2013 EPA Tribal Conference

Sustainable Water Infrastructure & Energy Management Systems

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Today’s Presentation

- Water Infrastructure Challenges
- EPA Region 9’s Sustainable Water Infrastructure Program
- Energy & Water Audits
- Energy Management Systems
- Example Projects & Sources of Funding
Water Infrastructure Challenges

- **Water Scarcity**
  - Shortages increasingly common

- **Climate Change**
  - Changing precipitation patterns, shrinking snow packs, increasing run-off…

- **Increasing Population**
  - More people, greater system demand

- **Aging Infrastructure**
  - Upgrades to cost $.3 to $1 trillion over next 20 years

- **Energy Uncertainty**
  - Increasing Cost/Decreasing Availability

- **Water/Energy Nexus**
The Water-Energy Nexus

- **Water embedded in Energy**

  - Each kilowatt-hour (kWh) of thermoelectric generation requires the withdrawal of ~ 25 gallons of water, primarily for cooling purposes.

  - On average, ~ 2 gallons of water are lost to evaporation for each kWh consumed.

  - In Arizona, 7.85 gallons of water are lost to evaporation per kWh consumed.
**Energy embedded in Water**

- Drinking water & wastewater systems account for approximately 3-4% of national energy use.
- Often the largest energy consumers of municipal governments, accounting for 30-40% of total energy consumed.
- In CA, 7.7% of total state electricity (18,282 GWh) is used by the water sector.

### Electric Consumption by Water Use Cycle Segment (CA)

- Supply & Conveyance: 83%
- Wastewater Collection & Treatment: 10%
- Water Distribution: 7%
- Water Treatment: 10%
- Discharge: 10%
- End Use: Agriculture, Residential, commercial, industrial
The Water-Energy-$\$$ Nexus

Energy represents the **largest controllable cost** of providing water and wastewater services to the public, and is generally on the order of 30-60% of a city’s energy bill.
The Water-Energy-$ Nexus...cont’d

• Why efficiency?

  • Yearly, 283 billion gallons of water are lost in CA urban water distribution systems
  
    • Accounts for over 2.5 billion kWh of wasted energy

  
  Assuming (conservatively) electricity costs $0.10 per kWh,

  CA could recover $255 million/yr in energy lost from leaks
Saving Water saves Energy; Saving Energy saves Water

Saving Water & Energy boosts the triple bottom line
We provide technical & financial resources to help communities increase:

- Water Efficiency
- Energy Efficiency
- Water Recycling
- Low Impact Development
- Renewable Energy Generation

We offer a systematic EMS approach (and a short cut):

1. Complete a water and/or energy AUDIT
2. Prioritize audit recommendations
3. Identify funding to IMPLEMENT projects
The short cut: start with an audit

- **What is an audit?**
  - Different types
    - Benchmarking
    - Walk-Through Audits
    - Detailed Process Audits

- **What does it do?**
  - Benchmarking
    - Preliminary energy/water use analysis (e.g. Portfolio Manager)
  - Walk-through -> Detailed Process Audits
    - Identify capital and operational opportunities for savings, and determine payback period
Energy Audits

• Identify capital and operational improvements
  • Capital improvements generally require more $
    • E.g. Upgrade motors & blowers, install variable frequency drives & more efficient aeration, etc.
  • Operational improvements can be achieved inexpensively
    • E.g. load shedding, suspending unnecessary equipment, implementing an EMS, etc.

• Identify renewable energy opportunities

• Can also assess designs of future projects
Water Audits

- Identify “Non-Revenue” water
  - Real losses, i.e. leaks
  - Apparent losses, i.e. unbilled/unmetered consumption

- Complete detection surveys to identify leaks and determine corrosion rates (to target pipe replacement)

- Optimize pressure zones (direct relationship between increasing pressure and water loss)

- Recommend metering systems
  - i.a., determine appropriate rate structures
Example Energy Audits Results

• 15 energy audits conducted at randomly selected (large & small) facilities

• Using only recommendations with a 7.5 year payback or less, the 15 energy audits identified a total of:

  ➢ 6,900 MWh/yr of potential energy reductions
  ➢ 1,700 MWh/yr of energy demand reduction
  ➢ $1.4M/yr potential cost savings
  ➢ 4.6 yr payback period (16% ROI)
  ➢ 6.9 million pounds/yr of reduced greenhouse gas emissions
<table>
<thead>
<tr>
<th>Energy Conservation Opportunities</th>
<th>Payback Period (yrs.)</th>
<th>Costs (Implementation)</th>
<th>Annual Savings ($)</th>
<th>Annual Energy Cost Savings</th>
<th>MWh/Year Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Rate Modifications (2): modifying rate schedules to be most efficient during peak and non-peak hours</td>
<td>avg = 0.12 0.1 to 0.14</td>
<td>$500</td>
<td>$3,600 - $10,000</td>
<td>13 - 48%</td>
<td>N/A</td>
</tr>
<tr>
<td>Electrical Demand Management (5) : monitoring total energy use/demand with installation of electrical metering, maximizing off-peak operations</td>
<td>avg = 0.2 0 to 1 $0 - $75,000</td>
<td>$1,000 - $115,800</td>
<td>0.7 - 7.3%</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Operational Improvements (11): Noncapital improvements to optimize treatment</td>
<td>avg = 1.7 0.7 to 5 $0 - $220,000</td>
<td>$100 - $35,700</td>
<td>0.1 - 26.5%</td>
<td>1 - 284</td>
<td></td>
</tr>
<tr>
<td>Pump Modification (6): adjusting effluent pumping, inline flow meters in collection/distribution systems, and pump controls</td>
<td>avg = 4.1 0 to 10.7 $0 - $35,600</td>
<td>$250 - $7,000</td>
<td>0.5 - 7.2%</td>
<td>2 - 26</td>
<td></td>
</tr>
<tr>
<td>Motor Efficiency Upgrades (4): replacing inefficient motors with high efficiency motors</td>
<td>avg = 4.9 0.7 to 8.2 $3,100 - $175,000</td>
<td>$2,800 - $44,300</td>
<td>1.3 - 7.6%</td>
<td>9.6 - 136.4</td>
<td></td>
</tr>
<tr>
<td>Component System Upgrades (5): Capital and operational improvements on UV, process water, scrubber, and compressed air systems</td>
<td>avg = 5.1 4 to 6.3 $130,000 - $500,000</td>
<td>$20,500 - $98,000</td>
<td>2.2 - 28.3%</td>
<td>105.7 - 441.5</td>
<td></td>
</tr>
<tr>
<td>Efficient Lighting Fixtures (5): implementation of more efficient lighting; includes reduced use and sensors</td>
<td>avg = 6.6 2.6 to 11.2 $7,000 - $154,000</td>
<td>$2,650 - $24,700</td>
<td>0.5 - 2.9%</td>
<td>9.1 - 122.1</td>
<td></td>
</tr>
<tr>
<td>Variable Frequency Drive Installation (3)</td>
<td>avg = 7.2 2.4 to 12 $15,700 - 126,500</td>
<td>$1,620 - $51,600</td>
<td>0.4 - 4.2%</td>
<td>15.4 - 482</td>
<td></td>
</tr>
<tr>
<td>Aeration Control/Improvements (4): smaller blower installation, operation changes, better control with meter installation</td>
<td>avg = 8.3 4.7 to 13.3 $5,000 - $244,000</td>
<td>$760 - $24,400</td>
<td>1.6 - 26.9%</td>
<td>6 - 200</td>
<td></td>
</tr>
</tbody>
</table>
Recommendations identified an average:
26% savings in energy costs

Recommendations with <1 yr payback period identified a total annual savings of $190K/yr (>100% ROI)
- Included non-capital OPERATIONAL improvements such as rate modifications, time-of-use, depowering equipment, and shutting down unnecessary processes
  - Identifiable with low cost self-assessments or walk-through audits
Energy Audit recommended a co-gen/CHP facility

- Producing heat and electricity by combusting biogas would:
  - Save $650K/yr
  - Reduce energy consumption by 4,000 MW/yr
  - Be paid back in 5.7 years
Key Takeaways

• All water and wastewater utilities would benefit from some level of energy and/or water auditing, especially with new construction

  • Small/mid-sized utilities are ideal candidates for inexpensive walk-through audits

• Operational changes = shortest payback periods

• Quality of auditors is key: they must have experience in the water industry
Audit Resources

• Visit our website
  • Energy Audit Information
    www.epa.gov/region9/waterinfrastructure/audit.html
  • Water Audit Information
    www.epa.gov/region9/waterinfrastructure/water-conserv.html

• Look for funding
  • Database for State Incentives for Renewable & Efficiency
    www.dsireusa.org
  • EPA Region 9 Water Infrastructure funding website
    www.epa.gov/region9/waterinfrastructure/funding.html

• E-mail us
  • ely.charlotte@epa.gov or byous.eric@epa.gov
Audit Resources... cont’d

• Schedule a free audit:
  o Region 9 Resources
    ▷ DOE Industrial Assessment Centers (US DOE)
      o Only if your energy bill is greater than $100,000/year
  o California resources
    ▷ Energy Partnership Program (CEC)
      o Contact Shahid Chaudhry: 916-654-4858/ Shahid.Chaudhry@energy.ca.gov
    ▷ California Wastewater Process Optimization Program (CalPOP)
      o www.calwastewater.com/index.html
    ▷ Your local Utility
      o E.g. PG&E provides two types of free energy audits: the on-site energy audit and the more comprehensive integrated energy audit

Let us know if you’re interested in getting an energy or water audit and/ or participating in free group energy management webinars and we can discuss your options
Audit Resources... cont’d

“Walk through” audit & self-assessment resources

- USEPA’s Water Energy Use Assessment Tool: [water.epa.gov/infrastructure/sustain/energy_use.cfm](water.epa.gov/infrastructure/sustain/energy_use.cfm)
- NYSERDA self audit forms: [www.epa.gov/region9/waterinfrastructure/audit.html](www.epa.gov/region9/waterinfrastructure/audit.html)
- Portfolio Manager: [www.energystar.gov/portfoliomanager](www.energystar.gov/portfoliomanager)
How do I organize all of this information and implement energy improvements on an ongoing basis??

A journey of a thousand miles begins with one step.

--Chinese proverb
EPA recommends an Environmental Management System (EMS) approach
  • a.k.a. Plan-Do-Check-Act
Designed to help utilities:
  • Systematically assess current energy costs and practices
  • Set measurable performance improvement goals
  • Monitor and measure progress over time
• Process outlined in EPA’s Guidebook: 
  water.epa.gov/infrastructure/sustain/cut_energy.cfm

**NEW** Rural and Small Systems Guidebook to Sustainable Utility Management
The Plan-Do-Check-Act Approach

**PLAN**
- Establish baselines
- Identify priorities
- Set improvement goals

**DO**
- Implement Action Plans to achieve goals

**CHECK**
- Monitor & measure
- Document results
- Find & fix

**ACT**
- Evaluate, Apply Lessons Learned, And modify as necessary

- Allows utilities to systematically assess and manage energy; to identify opportunities; and to take action
- NOT a project—a system to manage energy for the long haul
Energy Management SYSTEM

• **PLAN**
  • Senior Management Buy-In*
  • Energy Team
  • Energy Policy
  • Baseline Data/Audit Completion
  • Identification of Projects
  • Ranking of Projects
  • Setting Objectives and Targets
• **DO**

  • Energy Improvement Management Plans
    • Assign action items, define timeframe
    • Performance metrics
  
  • Set Up Operational Controls, including Communication and Training
    • How do you know if equipment is being run properly, what if staff leaves?
Energy Management SYSTEM

- CHECK
  - Monitoring and Measuring
  - Internal Review
  - Corrective Action
  - Communication & Training
Energy Management SYSTEM

• **ACT**
  • Management Review
  • Re-assessment of Energy Plans
  • Communication & Training
  • Share Successes
“Short-cut” EMS Approach

Step 1: BENCHMARK your energy use

Step 2: Perform an energy AUDIT

Step 3: IMPLEMENT audit recommendations

Step 4: Share your successes and REPEAT, for continuous improvement
Getting Started

- Review EPA’s Plan-Do-Check-Act webinars
  o Are you interested in joining next year’s webinar series?
- Examine existing policies
  o Is there an existing management strategy or policy statement that could be expanded to include energy/water savings?
- Look ahead
  o Is energy use a consideration in asset management/capital improvement planning?
- Secure management buy-in
  o Is senior management aware of the opportunities? It’s easy to demonstrate energy savings if you’re committed to finding them
Moving forward

Example projects and funding sources for:

- Water Efficiency
- Energy Efficiency
- Water Recycling
- Low Impact Development
- Renewable Energy Generation
Water Efficiency

• Install Leak Detection Equipment
• Join WaterSense/incentivize efficient products & practices
• Choctaw Nation
  • Install meters
• White Mountain Apache Tribe (SRF funding)
  • Upgrade to Energy efficient pumps
  • Improve distribution systems
• Hoopa Valley Tribe (USBR funding)
  • Incentivize Grey water & Rainwater
  • Recycle wastewater
Water Efficiency...cont’d

- EPA SRF Tribal set-aside
  www.epa.gov/region9/water/tribal/index.html

- HUD- Community Development Block Grant Program
  portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

- USDA- Rural Development

- USBR WaterSMART grants
  www.usbr.gov/WaterSMART/grants.html

- California-specific funding
  - e.g. Infrastructure and Economic Development Bank
    http://ibank.ca.gov/infrastructure_loans.htm
  - See CFCC website for more:
    www.cfcc.ca.gov/
Renewables & Energy Efficiency

- Install Variable-Frequency Drives
- Upgrade to Energy Efficient Motors and Motor Systems
- Upgrade Heating, Cooling, Ventilation Systems
- Install energy efficient lights and lighting systems
- Manage your electric load
- Sustainably manage biosolids
- Generate energy on-site
  - Co-Gen
  - Biodiesel
  - Hydro
  - Solar
  - Wind
  - Enhance biogas production through co-digestion
The Alaska Native Tribal Health Consortium received $700,000 for Energy Efficiency Upgrades at their Sanitation Facility in Selawik, Alaska. 

http://apps1.eere.energy.gov/tribalenergy/projects_detail.cfm/project_id=169

At the EBMUD WWTF, food waste is co-digested with biosolids. Digesting 100 tons of food waste per day, 5 days a week, provides sufficient power for an estimated 800 to 1,400 homes.

The Kashia Band of Pomo Indians of the Stewarts Point Rancheria received a $46,800 from DOE’s EECBG program for a new solar array.
• Funding sources mentioned on slide 32 also relevant
• DOE’s Tribal Energy & EECBG programs
  http://apps1.eere.energy.gov/tribalenergy/
  http://www1.eere.energy.gov/wip/eecbg.html
• Power Purchase Agreements (PPAs)
• EDA’s Economic Development Assistance Program
  • FY12 solicitation for public works www.eda.gov/ffo.htm
• Dept. of Treasury’s New Markets Tax Credit Program
  http://cdfifund.gov/what_we_do/programs_id.asp?programID=5

Rural Community Assistance Corporation (RCAC) Loans
• Prioritizes “green projects” www.rcac.org/pages/126
• Several USDA grants (See Lisa Butler’s presentation)
Green Infrastructure/LID

- Riparian Buffers
- Permeable Pavement
- Rain Harvesting
- Green Streets & Highways
- Pocket Wetlands
- Swales
- Green Roofs
- Planter Boxes
- Green Parking
- Rain Gardens
- Urban Forestry
- Downspout Disconnection
• Funding sources mentioned on slide 32 & ~33 also relevant
• EPA Brownfield grants
  www.epa.gov/brownfields/grant_info/index.htm
• EPA Clean Water Act grants
  • 106/Water Pollution Control grants
    www.epa.gov/region9/water/tribal/tribal-cwa.html#One
  • 319/Non-point Source grants
    www.epa.gov/region9/water/tribal/tribal-cwa.html#Two
• Additional Funding
  • NPS Rivers, Trails, and Conservation Assistance Program
  • DOT Transportation Enhancement Activities
  • NOAA Community Based Restoration Program
  • U.S. FS National Urban and Community Forestry Program
  • More $ ideas at water.epa.gov/infrastructure/greeninfrastructure/gi_funding.cfm
Green Infrastructure... cont’d

- EPA's Municipal Handbook: Funding Options
  - Discusses stormwater fees and loan programs
- Guidance for Municipal stormwater Funding
- Stormwater Program and Budget Planning Tool
  - Developed by the Center for Watershed Protection
- EPA's Financing Alternatives Comparison Tool
  - A financial analysis tool that helps identify the most cost-effective method to fund a water project.
Additional Resources

• National Sustainable Infrastructure website:
  http://water.epa.gov/infrastructure/sustain/
  • Asset Management page
    http://water.epa.gov/infrastructure/sustain/asset_management.cfm

• EPA’s Pond Manual
  www.epa.gov/ordntrnt/ORD/NRMRL/lrpcd/projects/ponds.htm

• EPA ORD’s Water Cluster Research
  www.epa.gov/nrmrl/watercluster/projects.html

• WERF’s Decentralized Water Resources Collaborative
  www.ndwrcdp.org/
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www.epa.gov/region09/waterinfrastructure