August 29, 2024

AWT FOR COOLING TOWERS: GSA WATER CONSERVATION GUIDANCE

Green Proving Ground | National Renewable Energy Laboratory

Agenda

Logistics
Andrea Silvestri, GSA Green Proving Ground

Introduction (5 minutes)
Cedar Blazek, Program Manager, GSA Pilot to Portfolio

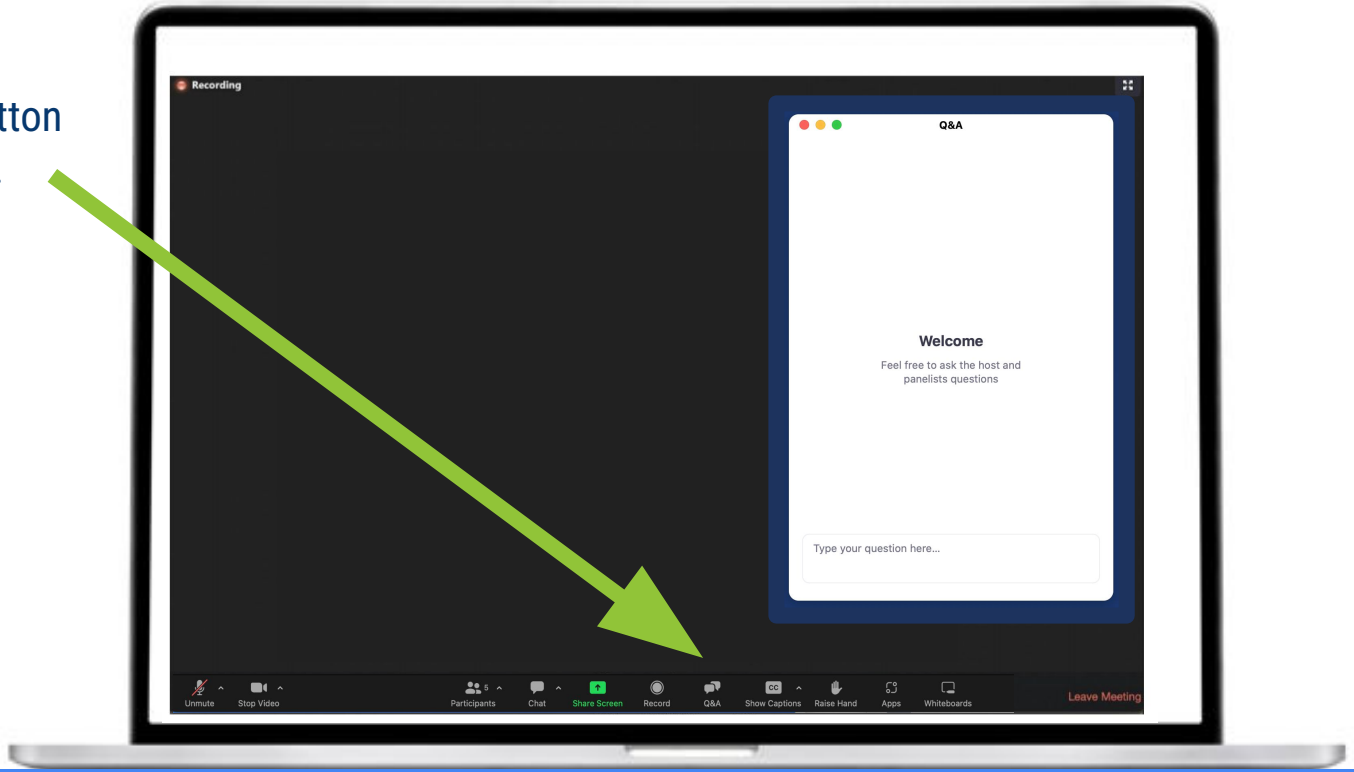
AWT for Cooling Towers Guidance (25 minutes)
David Sickinger, Principal Investigator, National Renewable Energy Laboratory

On-the-Ground Feedback (10 minutes)
Tyler Cooper, Jacob Lewis

Q&A (20 minutes)

How to Ask Questions

Click the Q&A button to ask questions.

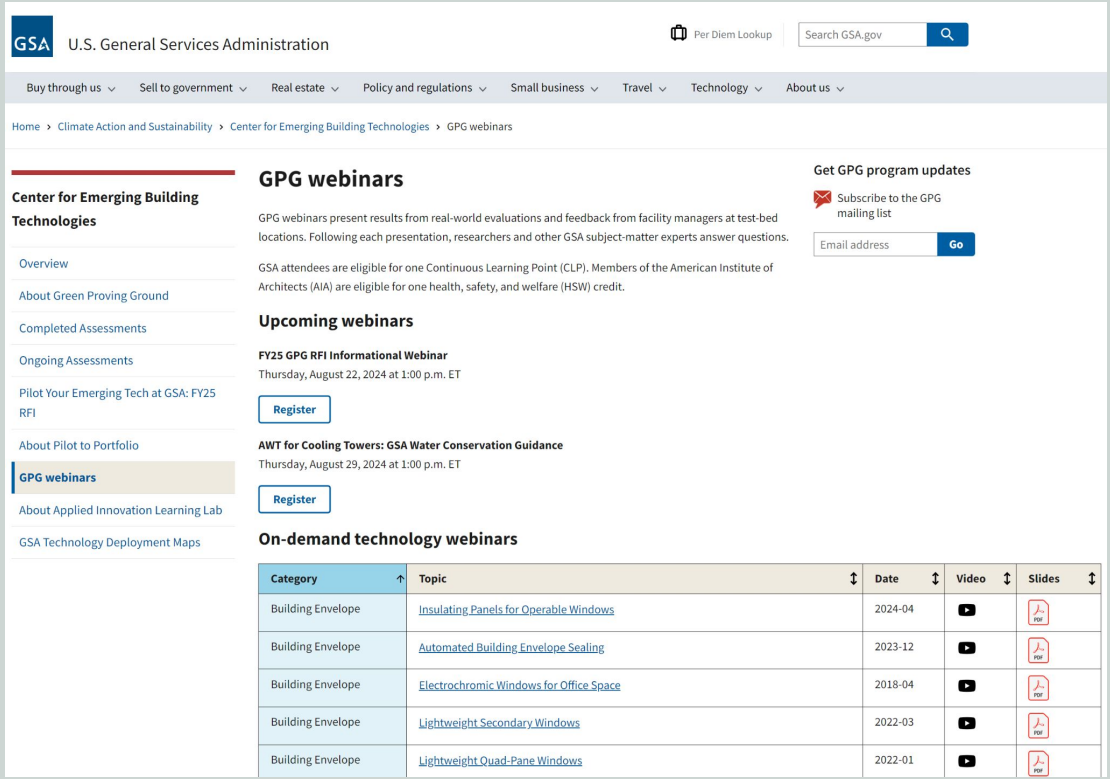


Webinar Recording and Slides

@ gsa.gov

The webinar is being recorded.

The recording and slides will be shared by email and posted to gsa.gov.



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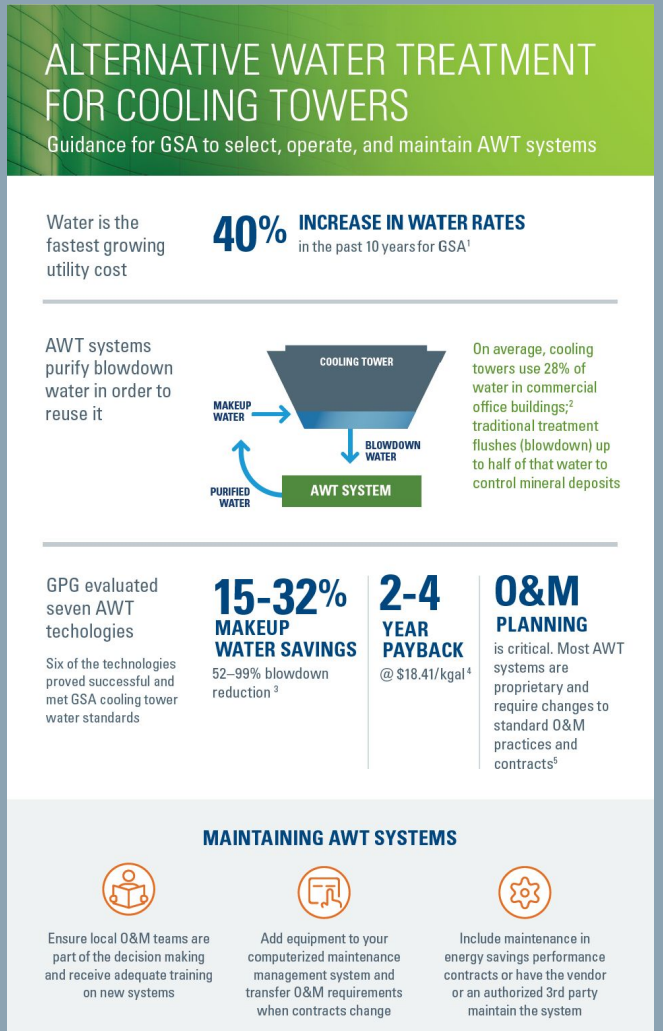

Welcome

Cedar Blazek
Program Manager, Pilot to Portfolio
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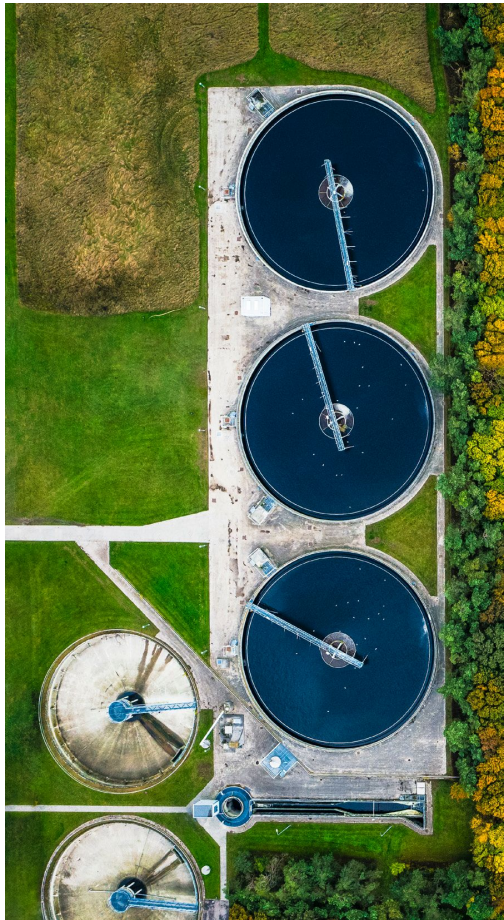
Cooling Towers and GSA

80%

of federally owned, GSA-managed floor space is conditioned by ~1,000 chilled water plant cooling towers



Drivers for Reducing Water Use

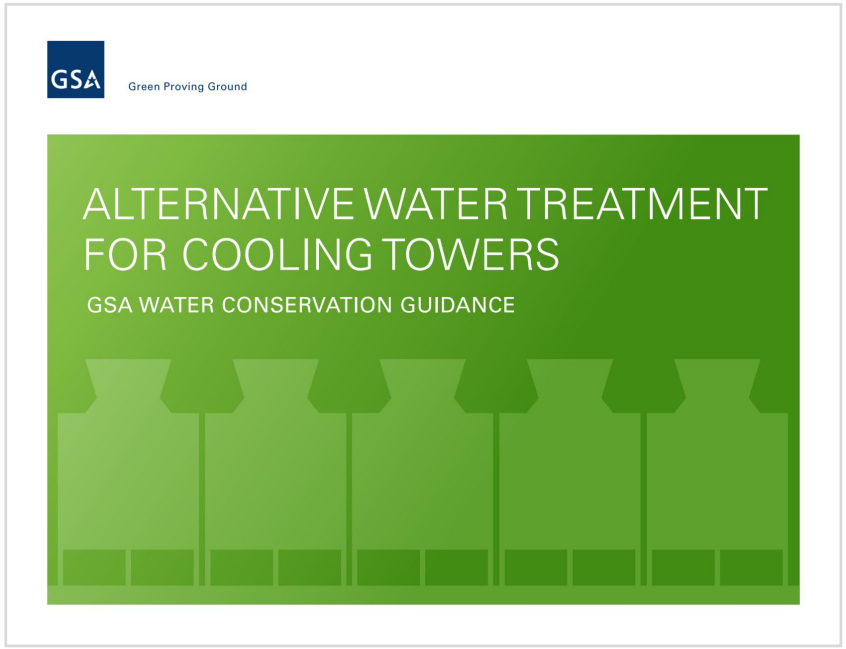
28% **OF WATER IN COMMERCIAL BUILDINGS**

IS USED BY COOLING TOWERS AND OTHER HEATING AND COOLING SYSTEMS

40% **INCREASE IN GSA WATER RATES IN THE PAST 10 YEARS**

Introduction to the Guide

This newly released document by GPG and NREL, provides guidance on selecting, installing, and operating alternative water treatment (AWT) systems and summarizes the findings from six GPG AWT evaluations.



Subject Matter Expert

David Sickinger
Researcher, National Renewable Energy Laboratory
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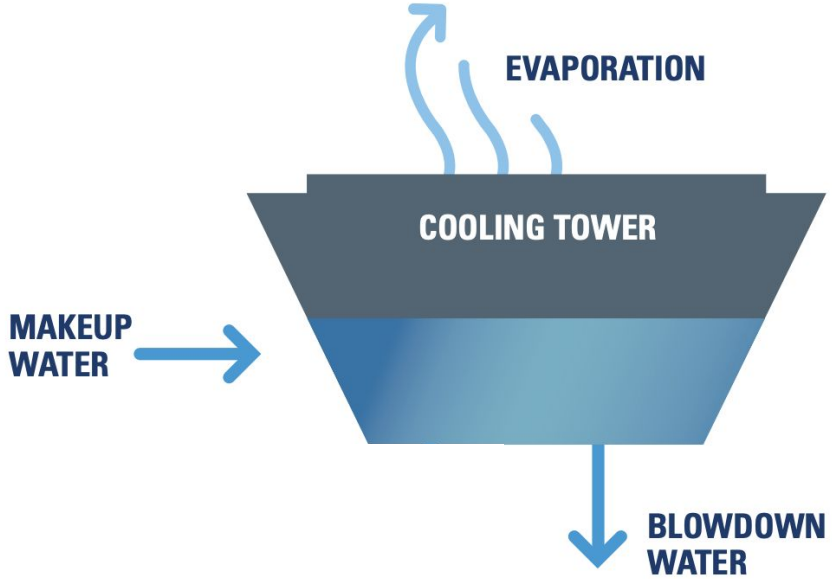
Traditional Cooling Tower Treatment

Scale, corrosion, and biological growth controlled with chemicals and blowdown

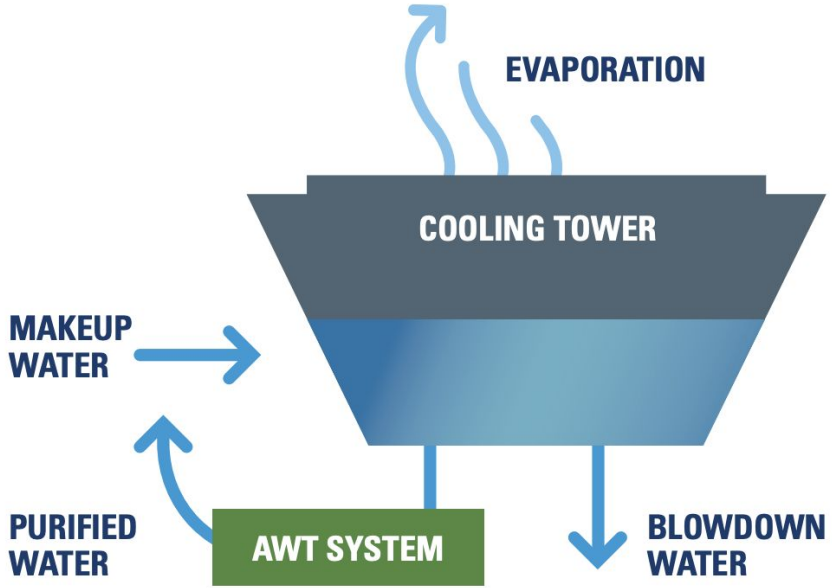


25-50%

COOLING WATER IS FLUSHED

TO MINIMIZE SCALE BUILD-UP

AWT Systems Purify Water to Reuse It



Most AWT systems rely on a proprietary technology offered by individual vendors

Seven AWT Systems Evaluated by GPG

Six proved successful and met GSA cooling tower water standards

15%–32%

MAKEUP WATER SAVINGS

52%–99% blowdown reduction

2-4

YEAR PAYBACK

@ $18.41/kgal

O&M

PLANNING

is critical. Most AWT systems are proprietary and require changes to standard O&M practices and contracts

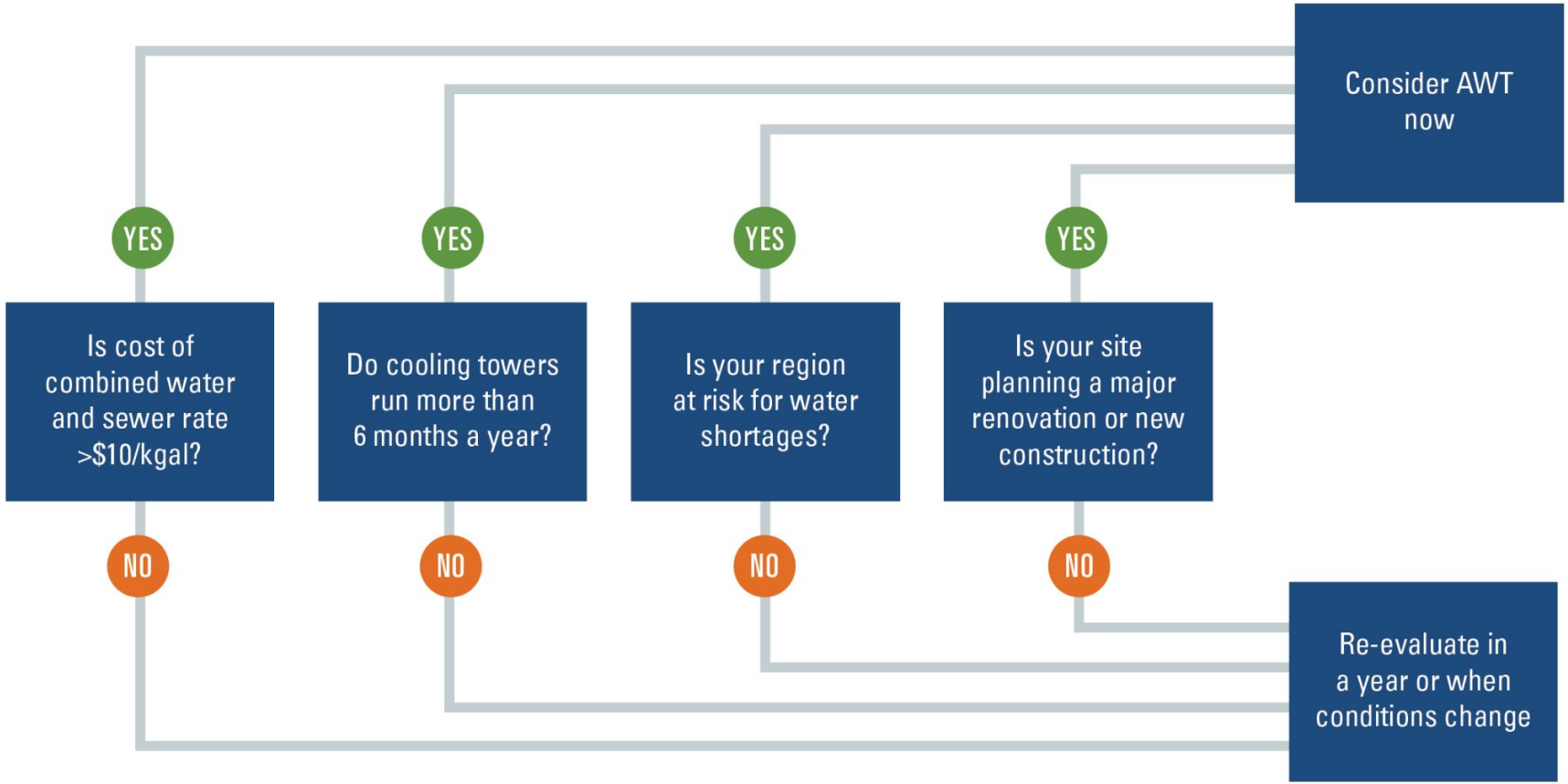
Maintaining an AWT System is Critical

Ensure local O&M teams are part of the decision making and receive adequate training on new systems

Add equipment to your computerized maintenance management system and transfer O&M requirements when contracts change

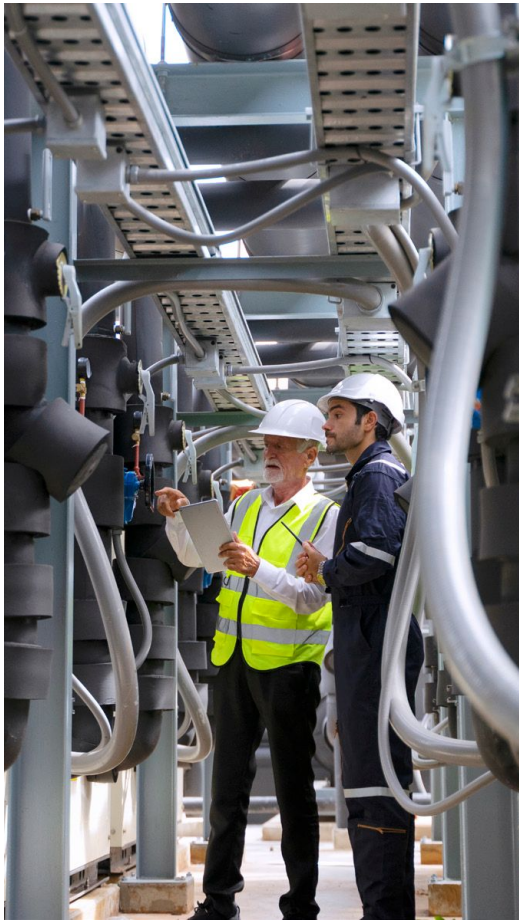
Include maintenance in energy savings performance contracts or have the vendor or an authorized 3rd party maintain the system

When to Consider an AWT System



Selecting an AWT System

- Obtain estimates and choose the most cost-effective option for your location
- Consider ongoing maintenance costs
- Ensure local O&M teams are part of decision-making

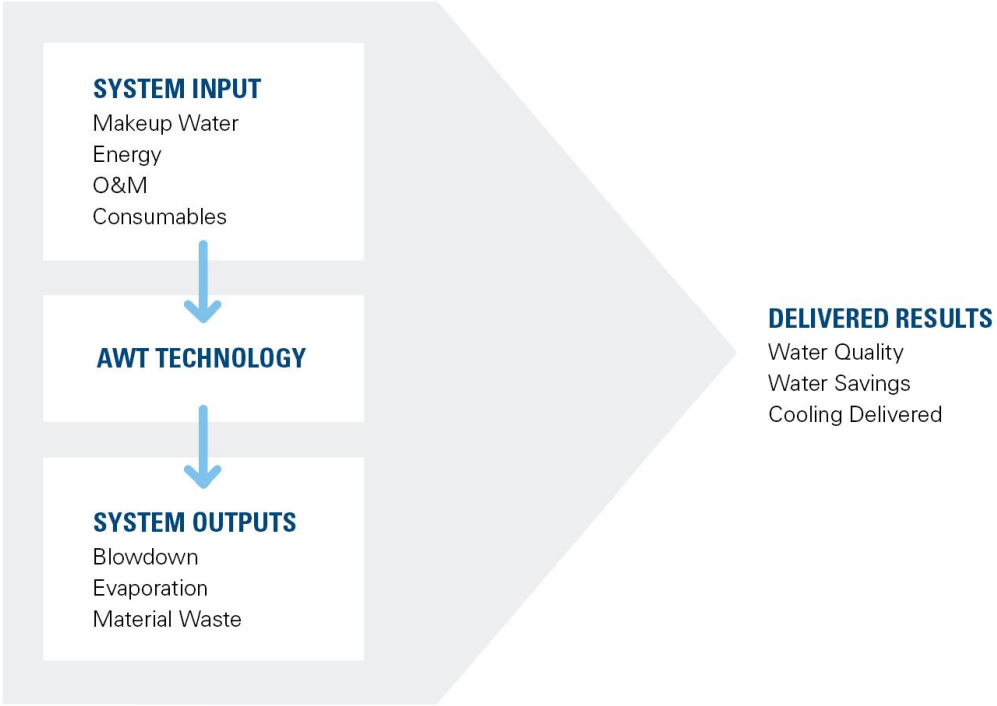


Evaluate Systems on Their Ability To:

- Conserve energy, water, and chemical costs.
- Minimize maintenance costs, extend system longevity, and improve reliability.
- Inhibit all system metallurgies against corrosion to prevent system failure and operation interruptions. Use corrosion coupons to measure corrosion.
- Control microbiological growths that can contribute to corrosion and deposit formations. Weekly measurement is recommended.
- Inhibit scale formations and deposit accumulations. Monthly measurement is recommended.
- Work with site conditions. AWT systems need to be designed for the specific facilities in which they will be installed.

You Can’t Measure What you Don’t Meter

- Measure water savings targets over a minimum 3-week period during the cooling season.
- Continue measuring water use over an entire cooling season.
- Establish a requirement for measuring ongoing water savings.
- Monitor water quality monthly.



Measurements Needed

Required: Baseline metering*

- Makeup water for cooling tower (gal)
- Blowdown water for cooling tower (gal)

Nice-to-Have: Likely available from water treatment reports**

- Makeup conductivity (avg µS/cm or mS/cm)
- Blowdown conductivity (avg µS/cm or mS/cm)

Nice-to-Have: Likely available from BAS

- Cooling tower (condenser water) supply and return temperatures (°F)
- Cooling tower (condenser) flow rate (gpm) or water pump status (ON/OFF) and speed
- Chiller water supply and return temperatures (°F)
- Chiller flow rate (gpm) or water pump status (ON/OFF) and speed
- Outdoor air temperature (°F) and humidity (%) or Weather Underground data, or equivalent external source

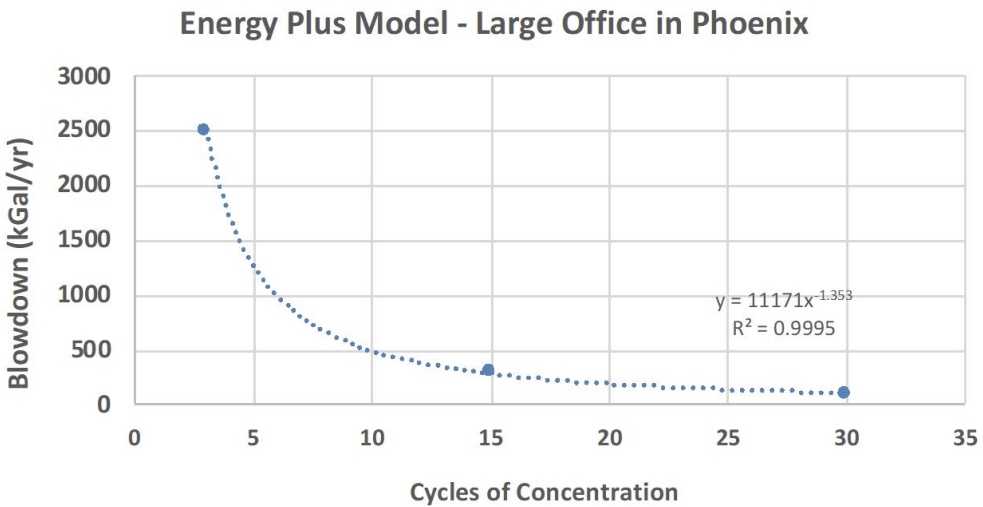
* GSA Region 8 has had the best results with inline magnetic flow meters because they eliminate issues with turbulence caused by pipe turns and can capture low-flow conditions.

**Recommend integrating the cooling tower meter into the building automation system (BAS) for increased visibility.

A Note About Cycles of Concentration

Majority of savings from CoC of 3 to 10, savings level off after CoC of 15

- CoC= Ratio of concentration in dissolved solids blowdown vs. makeup water
- Typical CoC: 2.5 to 7
- At a CoC of 3, around 33% of cooling tower water make up is wasted as blowdown
- Some AWT systems modify the conductivity setpoint to increase CoCs; some are able to reduce water use without increasing CoC



Selecting an AWT System: Things to Consider

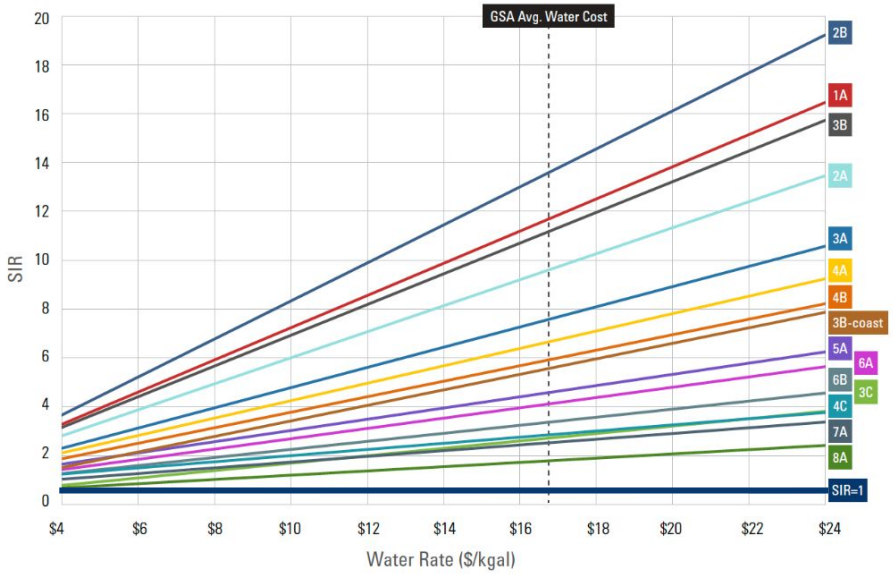
- **Vendor experience.** Vendors should have at least 3 years of experience with systems of equal size. Ask for references.
- **Space, weight, and access.** Fit through doors? Crane required? Roof structure support?
- **Installation location.** For instance, if installed in the mechanical room, check nearby floor drains.
- **Size of the cooling tower.** Some technologies have restrictions concerning the basin size.
- **Cybersecurity considerations.**
- **Service requirements** and availability of local support
- **Required changes** in O&M practices, staff training, and safety procedures.
- **Appropriateness of technology** for local water chemistry and environmental conditions

Selecting an AWT System: Things to Consider

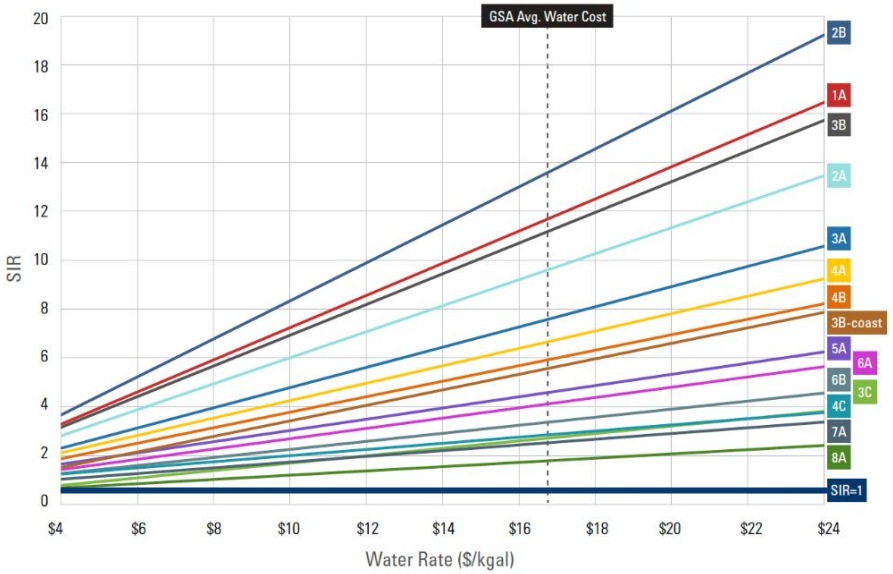
- **Power consumption** and local electricity rates.
- **Interface requirements** with existing systems (e.g., plumbing, electrical, communication, drain lines).
- **Available options** (e.g., auto-cleaning, power feed, control communication protocols)
- **Local limitations on sewer discharge.** Some localities restrict salt-based water softening.
- **Conductivity setpoint.** Some systems require the setpoint to be changed to realize savings.
- **Ongoing maintenance costs.** Some of the technologies eliminate or significantly reduce chemicals.
- **Ability for the site to meet AWT requirements**. Ask manufacturer to supply a checklist outlining necessary conditions, and verify conditions are met.

Water Costs Widely Fluctuate but Still Cost-Effective

$20K System Cost Sensitivity Analysis*



$35K System Cost Sensitivity Analysis*



*Based on a 15-year project life

Performance and Savings are Site Specific

Tower Performance

Incoming water quality variables, such as hardness, total dissolved solids (TDS), alkalinity, conductivity, seasonal changes to water quality, airborne particulate matter, and local insect populations, all impact cooling-tower water treatment system strategies and effectiveness.

Water Savings

Sites in hot climates with long cooling seasons and long cooling tower run times will typically have the largest water savings.

Water quality also impacts performance. Locations with excessively hard water, high pH, or high TDS typically operate at lower CoCs, use more water treatment chemicals, and will have the greatest opportunity for savings.

Installing an AWT System

Best practices and lessons learned

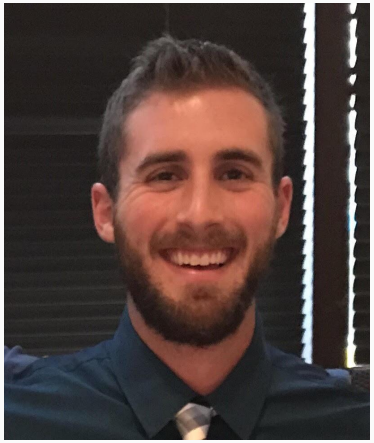
- Install metering for makeup water and blowdown
- Confirm the system has been installed according to the design specifications provided by the vendor.
- Capture water rebates where available.
- Incorporate water savings requirements into O&M contracts.
- Consider a side-stream filtration system.
- Consider a tower sweeper when installing a new cooling tower.
- Consider integrating AWT technology with BMS.
- Initiate commissioning immediately after installation.
- AWT systems should not replace redundant systems.

Maintaining an AWT System

Best practices and lessons learned

- Continue water monitoring after the AWT system is installed.
- Add equipment as a maintained asset in the NCMMS.
- Include maintenance in ESPCs.
- Establish a communication and support protocol/cadence with the vendor.
- Consider having the vendor or authorized third party maintain the AWT system.
- Train local O&M teams to operate the installed AWT system.
- Transfer O&M requirements when contracts change.
- Modify O&M contracts to reflect reduced chemical costs.
- Consider remote monitoring.

On-the-Ground Feedback



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R8 Site Selection

Need adequate cooling tower run time

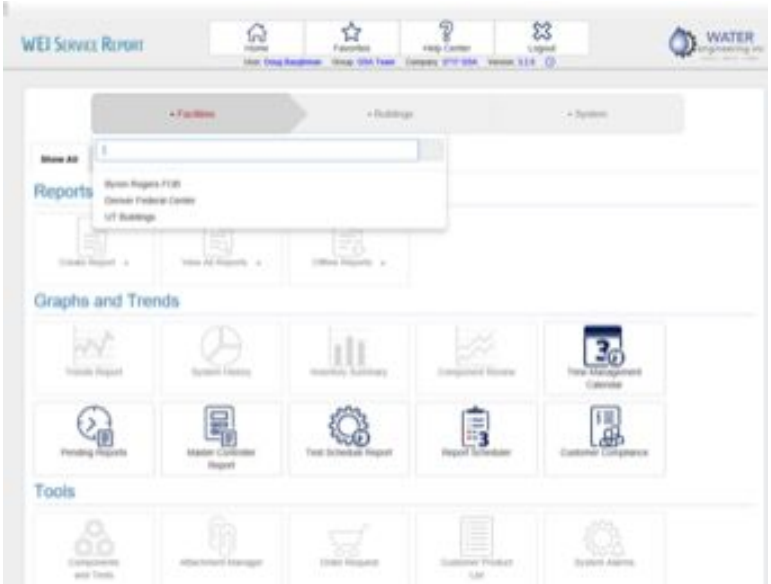
- 5-month season = good rule of thumb for positive ROI in Denver
- Knowing daily hours of tower operation will help you calculate savings
- Longer run-time will allow for higher CoC. 500-ton system outperformed 1500-ton system with a 40,000 gallon sump due to longer run times

We chose AWT systems to reduce water use while maintaining water quality, reducing blowdown and increasing CoC

R8 Maintenance

Old habits are hard to break

- Make sure O&M understands the new system and is committed to maintaining it
- Contracting needs to address/specify AWT treatment
- Helpful to have online reporting system to monitor results and O&M performance



R8 Lessons Learned

Bring expertise on board

- Inspect water circulation in the tower basin. Water should be able to flow easily under fill media. Algae blooms between media and exterior basin wall.
- Controller should store historical data and be accessible from USB or laptop device and connect to BAS using BACnet communication for monitoring and operation.
- Leasing could be an attractive option moving forward. Lease maintains equipment and provides support.
- Perform a borescope inspection before the install and the next time you perform annual maintenance. Supports performance and ROI claims.
- Maintain all service reports. Some systems offer online site to pull reports and maintenance can enter their test reports and order supplies.

Information to Include in AWT RFPs

Appendix includes guidance on facility information to share with AWT Vendors

- ☐ **12 months of consecutive water use data including both cooling tower make-up and blowdown.** If you provide copies of city water reports, identify relevant meters.
- ☐ **12 months of water treatment reports**. Ideally, use the same consecutive 12 months as for monthly water usage.

OR If water treatment reports are unavailable, provide:

- ☐ Site makeup water quality from city water reports
- ☐ Conductivity of water tower loop and typical Cycles of Concentration (CoCs)
- ☐ Calcium hardness

- ☐ **Existing water treatment description:** Briefly describe existing water treatment system, and whether you have an existing fixed-price contract with a water treatment contractor where cost of chemicals are included
- ☐ **Potential AWT sites:** Briefly describe the size and location of candidate AWT spaces (mechanical room or outside)

☐ **Cooling tower setup**

# of cooling tower cells	Cooling tower(s) capacity (tons)
Cooling tower age	Water conductivity (µS/cm)
Water temperature range (°F)	Ambient temperature range (°F)
Water peak flow rate (gal per min)	Peak water pressure (psi)
# of chillers	Chiller(s) capacity (tons)
Compressed air available (psig)	Power available (volts)

R9 Installation Experience

- Skid simplified installation, rolled it right through the door using a basic pallet jack
- Blowdown recovery system tied directing into pre-existing Aqualogix water softening system
- There was plenty of space in the mechanical room with a close by power source

R9 Operations Experience

Works alongside traditional chemical treatment, does not significantly change operations

- Staff monitors system daily to make sure its operational with no alarms, and ensures salt and chemicals are filled

Maintenance is straight forward

- Semi-annual system checks and annual instrument calibration
- $1095 yearly maintenance contract avoided at testbed by training onsite staff

R9 Lessons Learned

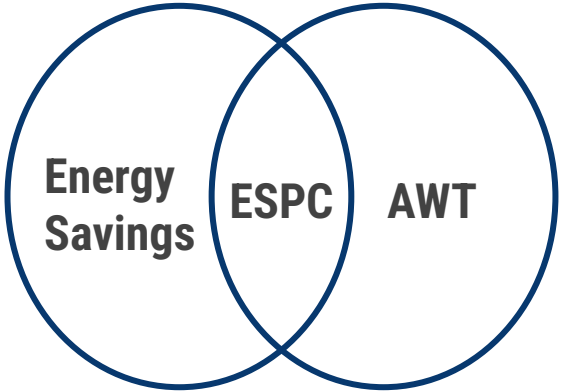
- Include water treatment provider in system selection and operations.
- Establish a baseline for your site prior to AWT installation and install metering for makeup water and blowdown during installation to measure water use.
- Continue water monitoring after the AWT system is installed. Require coupons for monitoring steel and copper corrosion.
- Add system as a maintained asset in the National Computerized Maintenance Management System (NCMMS).
- Train local maintenance teams on operating the installed AWT systems.Transfer maintenance requirements when O&M contracts change.
- Add equipment to daily O&M checklist.
- For energy savings performance contracts (ESPCs), include O&M&R in the contract.

From AWT to Energy Efficiency: ESPC is the Connection

- **Optimizing Cooling Tower Efficiency**
  - Effective water treatment reduces energy use in cooling systems.
  - Less energy demand aligns with ESPC goals for energy savings.

- **Maximizing Cost Savings with ESPCs**
  - Water efficiency leads to lower operational costs.
  - ESPCs can finance upgrades that improve both water and energy efficiency.

- **Integrating Water and Energy Management**
  - ESPCs provide a framework for combining water and energy improvements.
  - Holistic approach ensures comprehensive sustainability and cost savings.



Guidance for Energy Savings Performance Contracting

When including an emerging technology in an ESPC, project managers should:

- **Determine whether the ESCO or the O&M contractor is best positioned** to provide operations and preventative maintenance.
- **Capture the real cost of additional O&M** in the life cycle costing and task order financial schedules, if including in the ESPC.
- **Enter all new energy conservation measures (ECMs)** into the National Computer Maintenance Management System.
- **Ensure that the O&M contract is modified** to include the new equipment and preventative maintenance.

ESCO responsibilities should include:

- **Ensure ESPC team members are well-trained for operations and maintenance of the new systems** to avoid unnecessary equipment failures.
- **Verify that PMs are completed during inspections** to ensure that building systems are running optimally and the guaranteed savings are achieved.

ESPC Recommendations for Reducing Risk

- Require the ESCO to provide a proposal for:
  - Performing preventive maintenance on new equipment that is atypical for the first 3 years of performance
  - Providing an appropriate level of annual training to ensure all installed ECMs are operated and maintained within design specifications
- Require the ESCO provide a 3-, 5-, and 10-year extended warranty for equipment that is atypical for GSA facilities


Q&A

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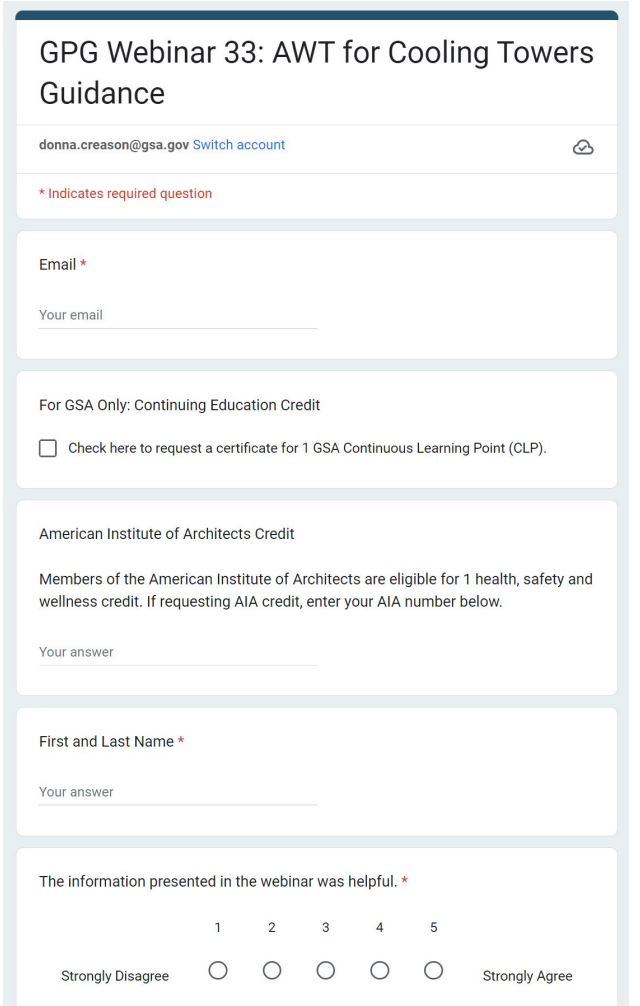

GPG Webinar 33: AWT for Cooling Towers Guidance

donna.creason@gsa.gov Switch account

* Indicates required question

Email *

Your email

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Your answer

First and Last Name *

Your answer

The information presented in the webinar was helpful. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Thank you!

For more information: gsa.gov/GPG

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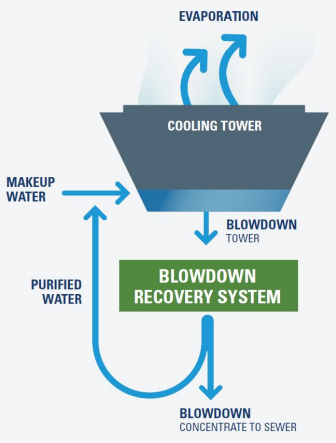
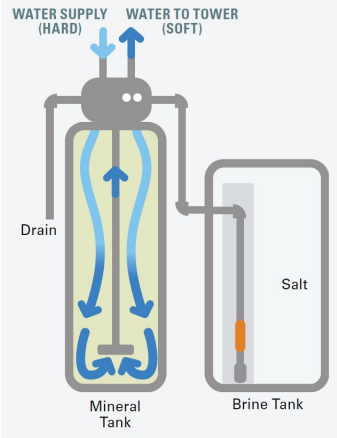
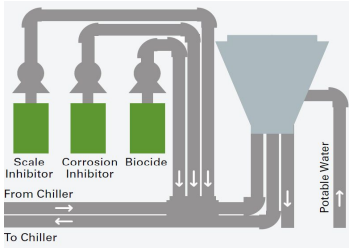
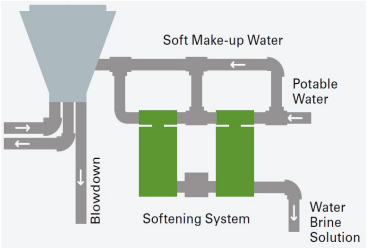
AWT Systems Evaluated by GPG

Chemical systems





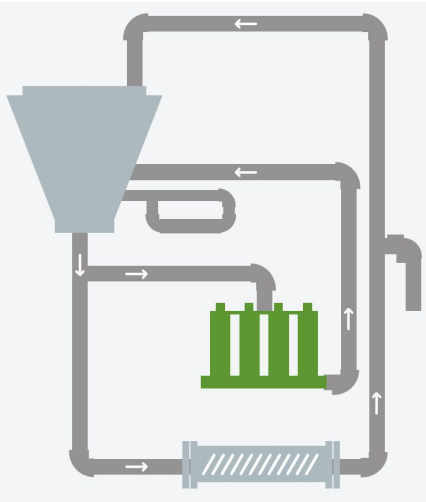




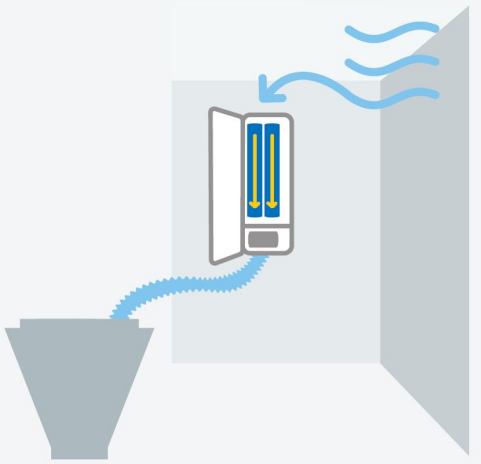
052. Blowdown Recovery Aqualogix	045. Monitoring & Partial Softening, Aqualogix	040. Chemical Scale Inhibition, Terlyn	040. Salt-Based Ion Exchange, WCTI

AWT Systems Evaluated by GPG

Non-chemical systems



038. Electrochemical , Dynamic Water Technologies



039 Advanced Oxidation, Clear Comfort (formerly Silver Bullet)