Long-Term Energy Optimization in Water Systems
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
Established in 2003

**Offices:**
- Tempe, AZ (HQ)
- Monrovia, CA
- San Diego, CA
- Emeryville, CA
- Chicago, IL
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 VMSE 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.
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

- 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

- Installation: 10%
- Pump: 40%
- Energy: 25%
- Maintenance: 3%
- Operating: 5%
- Downtime: 7%
- Environmental: 10%
**Recommended Pump Overall Plant Efficiency (OPE)**

<table>
<thead>
<tr>
<th>Motor HP</th>
<th>Low %</th>
<th>Fair %</th>
<th>Good %</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Well Pump</td>
</tr>
<tr>
<td>3 - 5</td>
<td>≤ 41.9</td>
<td>42.0 - 49.9</td>
<td>50.0 - 54.9</td>
<td>≥ 55.0</td>
</tr>
<tr>
<td>7.5 - 10</td>
<td>≤ 44.9</td>
<td>45.0 - 52.9</td>
<td>53.0 - 57.9</td>
<td>≥ 58.0</td>
</tr>
<tr>
<td>15 - 30</td>
<td>≤ 47.9</td>
<td>48.0 - 55.9</td>
<td>56.0 - 60.9</td>
<td>≥ 61.0</td>
</tr>
<tr>
<td>40 - 60</td>
<td>≤ 52.9</td>
<td>53.0 - 59.9</td>
<td>60.0 - 64.9</td>
<td>≥ 65.0</td>
</tr>
<tr>
<td>75 - up</td>
<td>≤ 55.9</td>
<td>56.0 - 62.9</td>
<td>63.0 - 68.9</td>
<td>≥ 69.0</td>
</tr>
</tbody>
</table>
Why Pumps?

Baseline OPE % for Booster Pumps

- 33% < 20%
- 12% 20% - 40%
- 10% 40% - 60%
- 13% 60% - 70%
- 32% > 70%

6 out of 10 booster pumps need a pump retrofit

Baseline OPE % for Well Pumps

- 40% < 20%
- 14% 20% - 40%
- 11% 40% - 50%
- 9% 50% - 65%
- 26% > 65%

7 out of 10 well pumps need a pump retrofit
Pump Overhaul Measures

<table>
<thead>
<tr>
<th>EE Measure</th>
<th>Typical OPE % Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pump Bowl Replacements</td>
<td>15% - 25%</td>
</tr>
<tr>
<td>2. Impeller Replacements</td>
<td>5% - 15%</td>
</tr>
<tr>
<td>3. Column Tube/Shaft Replacements</td>
<td>1% - 2%</td>
</tr>
<tr>
<td>4. Others</td>
<td>System Specific</td>
</tr>
</tbody>
</table>

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

Number of Pumps with this Measure
(Pumps can have more than one measure installed)

- Removal of Stages
- Pump Piping
- Increasing Pump Column
- Pump Trim
- Motor Rewind*
- Packing Replacement
- Additional Stages
- Motor Replacement*
- Well Cleaning
- Impeller Repair
- Bowl Repair
- Bearing/Spider Replacement
- Impeller Replacement
- Bowl Replacement

*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
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.
## Executive Summary: Phase 1

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

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Thank You.