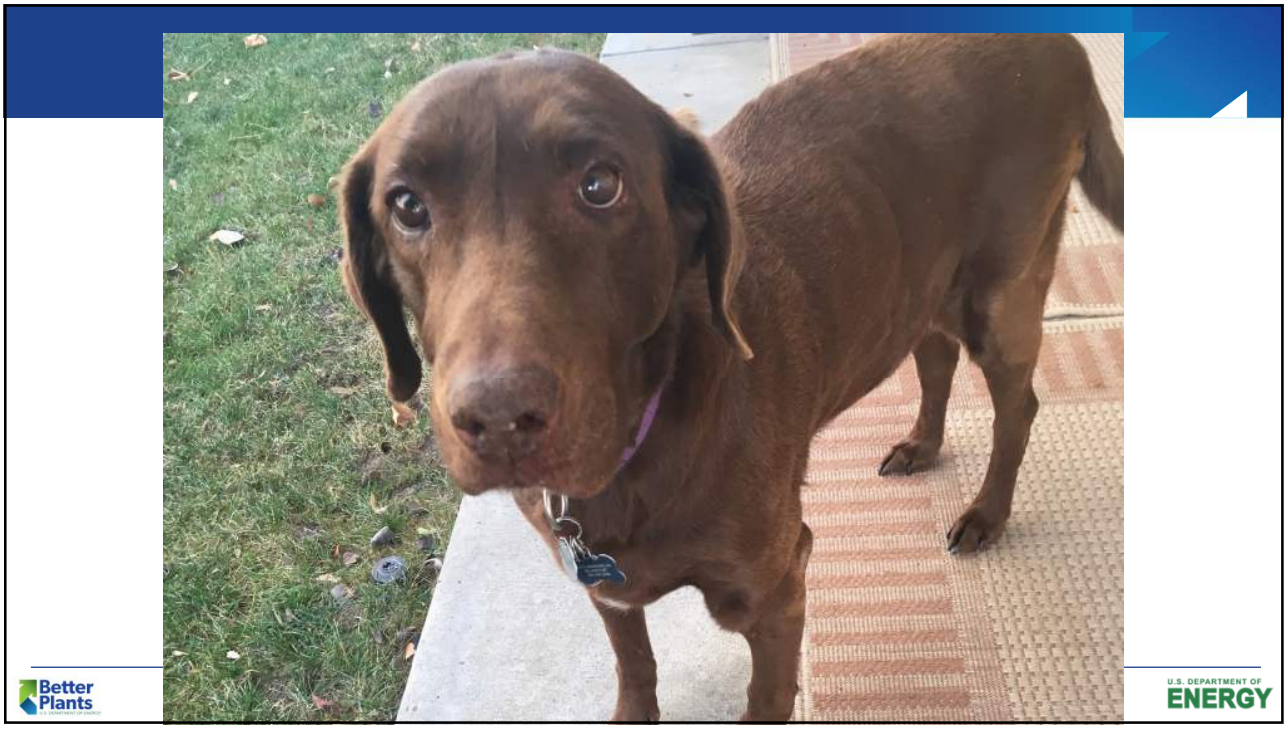
HANSEN ALLEN & LUCE inc
ENGINEERS

CascadeEnergy

aquafficiency
Saving energy, one gallon at a time

6

7



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Training Schedule Overview

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

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Today's Agenda

- Welcome and Introductions
- Energy Basics
- Break
- Success Stories
- Power Company Relationships
- Kahoot!
- Q&A

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Introductions

POLL

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OPPORTUNITY REGISTER

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Introduction to the Opportunity Register

#	Name	Description	Location	System	Submitted By	Assigned to	Status

MEASUR

Facility Basics | Find Treasure | Treasure Chest | Report

Find ways to save your hard earned treasure!

Use one of the following calculators to determine savings opportunities within your manufacturing facility.

Once an opportunity has been found, save the opportunity to your "Treasure Chest".

Add more details to each opportunity by clicking the icon and filling out an opportunity sheet.

Click the "Treasure Chest" tab to view a summary of your found treasure.

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ENERGY BASICS

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Energy 101

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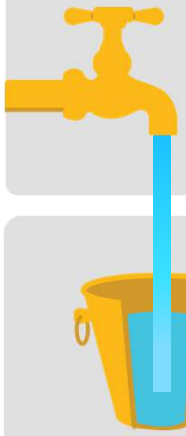
Units of Measure



Flow gpm — 100 gallons / minute

POWER kW (demand) — 60 kW

Volume gallons

100 gal / min * 60 min / hour * 24 hours / day = 144,000 gallons / day

ENERGY kWh (consumption)

60 kW * 24 hours / day = 1,440 kWh / day

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Units of Measure

Volume gallons

100 gal / min * 60 min / hour * 24 hours / day = 144,000 gallons / day

ENERGY kWh (consumption)

60 kW * 24 hours / day = 1,440 kWh / day

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Bonus $/day

1,440 kWh / day * $0.05 / kWh = $72 / day

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Reading Your Electricity Bill

ACME ELECTRIC — February 2019

Account ID	0004 1234-56789 8	Invoice Number	123456789
		Current Charges	$29,760.80
Billing Dates	12/31/2018-1/31/2019 32 days of service	Due By	2/15/2019

METER # ABC123456, Schedule 81 Secondary

Service Description	
Basic Charge	560.00
System Usage Charge	593.85
Off-Peak Usage of 195446.000 kWh x $0.0335	6,547.44
On-Peak Usage of 295347.000 kWh x $0.0504	14,885.49
Demand Charge of 932.000 kW x $1.9500	1,817.40
Transmission Charge of 932.000 kW x $0.910	848.12
Distribution Facility Capacity Charge of 1017.00 kW x $2.0600	2,095.00
	$27,347.32

Taxes and Adjustments	
City Tax (1.5%)	410.21
Public Purpose Charge (3%)	820.42
108 Regulatory Adjustments	29.47
115 Energy Efficiency Funding	1,153.38
	$2,413.48

Period Ending	Avg Daily Temp	Avg kWh per day	Avg Cost per day
1/31/2019	71.5	15338	930.03
1/31/2018	73.1	15021	889.25

kWh use

kW demand

POLL

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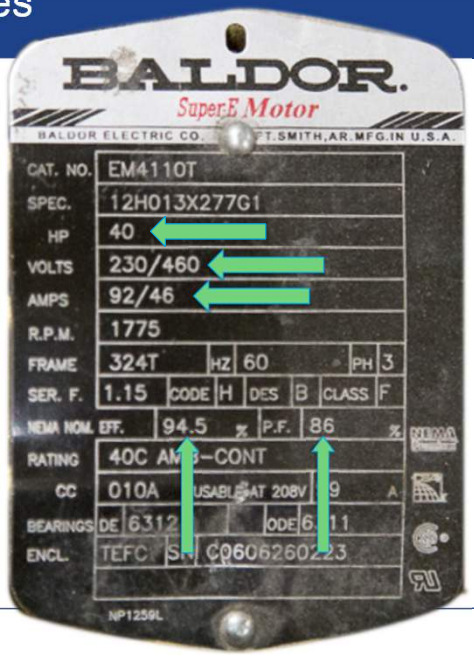
Motor Nameplates



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Estimating Power

Estimating from Motor HP and Load Factor

HP	= Motor HP from the nameplate (horsepower)
Load Factor	= Estimated capacity/loading (0-100%)
Motor Efficiency	= Motor efficiency rating from the nameplate

Motors & Power

Estimating Power from Motor HP and Load Factor

$$\text{Power (kW)} = \frac{0.75 * \text{HP} * \text{Load Factor}}{\text{Motor Efficiency \%}}$$

However, a simpler equation can be used for an estimate:

Power (kW) = HP x 0.75

Estimating Energy Cost

1. **POWER** (kW)
2. **HOURS** of operation
3. **RATE** per kWh (kilowatt-hour)

kWh = kW*Operating Hours

Cost ($) = kWh*$/kWh

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Electricity Example

Assume

Load Factor = 0.8

Continuous operation

$0.05/kWh

Power (kW)

$$= \frac{0.746 \text{ kW/HP} * \text{HP} * \text{Load Factor}}{\text{Motor Efficiency}}$$

= (0.75 * 40 * .80)/.945 = **25 kW**

Energy (kWh)

= kW * Annual Operating Hours

= 25 kW * 8760 hr/yr = **219,000 kWh/yr**

Annual Energy Cost ($)

= kWh * $/kWh

= 219,000 kWh * $0.05 = **$10,950**

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Sample Rates (cents/kWh) Across the US

Area	Industrial June 2016	All Sectors June 2016
New England	11.84	15.95
Middle Atlantic	7.18	12.92
East North Central	6.92	9.98
West North Central	7.77	10.47
South Atlantic	6.65	10.04
East South Central	6.06	9.19
West South Central	5.23	8.18
Mountain	6.79	9.90
Pacific Contiguous	10.12	13.59
Alaska & Hawaii	19.44	21.97
U.S. Total	**7.03**	**10.53**

July 2019:
US Ind. Avg: 7.18

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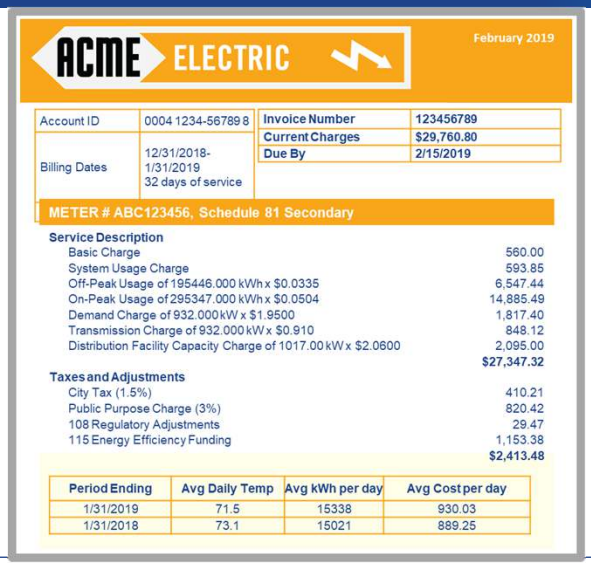
Reading Your Electricity Bill



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Electricity Example

200 hp Well

Power (kW)

$$\frac{= 0.75 * hp * \text{Load Factor}}{\text{Motor Efficiency}}$$

$$\frac{(0.75 \frac{kW}{\cancel{hp}}) * 200 \cancel{hp} * 0.80}{0.951} = 126 \text{ kW}$$

Monthly Demand Cost ($)

= kW * $/kW

$$= 126 \cancel{kW} * \frac{\$1.95}{\cancel{kW}} = \$246$$

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Electricity Example

200 hp Well

- **Power = 126 kW**
- **Billing Cycle = 32 days**
- **Rate = $0.05/kWh**

Energy (kWh)

$$= 126 \text{ kW} * 32 \cancel{\text{days}} * \frac{24 \text{ hours}}{\cancel{\text{day}}} = 97{,}000 \text{ kWh}$$

Bill Energy Cost ($)

= kWh * $/kWh

$$= 97{,}000 \cancel{\text{kWh}} * \frac{\$0.05}{\cancel{\text{kWh}}} = \$4{,}850$$

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BREAK

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SUCCESS STORIES

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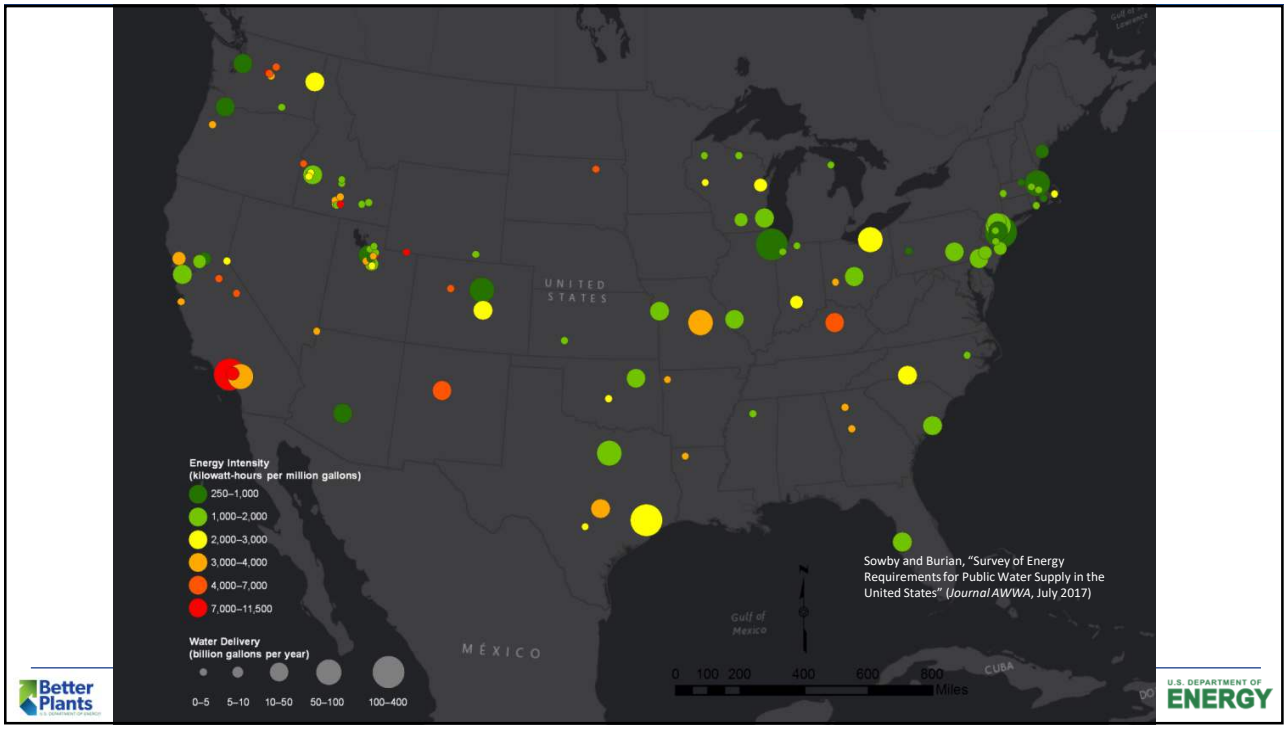
UNITED STATES
MÉXICO
Gulf of Mexico
CUBA
Energy Intensity
(kilowatt-hours per million gallons)
250–1,000
1,000–2,000
2,000–3,000
3,000–4,000
4,000–7,000
7,000–11,500
Water Delivery
(billion gallons per year)
0–5
5–10
10–50
50–100
100–400
0 100 200 400 600 800
Miles
Sowby and Burian, "Survey of Energy Requirements for Public Water Supply in the United States" (*Journal AWWA*, July 2017)
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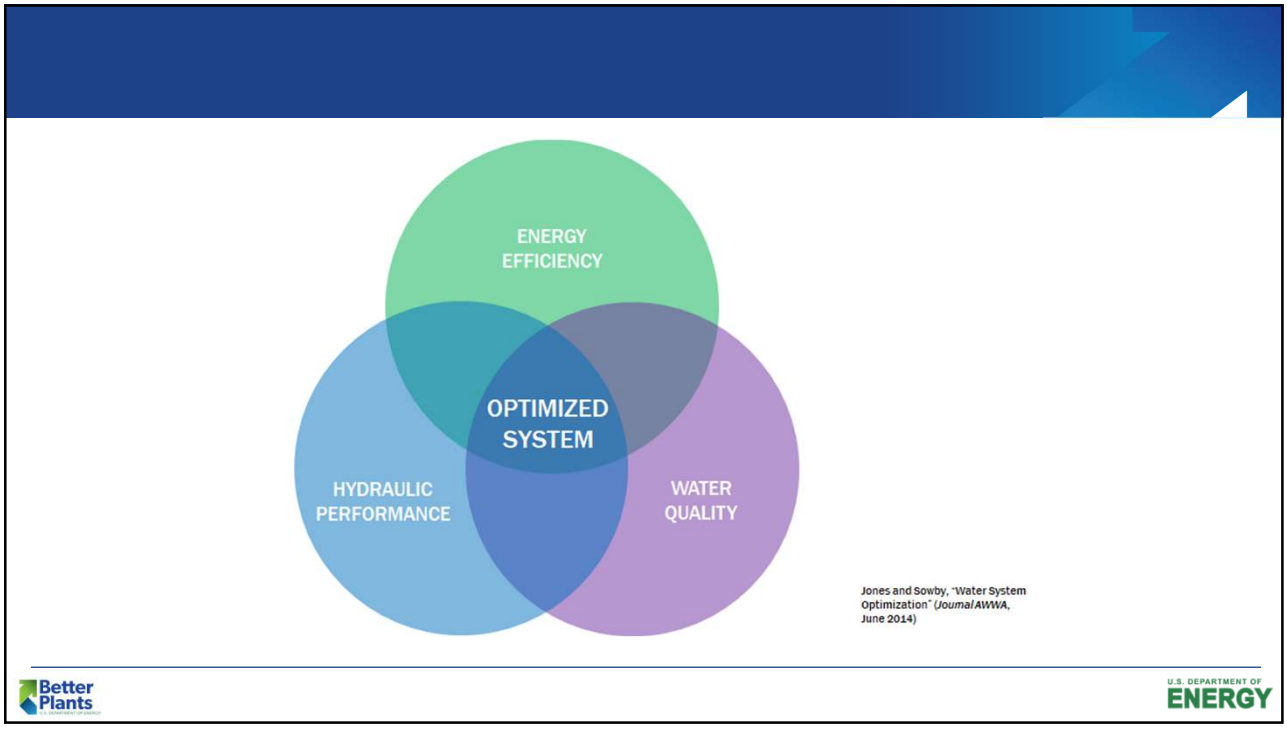
ENERGY EFFICIENCY
OPTIMIZED SYSTEM
HYDRAULIC PERFORMANCE
WATER QUALITY
Jones and Sowby, "Water System Optimization" (*Journal AWWA*, June 2014)
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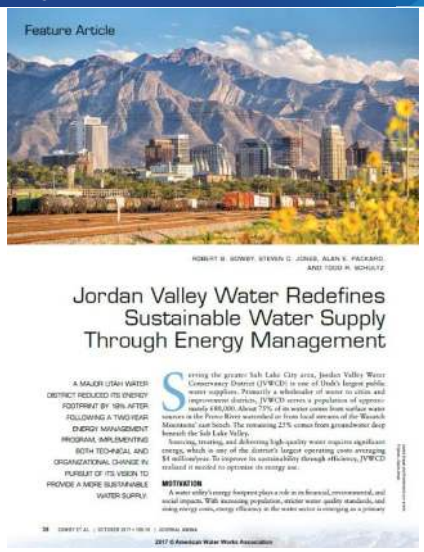
Jordan Valley Water Conservancy District, UT

19% reduction from baseline


Feature Article

Jordan Valley Water Redefines Sustainable Water Supply Through Energy Management

A MAJOR UTAH WATER DISTRICT REDUCED ITS ENERGY FOOTPRINT BY 19% AFTER FOLLOWING A TWO-YEAR ENERGY MANAGEMENT PROGRAM, IMPLEMENTING BOTH TECHNICAL AND ORGANIZATIONAL CHANGE IN PURSUIT OF ITS VISION TO PROVIDE A MORE SUSTAINABLE WATER SUPPLY.

Serving the greater Salt Lake City area, Jordan Valley Water Conservancy District (JVWCD) is one of Utah's largest public water suppliers. Primarily a wholesaler of water to cities and improvement districts, JVWCD serves a population of approximately 440,000. About 75% of its water comes from surface water sources in the Provo River watershed or from local streams of the Wasatch Mountains' east bench. The remaining 25% comes from groundwater deep beneath the Salt Lake Valley.

Sourcing, treating, and delivering high-quality water requires significant energy, which is one of the district's largest operating costs averaging $4 million/year. To improve its sustainability through efficiency, JVWCD realized it needed to optimize its energy use.

MOTIVATION

A water utility's energy footprint plays a role in its financial, environmental, and social impacts. With increasing population, stricter water quality standards, and rising energy costs, energy efficiency in the water sector is emerging as a primary

2017 © American Water Works Association

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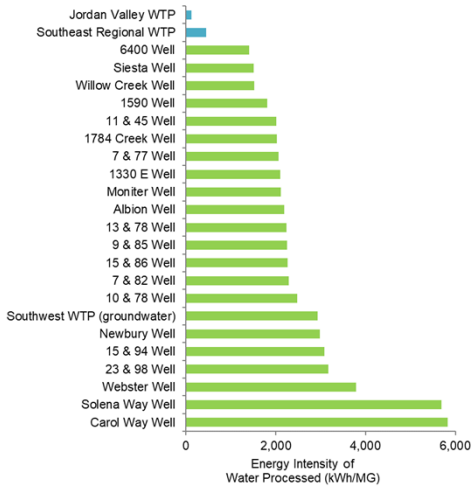
Jordan Valley Water Conservancy District, UT



"Until the team examined the data, they had assumed that the newest or most conveniently located wells were the most efficient."

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Jordan Valley Water Conservancy District, UT

"Instead of asking, 'How can we make this pump or building more energy efficient?' the team asked the deeper question, 'How can we provide an energy-efficient water supply?'"

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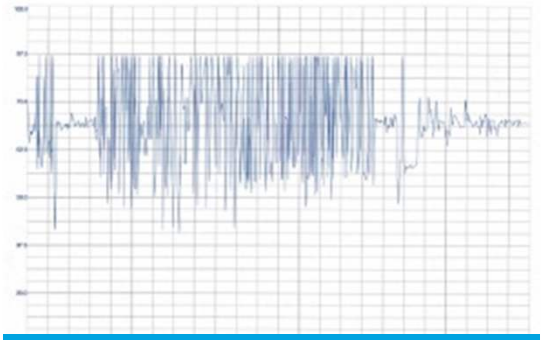
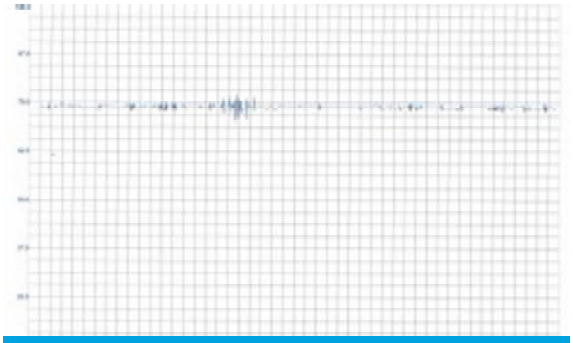
City of Blackfoot, ID

- 11% reduction from baseline



Well #11 before PID loop tuning



Well #11 after PID loop tuning

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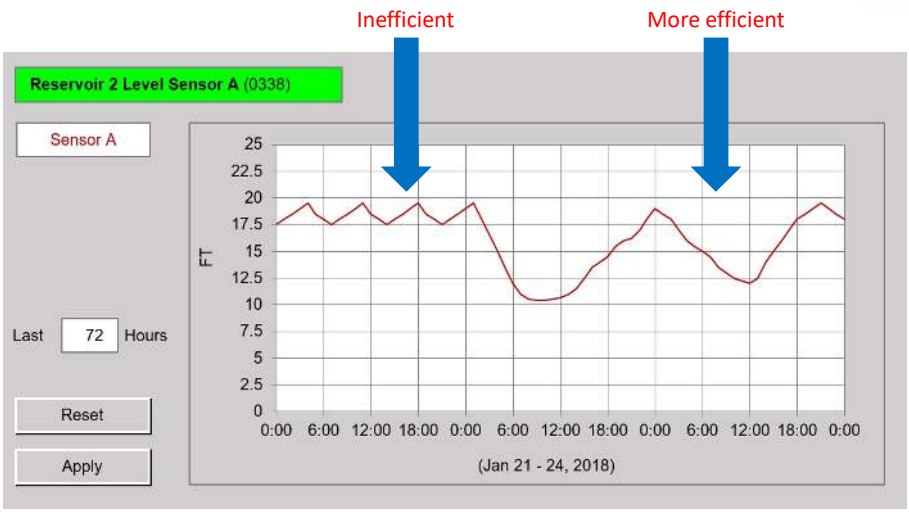
City of Rexburg, ID



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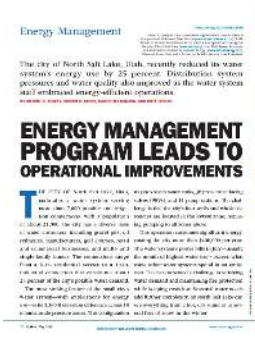
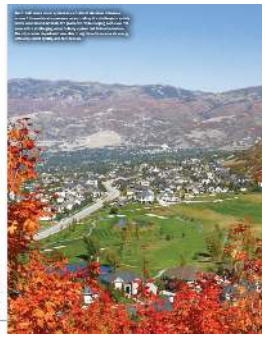
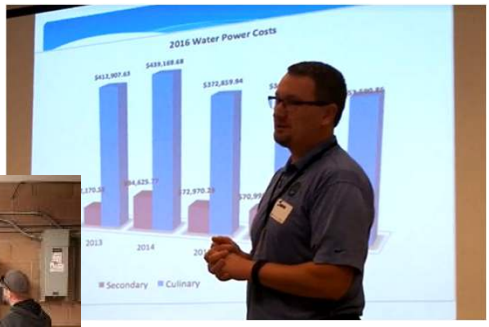
City of North Salt Lake, UT

- 25% reduction from baseline


Energy Management

ENERGY MANAGEMENT PROGRAM LEADS TO OPERATIONAL IMPROVEMENTS





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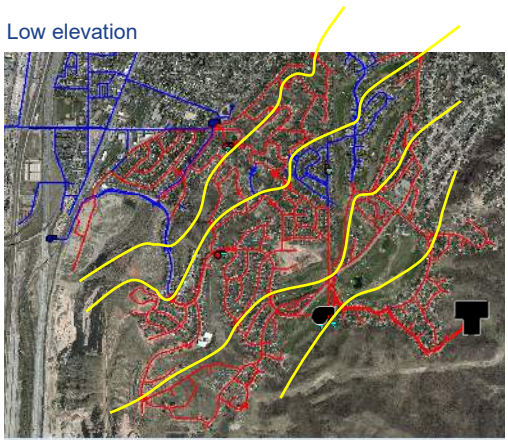
City of North Salt Lake, UT

- 25% reduction from baseline

BEFORE
adjusting PRVs

Pumped water falls back to lower zones

Low elevation



High elevation

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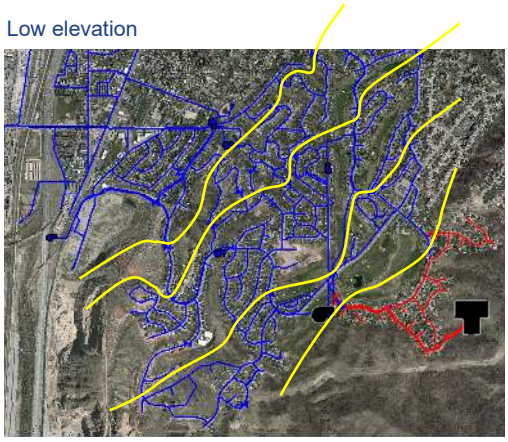
City of North Salt Lake, UT

- 25% reduction from baseline

AFTER
adjusting PRVs

Pumped water stays in upper zones

Low elevation



High elevation

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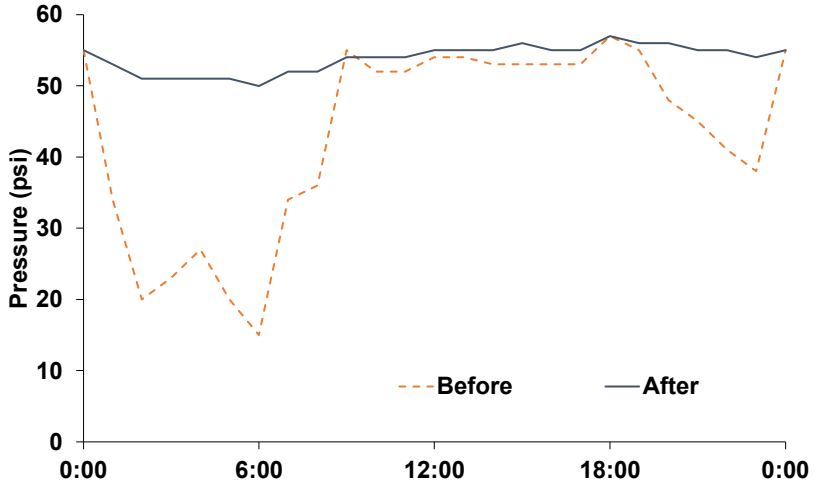
City of North Salt Lake, UT



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SUEZ Water Idaho (Boise, ID)

"The cohort will make your system better because you'll understand your system better. It forces you to ask, 'is this system as efficient as it could be?' And the answer is, 'probably not.'"

- Bill Carr, former Suez Water Production Manager

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City of Kimberly, ID

"You have to put the effort into it. But once you get going, we found it's just as easy to operate efficiently as it is to not."

- Jed Kloer,
City of Kimberly
Public Works Foreman

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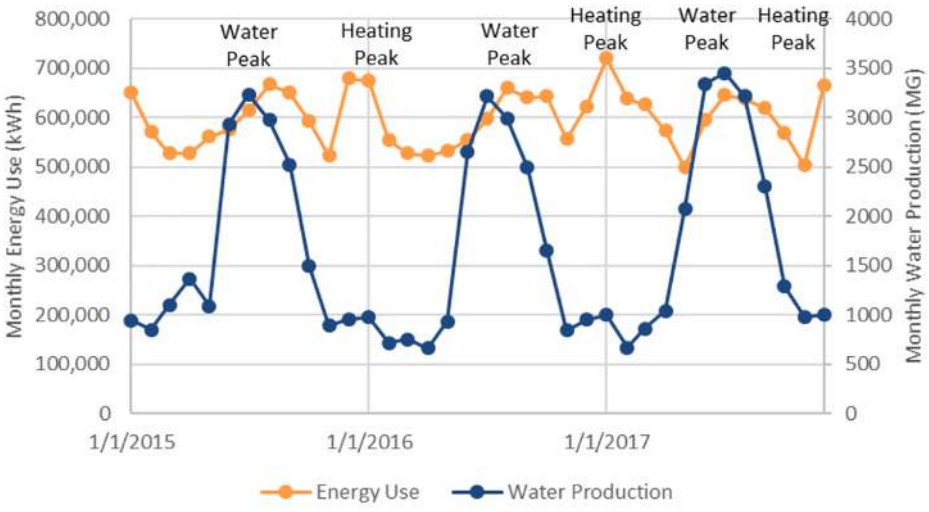
Heating for equipment for humans?



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Nob Hill Water, WA

- 7% reduction from baseline
- Reduced the number of pumps running
- Adjusted HVAC settings
- Fixed water leaks

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City of Yakima, WA

- 15% reduction from baseline
- Fixed compressed air leaks
- Fixed water system leaks
- Adjusted tank level setpoints
- Chlorine residual improved

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POWER COMPANY RELATIONSHIPS

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City of McCall

Idaho Power
8,969 followers
1mo •

The City of McCall recently worked with Idaho Power and SPF Water Engineering, LLC to install variable frequency drive controllers at one of their pump stations.

The City received a $32,446 incentive from Idaho Power's Commercial and Industrial Energy Efficiency program and is saving 180,258 kWh/year. That's enough energy to power over 15 average size homes for a year!

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What's in it for you?

- $$$$
  - Save 10 hp, then we're talking about $10 - $16K.
- Free assistance
- You get ongoing energy savings for life of the equipment.
- Often reduced maintenance cost from turning off or turning down equipment.
- Aesthetic and comfort improvements – e.g. better lighting, better HVAC.

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Incentives

- Typically capped at 50 to 70% of project cost:
  - You get the lesser of the rate-based incentive OR 50 to 70% of project cost.
  - Project cost can include design fees and can be incremental cost between "baseline" and "efficient" equipment for new construction.
- Paid based on Measured and Verified (M&V) savings.
  - The payment comes after the project is complete, so capital funds still needed upfront to cover the project.

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Estimating payback

- Estimated annual savings: 100,000 kWh
- Estimated energy cost: $0.05/kWh
- Estimated annual savings = 100,000 kWh x $0.05/kWh= $5,000
- Estimated project cost: $50,000
- Estimated payback before incentive
- = project cost/annual savings=$50,000 / $5,000/year=10 years
- Estimated incentive = lesser of 70%*$50,000=$35,000 or 100,000 kWh*$0.18/kWh=$18,000
- Estimated payback with incentive
- =($50,000-$18,000)/$5,000/year = 6.4 years

Homework

- Microsoft Forms
- One per water system
- Tell us about your water system

On your smart phone
Go to: https://kahoot.it/
Game PIN:

KAHOOT!

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Takeaways

- Look at your water system from a different perspective

- 1 hp = 0.75 kW
- You can save energy without sacrificing water quality too!
- Talk to your power provider about incentives

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Closing

Questions
Comments
Discussion

Email Wendy at:
wendy.waudby@cascadeenergy.com

SEE YOU TUESDAY!

aquafficiency
Saving energy, one gallon at a time

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