Smart Management for Small Water Systems

Ask the Experts – Energy Management in Water Supply & Distribution Systems

Sept. 12, 2017 | Webinar on www.efcnetwork.org

Dawn Nall, Southwest Environmental Finance Center

Nicholas Willis, Wichita State University Environmental Finance Center

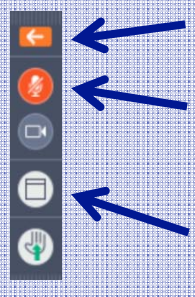
EFCN environmental finance center network

American Water Works Association

This program is made possible under a cooperative agreement with the U.S. EPA.

Logistics

Opening the control panel



Show your control panel

All phones/microphones are muted for the duration of the webinar

Toggle between full screen/window screen view

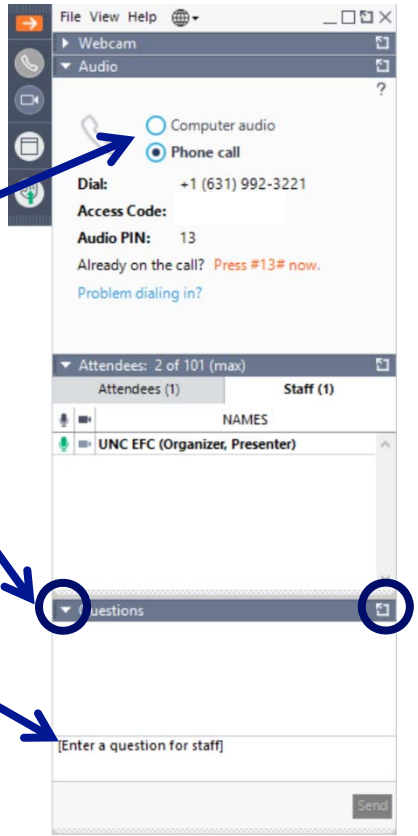
Using the control panel

Audio: please choose between computer audio or phone call

If you do not hear audio right now, please check your speaker volume or enter #[your Audio PIN]# if using phone

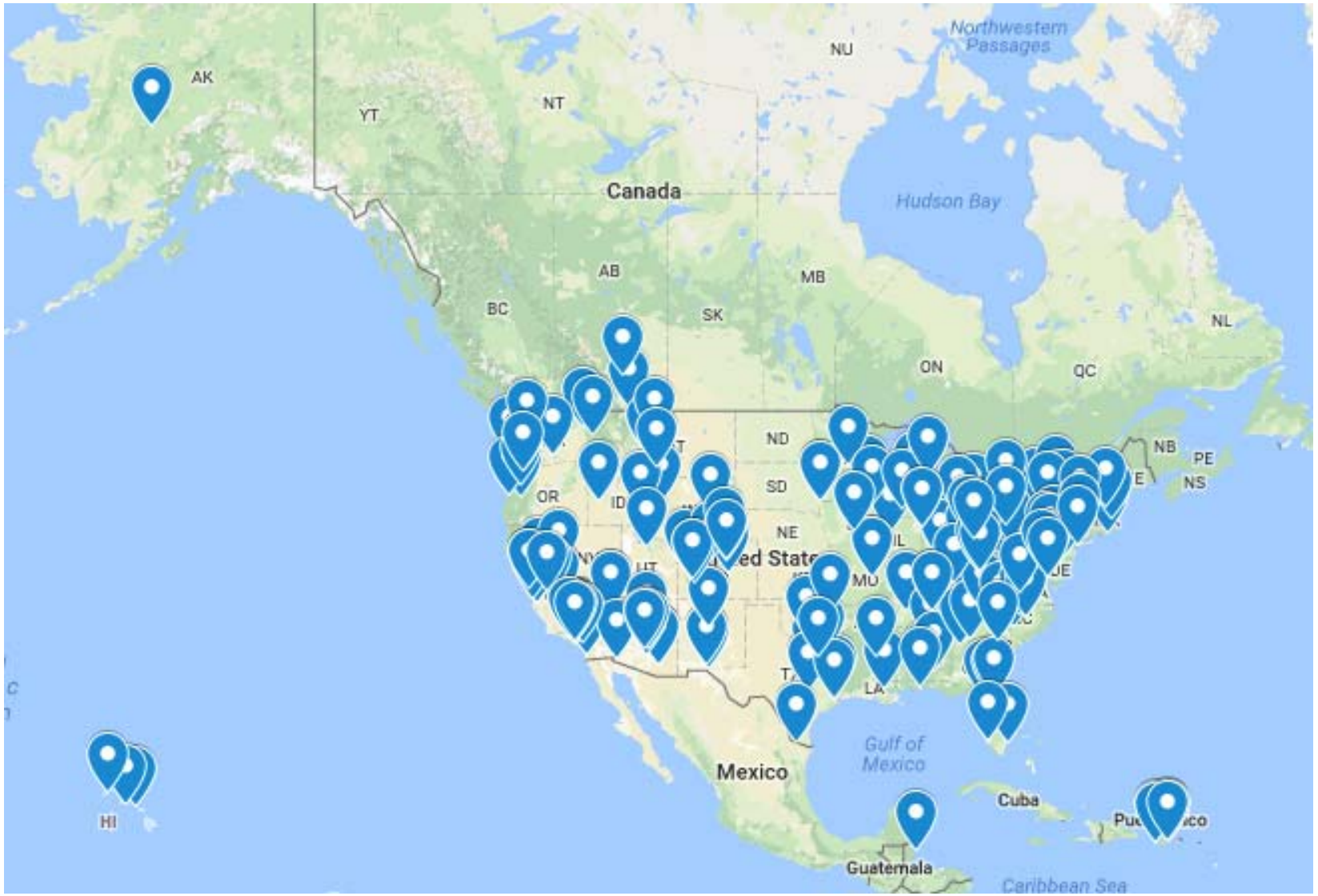
Click ▶ to open in Control Panel

Submit **questions** in the Questions box at any time, and press [Send]



Click ⧉ to open in separate box and resize

Registrants of this Webinar



Certificate of Completion

For attendees who have an AWWA customer record, your certificate will be uploaded within 30 days. For attendees who do not have an AWWA customer record, you will receive an email from AWWA requesting you to create a customer record (by a specific date) to receive your certificate. If you do not create a customer record, you will not receive a certificate.

AWWA emails may be blocked or go to your Junk mail. To avoid this issue, add ***educationservices@awwa.org*** to your email Contacts or check your Junk mail frequently.

AWWA recommends that you check with your licensing agency to learn about its criteria, rules, and what you need to do in order to receive credit for your attendance. It is your responsibility to verify this information with your licensing agency.

AWWA follows the IACET Standard of CEU calculation.
0.1 CEU = 1 Contact Hour or 1 Professional Development Hour

Questions? Please contact ***educationservices@awwa.org***

About the Environmental Finance Center Network (EFCN)

The Environmental Finance Center Network (EFCN) is a university-based organization creating innovative solutions to the difficult how-to-pay issues of environmental protection and improvement. The EFCN works with the public and private sectors to promote sustainable environmental solutions while bolstering efforts to manage costs.

The Smart Management for Small Water Systems Program

This program is offered free of charge to all who are interested. The Program Team will conduct activities in every state, territory, and the Navajo Nation. All small drinking water systems are eligible to receive free training and technical assistance.

What We Offer

Individualized technical assistance, workshops, small group support, webinars, eLearning, online tools & resources, blogs

The Small Systems Program Team

- Environmental Finance Center at The University of North Carolina at Chapel Hill
- Environmental Finance Center at Wichita State University
- EFC West
- New England Environmental Finance Center at the University of Southern Maine
- Southwest Environmental Finance Center at the University of New Mexico
- Syracuse University Environmental Finance Center
- Environmental Finance Center at the University of Maryland
- American Water Works Association (AWWA)

UNC ENVIRONMENTAL FINANCE CENTER

WSU WICHITA STATE UNIVERSITY HUGO WALL SCHOOL OF PUBLIC AFFAIRS Environmental Finance Center

EFCWest Environmental Finance Center West

New England Environmental Finance Center

SOUTHWEST ENVIRONMENTAL FINANCE CENTER

Environmental Finance Center Syracuse University

ENVIRONMENTAL FINANCE CENTER

American Water Works Association

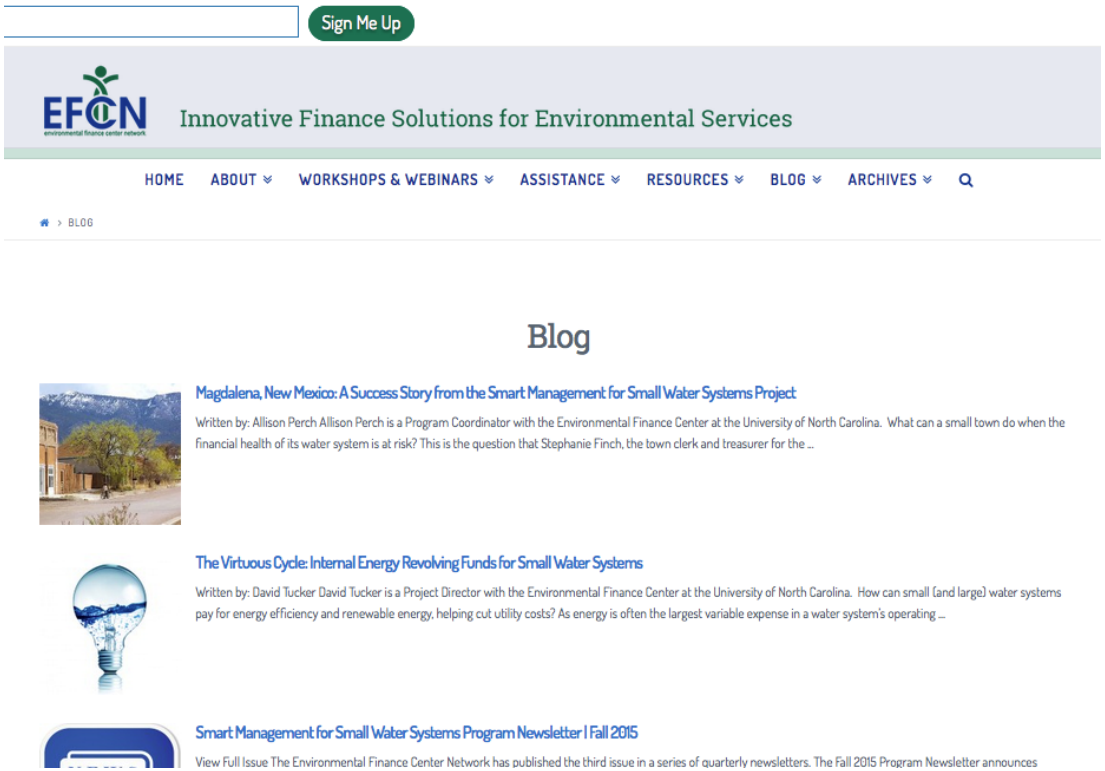
Areas of Expertise

- Asset Management
- Rate Setting and Fiscal Planning
- Leadership Through Decision-making and Communication
- Water Loss Reduction
- Energy Management Planning
- Accessing Infrastructure Financing Programs
- Workforce Development
- Water Conservation Finance and Management
- Collaborating with Other Water Systems
- Resiliency Planning
- Managing Drought

Small Systems Blog

Learn more about water finance and management through our Small Systems Blog! Blog posts feature lessons learned from our training and technical assistance, descriptions of available tools, and small systems “success stories.”

efcnetwork.org/small_systems_blog/



Energy Management

Program Goals

Energy Management Goals

- Improve energy efficiency & manage total energy consumption
- Control peak demand for energy
- Manage energy cost volatility
- Improve energy reliability

Improve Efficiency & Manage Total Consumption

- Cost of electricity is based on two main components
  - Quantity of electricity used (kWh)
  - Demand for electricity
- On-peak vs. off-peak consumption affects rates
- Understanding the electric utility's pricing policies (rate structures) is critically important

Control Peak Demand for Energy

- Electric utilities typically include a “demand charge” in their rate structure
- Lower variability in electric demand over time (flattened demand curve)
  - Minimize changes in peak demand throughout the course of a billing period
  - Shifting loads from peak periods, typically during daylight hours, to off-peak periods
- Potential for significant cost savings by minimizing demand charges

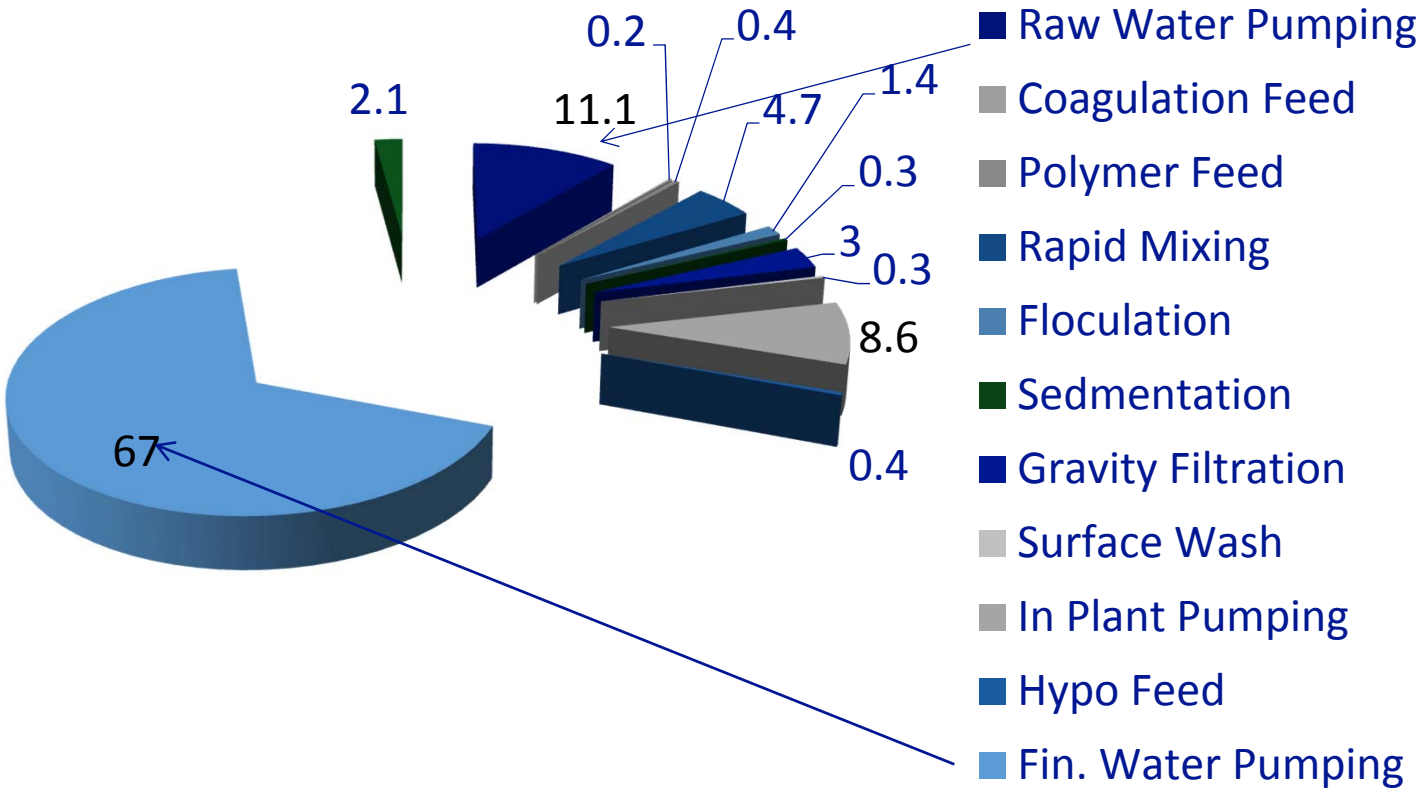
Manage Energy Cost Volatility

- Energy costs fluctuate
- Dramatic changes stress budgets
- Protect against volatility as much as possible
  - Reducing need for energy
  - Long-term procurement of energy
  - Provisions for alternative energy sources
  - On-site generation of energy

Improve Energy Reliability

- Water utilities should be able to provide critical systems with adequate backup power
- Energy planning process should identify opportunities to improve energy reliability
  - Protection against complete loss
  - Identify changes in power quality that can damage equipment and/or
  - Institute operating procedures to address changes in overall power availability

Energy Use By Water Treatment Process
10 MGD - Percent Energy Use



Q&A

Please note – regional and state specific questions (i.e. extreme temperatures, specific regulations, etc.) can be addressed via one-on-one technical assistance

http://efcnetwork.org/assistance/request-assistance/

Q: How can I do a quick evaluation of my system?

Understand your Energy Bills

MOUNTAIN PARKS ELECTRIC, INC.
Your Touchstone Energy® Cooperative

Granby Office Hours: 8:00 AM-5:00 PM Monday-Friday

Mountain Parks Electric, Inc.
321 West Agate Avenue, PO Box 170
Granby, CO 80446-0170
Phone: 970-887-3378
TOLL FREE: 877-887-3378
600 3rd Street, Walden, CO 80480
Phone: 970-723-4500
Website: mpei.com

Statement Date:	01/10/2013
Account#:	100264200
Statement ID:	18885198
Billing Cycle:	Cycle 1
Rate Description:	4-5
Multiplier:	1

Account For:
Account Number:
SERVICE ADDRESS: NO VALID SERVICE ADDRESS
WELLS 8 & 9

Previous Balance	192.41
12/24/12 Payment -- Thank You	-192.41

Current Billing Detail

01/10/13 Energy Charge	73.85
01/10/13 Service Availability Charge	29.00
Total Current Charge	**102.85**

SERVICE PERIOD **12/01/2012-12/30/2012**

Meter Reading Summary:

	Meter Number	Present Reading	Previous Reading	Multi	Usage	Days of Service
KWH Meter Reads	98911457	52970	52224	1	746	29

KWH Usage by Month

Understand your Energy Bills

OPT-V TOU Secondary Small Gen

Meter Number: 041069590

Contract Demand

Master: 550

Summer: 550

Winter: 550

Bill Month	Bill Year	Customer Charge	On-Peak Actual Demand(Winter)	On-Peak Billing Demand	On-Peak Billing Demand Amount	On-Peak Actual Demand(Summer)	On-Peak Billing Demand	On-Peak Billing Demand Amount	Off-Peak Actual Demand	On-Peak Energy(Winter)	On-Peak Energy(Winter) Amount
10	2016	$32.17	369.6	370	$2,084.47	356	356	$2,244.14	388	20,960	$1,309.77
9	2016	$32.17				392	392	$6,514.65	379.2		
8	2016	$32.17				383.2	383	$6,365.08	373.6		
7	2016	$32.17				360.8	361	$5,999.46	360.8		
6	2016	$32.17	356.8	357	$1,334.25	361.6	362	$3,538.87	372.8	13,520	$885.70
5	2016	$32.17	358.4	358	$3,249.39				368	26,560	$1,739.95
4	2016	$32.17	381.6	382	$3,467.22				391.2	31,200	$2,043.91
3	2016	$32.17	411.2	411	$3,730.44				399.2	42,000	$2,751.42
2	2016	$32.17	414.4	414	$3,757.67				415.2	42,240	$2,767.14
1	2016	$32.17	416	416	$3,775.82				434.4	39,680	$2,582.13
12	2015	$32.17	404.8	405	$3,675.98				398.4	37,760	$2,434.84
11	2015	$32.17	375.2	375	$3,403.69				393.6	40,240	$2,594.76

Bill Month	On-Peak Energy(Summer)	On-Peak Energy(Summer) Amount	Off-Peak Energy	Off-Peak Energy Amount	Economy Demand	Economy Demand Amount	Renewable Energy Rider	Sales Tax	# of Days	Adj	Total Charges
10	19,760	$1,234.78	113,200	$3,776.92	18	$22.55	$4.19	$749.63	29	N	$11,458.62
9	50,400	$3,216.86	131,120	$4,550.21			$3.92	$1,002.25	33	N	$15,320.06
8	47,600	$3,124.56	111,680	$4,078.33			$3.55	$952.26	29	N	$14,555.95
7	46,400	$3,043.68	108,160	$3,944.86			$3.55	$911.66	29	N	$13,935.38
6	29,440	$1,928.61	135,040	$4,913.57	11	$13.78	$3.55	$885.54	34	N	$13,536.04
5			118,000	$4,293.55	10	$12.53	$3.55	$653.18	29	N	$9,984.32
4			128,640	$4,680.70	9	$11.27	$3.55	$716.72	32	N	$10,955.54
3			119,120	$4,334.30			$3.55	$759.63	30	N	$11,611.51
2			127,680	$4,645.76	1	$1.25	$3.55	$784.53	28	N	$11,992.07
1			153,280	$5,510.40	18	$22.55	$3.55	$834.86	33	N	$12,761.48
12			119,120	$4,211.84			$3.55	$725.09	30	N	$11,083.47
11			108,000	$3,818.66	19	$23.80	$3.55	$691.36	29	N	$10,567.99

Typical Electric Bill Components

- Customer charge
- Consumption charge (by kWh)
- Demand charge (by kW or kVa)
  - May not apply in some rate structures, e.g. residential electric rate structures
- Other charges
- You may be able to switch rate structures

Understand your system

- How old is your energy using equipment?
- How has that equipment been maintained?
- How is the equipment being operated?
  - What are the run times?
  - How many starts/stops per hour?
- Is it being used as intended/designed?
  - Where is the pump operating on the pump curve
  - http://efcnetwork.org/publication/tech-brief-reading-centrifugal-pump-curves/
- Are air compressors running when no air is being used? Leaky air lines?

Understand your buildings

- Air Conditioning / Heating leaking out windows, doors, or other penetrations?
- Lighting – is it efficient? Is it in use only when needed?
- Thermostats – working? Set too high/low?
- Is equipment heating up the room?
- Is cold water cooling the room?

Understand your distribution system

- Water Loss = Energy Loss
- What pressures exist throughout the distribution system?
  - Booster pumps – VFDs?
  - PRVs and other pressure zone valves working?
- System inefficiencies

Q: Inefficient pump stations often look the same as efficient ones. How can we tell the difference?

Pump station efficiency

- Understand meter readings & bills
- Quick comparison
  - Calculate
  - Total gallons/kWh/psi increase
- Look at station
  - Is it maintained?
  - Is all equipment in-service?
- Look at distribution system
  - Is it leaky?
  - Are there other inefficiencies in moving water?

Distribution system inefficiencies

- Looping of water
  - Water is pumped to higher pressure then bleeds back through PRV to initial pressure zone
- Using more expensive supply
  - In pressure zones with >1 supply – is the cheapest being used to supply?
- Leaping pressure zones
  - Water pumped to highest pressure zone from lowest zone then released to middle zone through pressure reducing valve
- Too high of pressure

Q: What is the easiest change to minimize energy use?

Easy ways to reduce energy use

- Process changes often have no upfront costs
  - Faster & easier than new equipment installs
- Possible changes
  - Reduce runtimes or number of units in treatment (contact regulators)
  - Look for water loops in treatment plant & distribution
- Minimize demand charges
  - i.e., backwash pumps
    - High horsepower, few hours per week – likely drive demand charges
    - May be several hundred dollars monthly
    - Turn off equivalent power of equipment if possible

Categories for Energy Efficiency Opportunities

- Capital program or equipment replacement
- Process change
- Operational change
- Automation or controls
- Maintenance improvements
- Business measures

Potential High Impact Projects

- Water system optimization
- Pumping system efficiencies
- Motor management
- Promote water conservation
- Reduce heating and cooling load for buildings and well-houses
- Use of renewable energy

Q: For a small system with 1 or 2 wells with submersible pumps, can high efficiency motors and variable frequency drives pay for themselves in energy?

Electric Motors

- Extremely reliable
- ~90% of lifetime cost is electric bill, not motor
- Can be rewound several times
- Readily available
- Failure may be a sign of other problems
- Most plant motors are Totally Enclosed Fan Cooled (TEFC)

Electric Motor Efficiency

- General rules of thumb:
  - Larger kW motors convert a higher percentage of energy into work
  - Three phase motors are more efficient than single phase motors
  - Motors are typically most efficient operating at ~75% of nameplate (i.e., 75 hp load on 100 hp motor).

Does motor replacement pay for itself?

- Depends on:
  - Energy cost
  - Motor runtime
  - Cost of motor
  - Cost of installation
  - Differences in efficiency
- Economics improved with:
  - More expensive energy costs
  - Longer runtimes
  - Greater increases in efficiency

Future Motor Purchases

- Motor policy development:
  - All replacements should be NEMA Premium
  - Super Premium Efficient Motors are entering market (IE4)
    - Many cases allow for removal of gearbox as variable speed drive and new motor technology allow for direct couplings and still meet speed requirements
    - IE5 motors entering market
  - High usage motors should generally be replaced – not rewound

Variable frequency drives

- Adjusts frequency of input electricity to vary motor speed.
- Centrifugal loads – affinity law.
- Very high power savings if the speed of the motor can be dropped without sacrificing performance.
- Requires inverter rated motors

Table 1

% Speed	% Flow	% Horsepower Required
100	100	100
90	90	73
80	80	51
70	70	34
60	60	22
50	50	13
40	40	6
30	30	3

Table from vfds.org

Benefits of variable frequency drives

- Power savings
  - Particularly with centrifugal loads
- Soft start/soft stop capable
  - Reduce equipment wear & tear
  - May reduce pressure spikes in distribution system
- Improve power factor (kVa on bills)
- Can be programmed with SCADA system

When to add VFDs to your pumping system?

- Generally cost-effective if removing throttling valve
  - May check to be sure pumps are sized correctly
- May be cost effective with:
  - Systems where VFDs reduce main breaks
  - Systems with reasonable run-times (8+ hours/day)
  - Systems looking to upgrade control systems
  - Systems with high-cost electricity
  - Systems needing to remove elevated storage for maintenance

Is there data available across multiple utilities for water loss?

- AWWA
  - The AWWA Water Audit Compiler© (Compiler) was launched in 2011 and can be utilized to quickly assemble water audit data from multiple water utilities; allowing for comparisons of data across water utilities.
  - https://www.awwa.org/resources-tools/water-knowledge/water-loss-control.aspx

Q: What are some ways to modify/replace existing equipment, operations and infrastructure to gain long-term energy cost reductions?

Existing equipment

- Utilize predictive maintenance to ensure:
  - Heat generation causes identified/eliminated
  - Proper lubrications utilized
    - Energy saving lubrications can save up to 5% on gearboxes
      - Plus longer life in some cases
- Use cogged belts instead of v-belts
  - ~2% energy savings
- Keep lighting clean

Existing operations

- Consider if existing shifts may be changed
- Pumping automation
- Track energy usage
  - Additional meters in plants/wellfields
  - Amp meters
- Strongly consider minimizing vehicle usage
  - SCADA controls to turn remote units on/off
  - Remote meter reading

Existing infrastructure

- Minimize number of times water is pumped
- Know where high velocities exist in distribution
- AWWA Water Audits
- Reduce flushing through upgrades
  - More looping
  - Chlorination in distribution
  - Disinfection byproduct controls in plant/storage

What tools are available to help?

- EFCN's Electricity Baseline Builder Spreadsheet
  - http://efcnetwork.org/tool/electricity-baseline-builder-water-utilities/
- NYSERDA's Water Checklist
  - http://efcnetwork.org/wp-content/uploads/2016/02/water-check-list-002.pdf
- EPA's ENERGY STAR Portfolio Manager®
  - https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager
- Energy.gov software tools list
  - https://energy.gov/eere/amo/software-tools
- AWWA "Energy Management for Water Utilities" 2016

Q: How can we plan for future energy challenges, both availability and costs?

- Know your energy bills
  - Track usage to uncover issues (kWh/million gal) & demand charges
- Know your system's inefficiencies & plan to remove them
- Set a policy to only purchase efficient equipment & electric motors

Future energy planning cont…

- Maintain system & equipment
- Incorporate energy efficiency in capital improvements
  - i.e., does system's hydraulic model indicate a lot of friction in certain pipe segments?
  - Can distribution system changes eliminate issues?
- Pay attention to new energy opportunities
  - Electric utilities may offer:
    - Efficiency audits/rebates
    - Alternative pricing/usage schemes

Future energy planning cont…

- If system has high water loss, actively work:
  - Begin AWWA Water Audit
  - Implement solutions
  - Maintain good records
  - Perform annual audits

Nicholas Willis
Program Manager
WSU EFC
nicholas.willis@wichita.edu
(316) 978-6538

Smart Management for Small Water Systems

Dawn Nall
Program Manager
SW EFC
dnall@unm.edu
865-210-5604

Thank you for joining us today, and we hope to see you again!

www.efcnetwork.org

EFCN environmental finance center network

American Water Works Association