LINCUS INCORPORATED

Long-Term Energy Optimization in Water Systems

Presented to: SWEEP 2018 Conference

Presented by: Hob Issa

Date: November 2018

Agenda

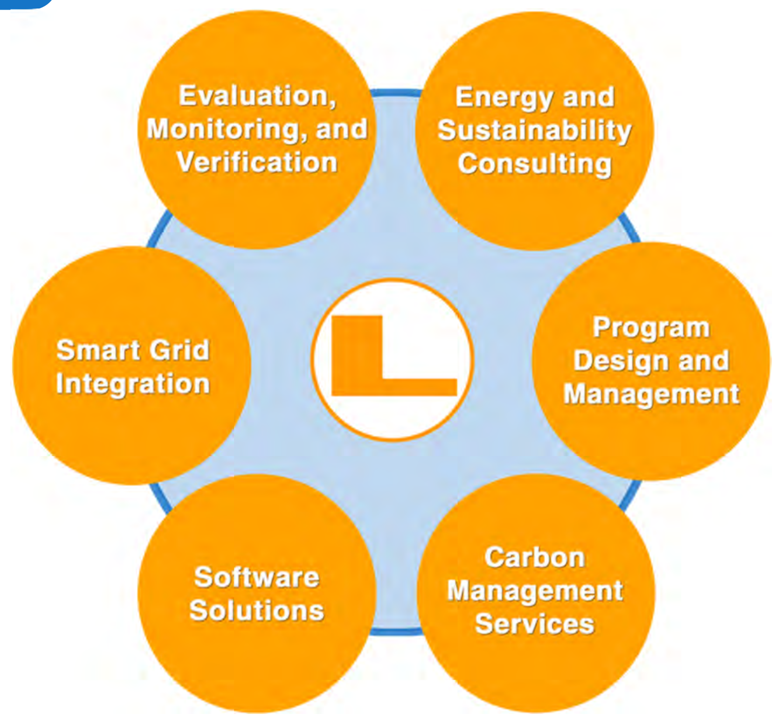
- Introduction to Lincus
- The Water-Energy Nexus
- Why this Segment is Important
- Prioritizing Water Segment Opportunities
- Hurdles and Strategies
- Prioritizing Water Segment Opportunities
- Case Studies

Introduction

Established in 2003

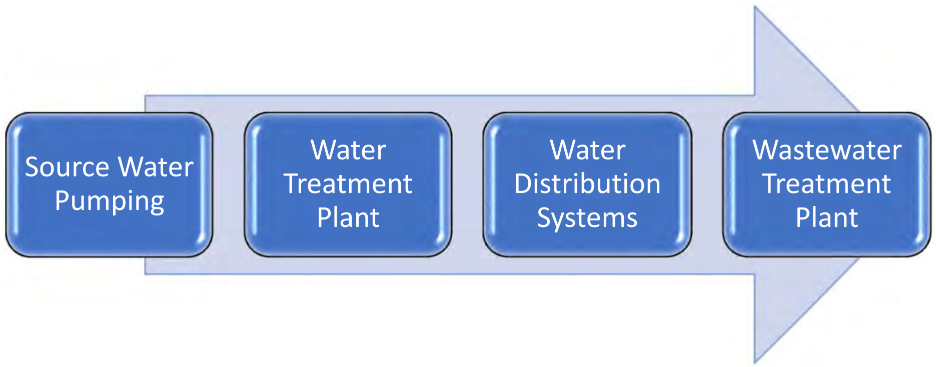
Offices:

- Tempe, AZ (HQ)
- Monrovia, CA
- San Diego, CA
- Emeryville, CA
- Chicago, IL



sustainability

Why is this Segment Important?



Energy Consumption in the USA

- EPA estimates 3-4% of national electricity consumption.
- Largest consumer of energy in municipalities, ~30-40% of total energy consumed.

Annual USA Energy Savings for this Segment

- 12.9 Billion kWh
- $1.224 Billion
- Assuming conservative energy savings of 10%

Lincus' WISE™

- Program Focuses on all electric consumption of this segment.
- Water-Energy Nexus
- GHG Reduction

Hurdles

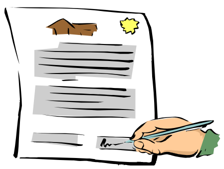
- Lack of understanding by Customers of Utility-qualified measures
- Lack of staffing for project management by Customers
- Onerous procurement process
- Limited funding for the projects
- How to navigate Utility’s incentive and rebate process for projects
- How to implement projects to sustain savings in the long-run

Strategies

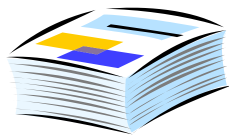
End-to-End Customer Engagement

- Comparative Energy Analyses and Energy Engineering
- Objective Third-Party Technical Review
- Project Management
- Project energy-efficiency Scope-of-Work and Specifications
- Simplified Procurement
- Financing
- Ongoing Energy Management Tools

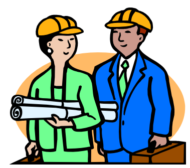
Example of IOU Process



1 Customer elects to participate in WISE Program Agreement



2 Perform Benchmarking Benchmarking Report

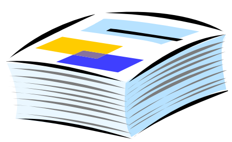


3 Energy assessment performed PFS & Customer Agreement & OBF Application

4 Application(s) submitted & IOU performs Pre-Inspection, Project Application Review, and Credit Check (OBF)

5 Project approved

6 RFP is developed which requires vendors to provide carrying cost for project until step 10 is reached



7 If applicable, OBF application is resubmitted based on final Contractor project cost.

Installation Commencement

8 Install Project Installation Report

9 IOU performs Post-Inspection and reviews Installation Report

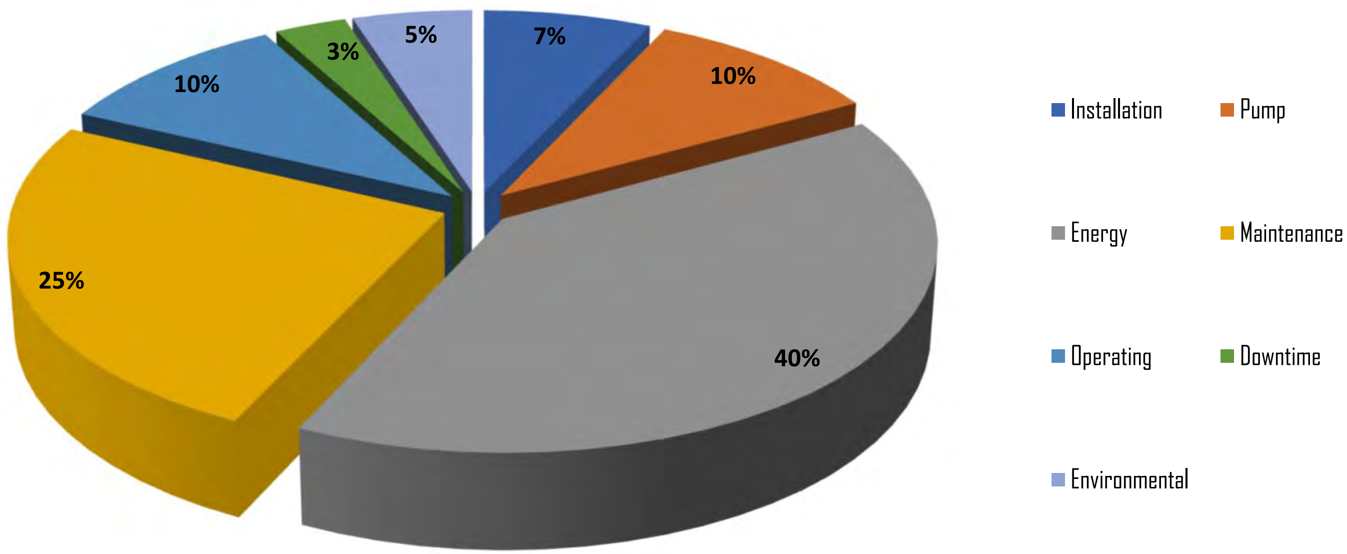
10 Customer receives incentive and OBF (if applicable) check from IOU

Prioritizing Water Segment Opportunities

DG	• Solar photovoltaics • In-conduit hydro • CHP, fuel cells • Small wind
Integrated Water and Energy Management	• SCADA upgrades • Load-shifting • Demand response
Water Conservation	• Agricultural end-use water conservation programs • Residential and commercial conservation
Energy Efficiency – Hydraulic Modelling	• Leak detection and repair • Pressure optimization • Distribution optimization
Energy Efficiency – System Optimization	• Pump sequencing • VFDs and controls • Process optimization
Energy Efficiency – Component Optimization	• Pump efficiency improvement • Valve replacements • Blower efficiency improvement

Why Pumps?

Life Cycle Cost of a Pump



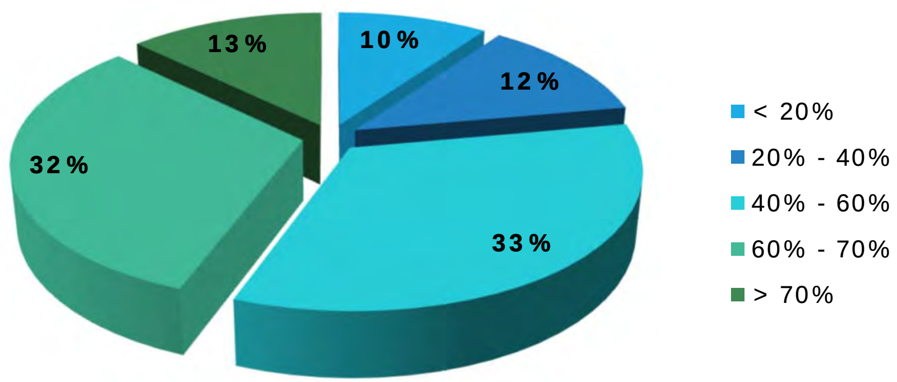
Why Pumps?

Recommended Pump Overall Plant Efficiency (OPE)

Motor HP	Low %	Fair %	Good %	Excellent		
				Well Pump	Booster	Submersible
3 - 5	≤ 41.9	42.0 - 49.9	50.0 - 54.9	≥ 55.0	≥ 55.0	≥ 52.0
7.5 - 10	≤ 44.9	45.0 - 52.9	53.0 - 57.9	≥ 58.0	≥ 60.0	≥ 55.0
15 - 30	≤ 47.9	48.0 - 55.9	56.0 - 60.9	≥ 61.0	≥ 65.0	≥ 58.0
40 - 60	≤ 52.9	53.0 - 59.9	60.0 - 64.9	≥ 65.0	≥ 70.0	≥ 62.0
75 - up	≤ 55.9	56.0 - 62.9	63.0 - 68.9	≥ 69.0	≥ 72.0	≥ 66.0

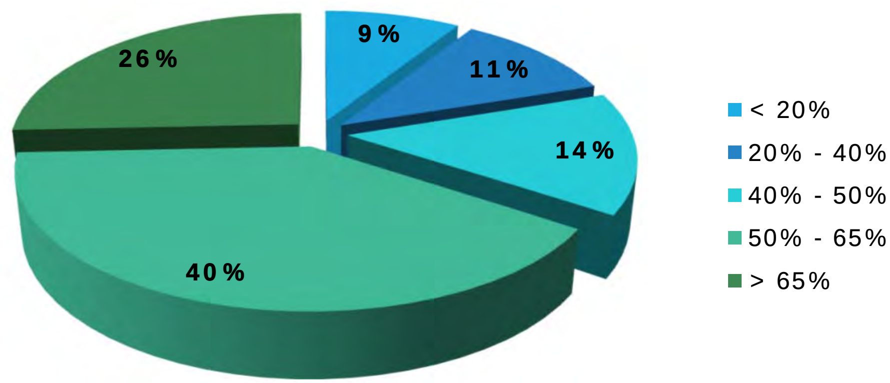
Why Pumps?

Baseline OPE % for Booster Pumps



6 out of 10 booster pumps
need a pump retrofit

Baseline OPE % for Well Pumps



7 out of 10 well pumps
need a pump retrofit

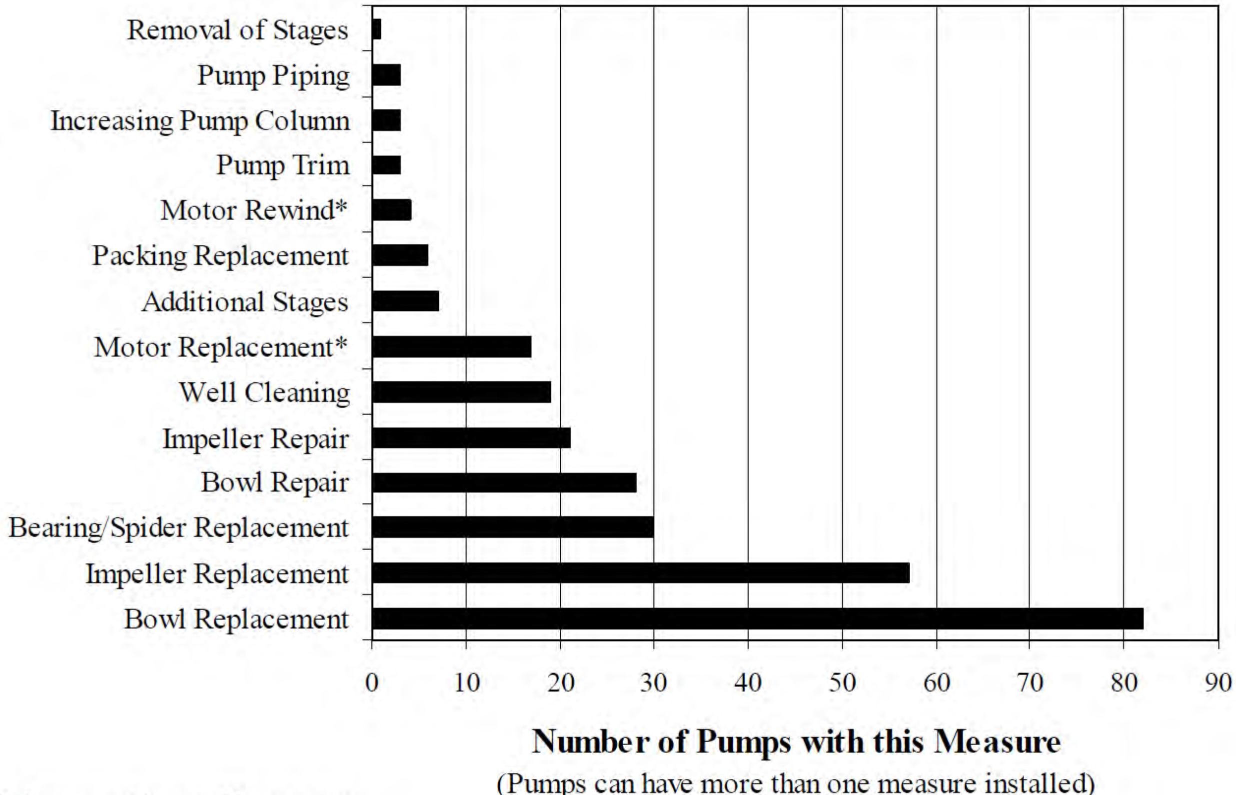
Pump Overhaul Measures

EE Measure	Typical OPE % Savings
1. Pump Bowl Replacements	15% - 25%
2. Impeller Replacements	5% - 15%
3. Column Tube/Shaft Replacements	1% - 2%
4. Others	System Specific

Additional Measures include:

- Right Sizing Pumps
- Pump schedule changes (EE/DR)
- Matching system conditions with the design conditions
- Variable Speed Drives and High Efficiency motors

Improving OPE in Well Pumps



*Measure not incented by program

Case Study: Water District #1

Water District Facts

- Service Territory: 47 square miles delivering ~18 billion gallons of water per year
- System: 13 distribution zones, 28 groundwater wells, 22 booster stations, 3 water treatment plants, and 34 reservoirs with 90 MG capacity
  - Well pumps are used to fill reservoirs for blending
  - Booster pumps distribute source water to the distribution zone through reservoir level on-off controls

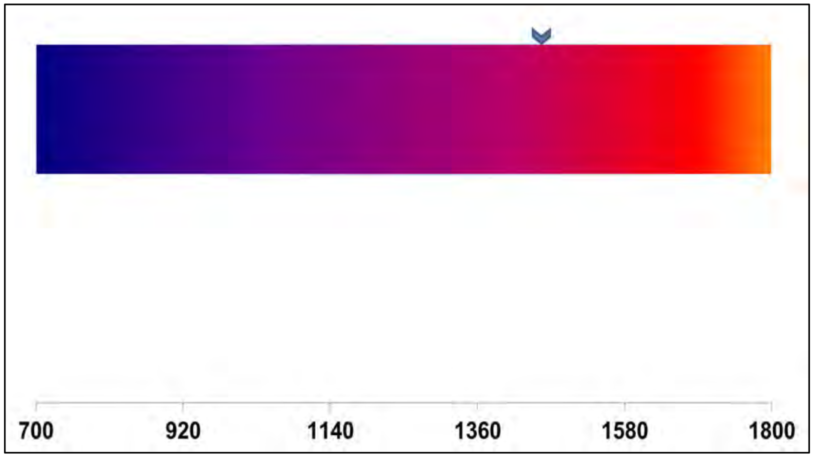
Annual Electric Bill

- ~$3.7 million w/ highest use in summer months

Case Study: Water District #1

Benchmarking Analysis

- According to the California Energy Commission (CEC):
  - Water distribution consumes 700-1200 kWh/MG pumped
  - Groundwater sources consume anywhere from 700 kWh/MG to 1,800 kWh/MG pumped
- District's pumps consume an average of 1,403 kWh/MG based on the pump test data provided for review.



Case Study: Water District #1

Executive Summary: Phase 1

Energy Efficiency Measure (EEM)	Energy Savings		Annual Utility Savings	Measure Cost	Total Incentive	Net Measure Cost	Simple Payback	Savings: % of Total
	kW	kWh						
EEM 1: Pump Efficiency Improvement	119.4	1,253,698	$161,651	$735,000	$118,202	$616,797	3.8	4%
EEM 2: Optimize Well Pump Sequencing	0	462,177	$59,593	$196,781	$36,974	$159,807	2.7	2%
EEM 3: Optimize Zone & Pump Sequencing	3.3	526,441	$74,583	$306,500	$42,612	$263,888	3.5	2%
EEM 4: Optimize Booster Pump Sequencing	85.02	527,149	$74,683	$479,353	$54,926	$424,427	5.7	2%
Totals	**207.72**	**2,769,465**	**$370,510**	**$1,717,634**	**$252,714**	**$1,464,919**	**4.0**	**10%**

Case Study: Water District #1

EEM #1: District Wide Pump Overhauls: 4% in Energy Savings

- Overhauled 10 booster pumps (50-300hp)
- Overhauled 4 well pumps (100-500hp)
  - Existing overall plant efficiencies 57.9-66.9%
  - Proposed overall plant efficiencies 68-72%

EEM #2: Well Pump Sequencing: 2% in Energy Savings

- The energy intensity of pumps varies throughout the district's system
- The district installed kW meters and using existing flow meters to sequence 24 well pumps filling common reservoirs
- Pumps with lower energy intensity (kWh/AF or kWh/MG) were prioritized in meeting the system demands

Case Study: Zone Optimization & Sequencing

EEM #3: Zone Optimization & Sequencing: 2% in Energy Savings

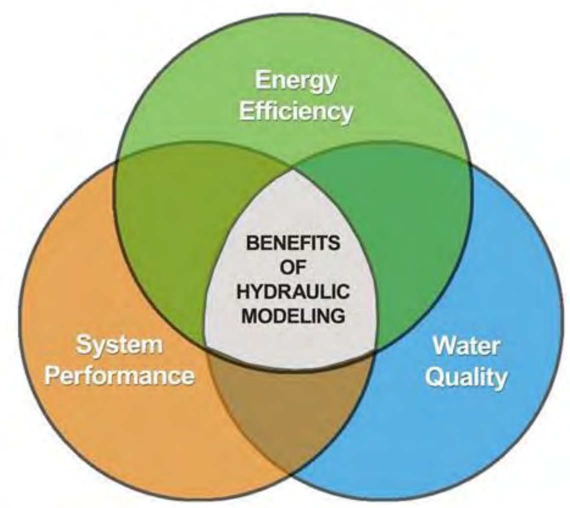
- Eliminated requirement of 3A boosters to provide the additional head to maintain pressure in the subzone
- Boosters in Stations 3 & 3A with lower energy intensity are prioritized

EEM #4: Zone Optimization & Sequencing: 2% in Energy Savings

- The district installed kW meters
- Using existing flow meters we sequenced 47 booster pumps filling common reservoirs and supplying similar zones
- Pumps with lower energy intensity were prioritized in meeting the system demands

Calibrated Hydraulic Modeling

- Hydraulic Modeling allows for energy simulation of a water distribution system
- Can result in up to a 50% reduction in energy use
- Optimizes pressure in the system leading to lesser leaks
- Provides much-needed redundancy in the system by taking one pump out of operation



WISE™ Customers

City of Tulare California · City of Palm Springs California · City of Orange · City of Redlands · City of Delano · City of Auburn California · City of Hanford California

Great Oaks Water Company · Concord · The City of Pleasanton · sanjoseca.gov · Rainbow Municipal Water District · City of Hayward · Olivenhain Municipal Water District · SCWD · County of Placer · Semitropic Water Storage District

Padre Dam Municipal Water District · NCWD · City of Alhambra California · City of San Bernardino · Tracy · Jurupa Community Services District · Pittsburg California · Cucamonga Valley Water District · City of Upland California

AVEK A Public Agency · City of Upland California · Kern County Water Agency · County of Los Angeles California · City of Pomona California · Livermore California · Yucaipa Valley Water District

City of Antioch California · California Water Service Co. · City of Newport Beach California · United Water Conservation District · Central Basin Municipal Water District · San Bernardino County · Elsinore Valley Municipal Water District

Goleta Sanitary District · Buena Park California · City of Glendora · City of Placerville · Adelanto · City of Ventura · The City of Blythe California · North Kootenai Water & Sewer District · Inland Empire Utilities Agency

Wheeler Ridge-Maricopa Water Storage District · Corona · City of Lynwood California · City of South Pasadena California · The City of Burlingame California · Santa Margarita Water District · Las Virgenes Municipal Water District

City of La Palma · The City of San Diego · Woodland · Brea California · Castaic Lake Water Agency · Idyllwild Water District · Calleguas Municipal Water District

City of Norwalk · The City of Brentwood · moulton niguel water district · Kern Water Bank Authority · James Irrigation District · Encina Wastewater Authority · Western Municipal Water District · California American Water · The City of Barstow

City of Monterey Park California · City of La Verne · City of El Monte · County of Nevada California · Daly City California · City of Rialto California · City of Downey California

Questions

What questions may we answer for you?

Contacts

Name: Hob Issa
Title: Vice President
Phone #: 949-244-6528
Email: hissa@lincus.com

Name: Cody Coeckelenbergh
Title: Director
Phone #: 626-241-2856
Email: CodyC@lincus.com