Labs2Zero
Decarbonizing the World's Laboratories

Forum: Water Reduction and Reuse in Labs

I2SL Circular Economy for Labs Community of Practice

I2SL
International Institute for Sustainable Laboratories

Housekeeping

- All attendees are muted to minimize background noise.
- Submit questions via the Q&A box on your Zoom control panel. There will be a Q&A session after all presentations are finished.
- If you experience any technical difficulties, submit your question through the Q&A box and the Zoom host will troubleshoot the issue.
- This webinar is being recorded.

Labs2Zero

Today's Agenda

- Community of practice, objectives, I2SL updates
- Presentations
  - WaterSense at Work best practices for labs
  - University of British Columbia waterless condenser lending program results
  - University of Georgia autoclave/solenoid valve leak education and replacement lessons learned
  - Lehigh University stormwater reclamation/reuse
- Panel discussion/Q&A

Today's Speakers

- Robbie Pickering, Eastern Research Group
- Kate Andrews, University of British Columbia
- Star Scott, University of Georgia
- Patrick Murphy, Vanderweil Engineers

2024 Education Week

www.i2sl.org/ed-week-2024

April 15-18

2024 Education Week

VIRTUAL INTERNATIONAL

Cohosted by I2SL, EGNATON, and SLCan

A Global View on Laboratory Sustainability

I2SL International Institute for Sustainable Laboratories

Dedicated to advancing sustainable laboratories globally.

2024 Sustainable Laboratories Award Program

- Lab Buildings and Projects
- Lab Programs and Initiatives
- Phil Wirdzek Leadership Award

Applications due by **midnight on April 5, 2024**

Visit www.i2sl.org/sustainable-labs-awards for criteria and submission guidelines.

I2SL Sustainable Laboratory Awards

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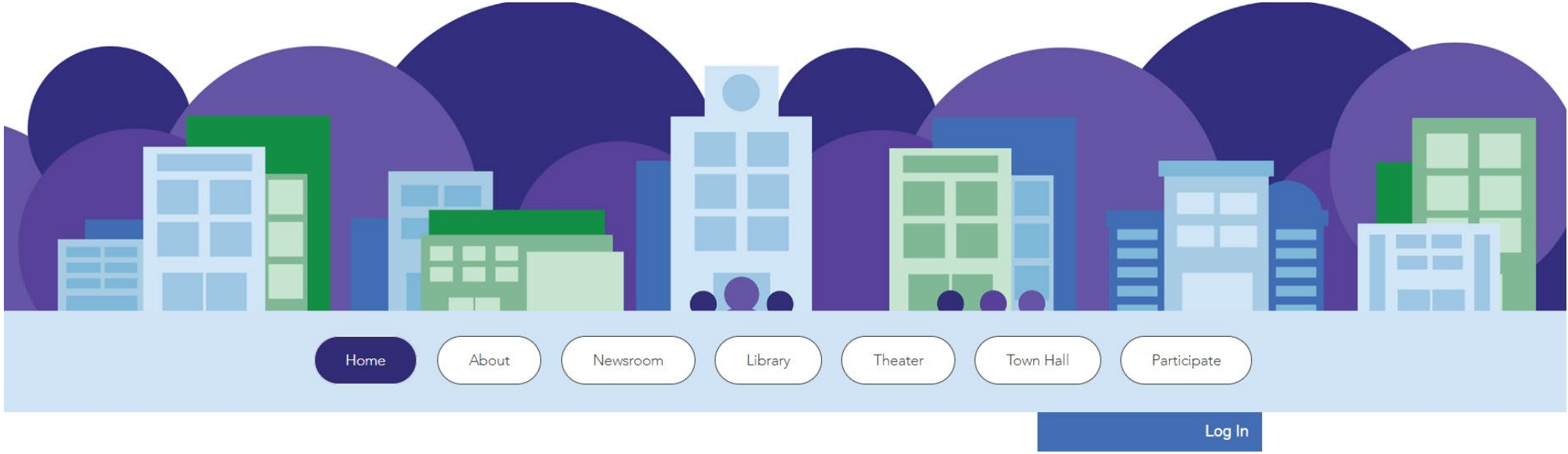
Circular Economy for Labs Community of Practice

- Waste diversion
- Procurement
- Free to join
- Interactive site
- Q&A forum
- Blog/library
- Videos
- Supplier-user coordination
- Webinars/roundtables



Circular Economy for Laboratories Community of Practice

International Institute for Sustainable Laboratories

www.circulareconomy.i2sl.org

Dedicated to advancing sustainable laboratories globally.

Join the Conversation!

- January: Revisiting EPS
- February: Score Your Energy
- March: Water: Worth Saving
- April: Green Labs/Earth Day
- May: Clean Labs Save Space
- June: Composting Bedding
- July: Waste/Toxics Reduction
- August: Freezer Challenges
- September: (Give) Back to School (Reuse and Donation)
- October: Award-Wining Ideas
- November: Recycling
- December: Ice Packs

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Circular Economy for Laboratories | Community of Practice

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Best Practices for

Water-Efficient Laboratory Equipment

Robbie Pickering

Environmental Engineer, ERG, Contractor to EPA WaterSense

March 20, 2024

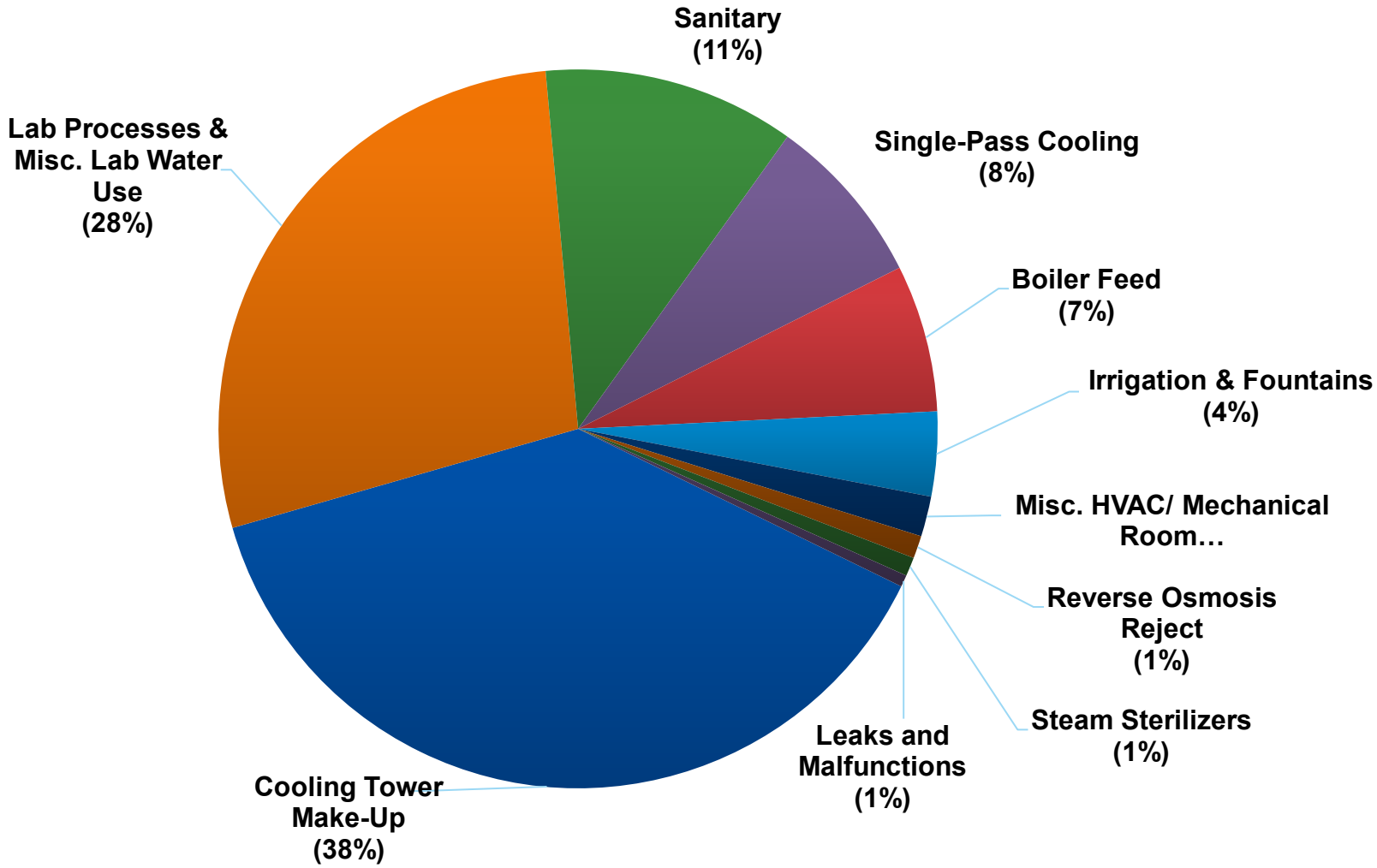
What Is WaterSense?

WaterSense is a voluntary program launched by EPA in 2006 that provides a simple way to identify water-efficient:

- Products
- Programs
- Practices
- Homes

The label indicates water efficiency **and** performance

Water Use Profiles of a Laboratory



Typical EPA laboratory building water use, based on data collected during water assessments conducted at EPA's laboratories between 2011 and 2019.

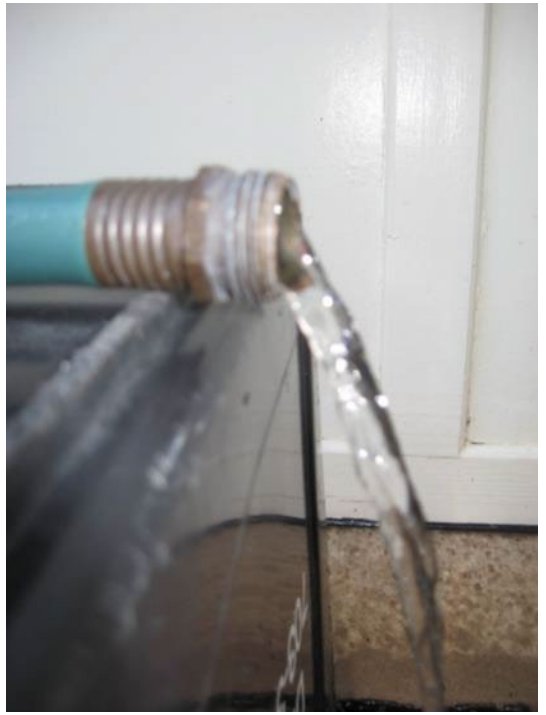
Eliminate Single-Pass Cooling

Single-pass or once-through cooling systems use water to remove heat and cool equipment

Types of equipment that could use single-pass cooling include:

- Air conditioners
- Refrigeration systems
- Air compressors
- Ice machines
- Vacuum pumps
- Condensers

Instead of single-pass cooling, use air-cooled equipment or point-of-use or building chilled water loop for heat exchange.



1 gpm

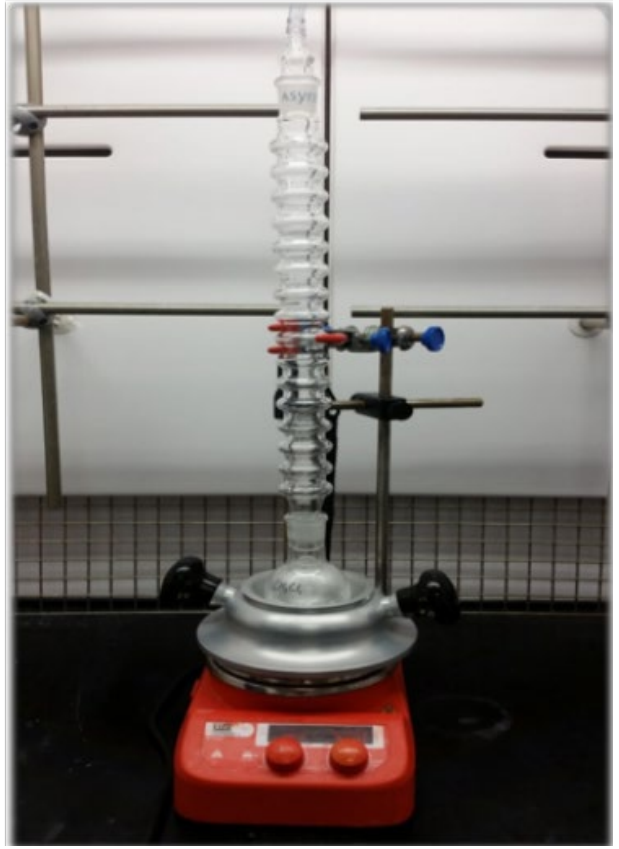
525,000 gal/year

$5,600/year*

Waterless Condensers

Waterless condensers can be used for synthetic experiments that require reflux and distillation in chemistry labs:

- Eliminate up to 1 gallon of water per minute compared to water-cooled condenser units (adds up if you have multiple condensers!)
- Reduce risk of laboratory flooding
- Easy to set up–don't require tubing or connectors for water cooling
- More time and lab space for other research activities



Waterless condenser

Autoclaves/Steam Sterilizers

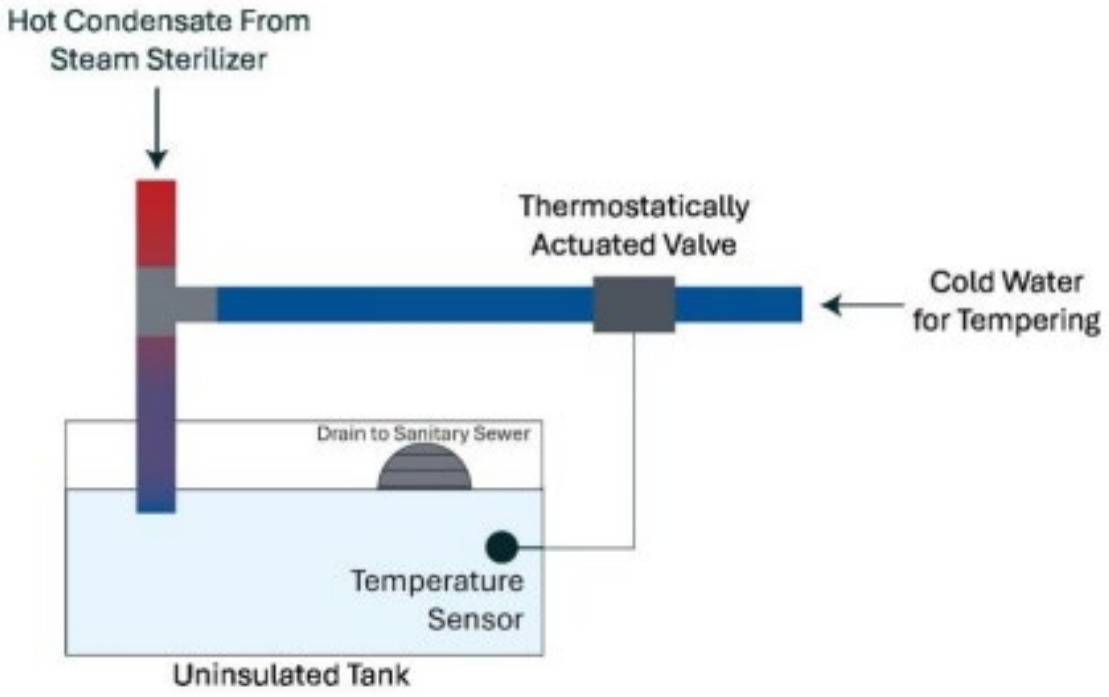
How They Use Water

- Water is used to produce steam
- Tempering of steam condensate prior to discharge
- Sometimes to create a vacuum for drying (e.g., liquid ring vacuum pump or venturi-based water ejector)

Autoclaves/Steam Sterilizers

Best Practices

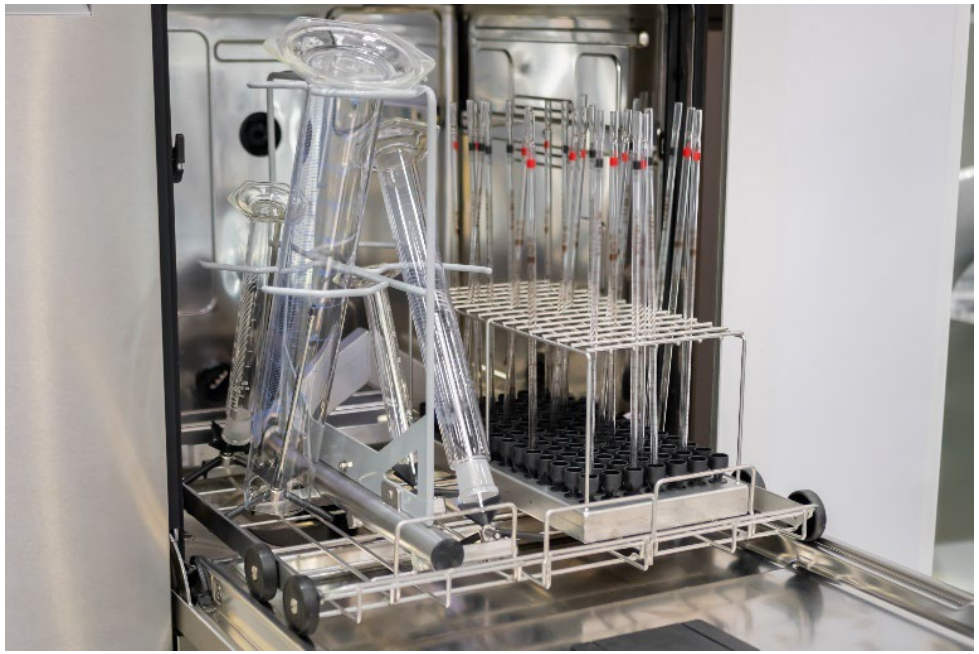
- Turn off or set to idle when not in use
- Retrofit older models that apply tempering water continuously with a temperature actuated valve and/or cooling tank
  - Up to 90 percent reduction in water use
- Inspect regularly and educate lab staff to identify when a problem occurs
- Install systems that can recover/recirculate water used to create vacuum
- Newer models are often designed with water and energy efficiency in mind and have many of these options built in



Glassware Washers

Best Practices

- Newer models include flow control and sensing capabilities, which allow less water
- Staff education
  - Only use the number of wash/rinse cycles to get the desired level of cleanliness
  - Run full loads
- When purchasing new systems
  - Compare energy and water consumption
  - Don’t oversize new equipment
  - Consider add-on efficiency features, such as water recycling systems or heat recovery

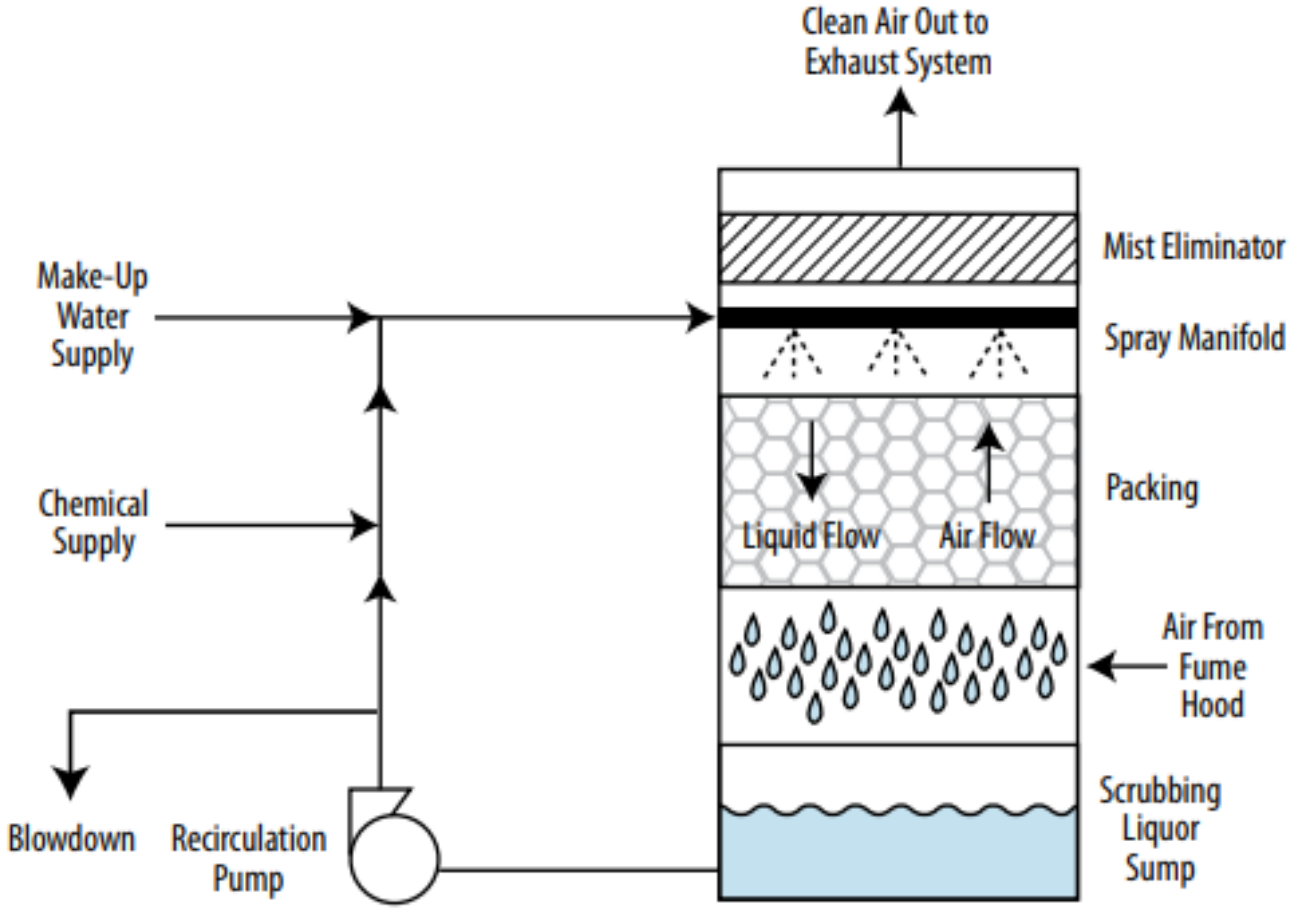


Lab glassware washer

Fume Hood Water Use

How They Use Water

- Direct Use (Wet Scrubbers)
  - Contaminated air from fume hoods pass through water spray or wetted media, which absorbs contaminants
  - Water lost to evaporation
  - Some water needs to be periodically blown down to control minerals and contaminants
- Indirect Use
  - Replacement of conditioned air in labs often has a water footprint (from cooling tower use)



Reducing Evaporative Heat Load Saves Water

- Every ton of cooling (12,000 Btu/hour) requires evaporation of 1.5 gallons of water/hour
- Building energy-saving projects provide direct water savings
- Classic example of the water-energy nexus
- Evaporated water is a consumptive use!

Fume Hoods

Best Practices:

- Turn off wet scrubber systems when not needed
- Shut the sash to reduce airflow and evaporation
- Use recirculating systems for scrubber fluid
- Maintain liquid level controller and water make-up valves
- Control blowdown based on scrubber fluid chemistry (using a pH, oxidation-reduction potential , or conductivity controller) rather than allow continuous or timed blowdown

Water Reuse Opportunities

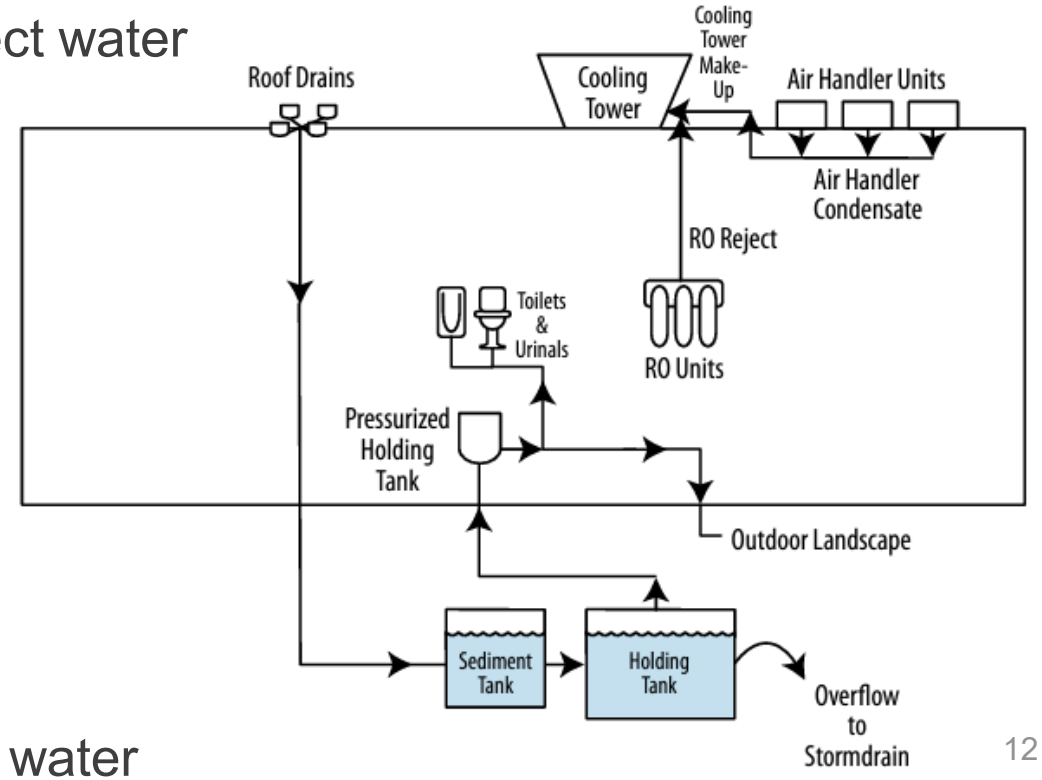
Consider using onsite water sources for end uses if quality allows.

Potential onsite water sources:

- Rainwater/stormwater
- Condensate from air conditioning equipment
- Filter and membrane (e.g., reverse osmosis) reject water
- Cooling equipment blowdown
- Steam condensate

Potential end uses:

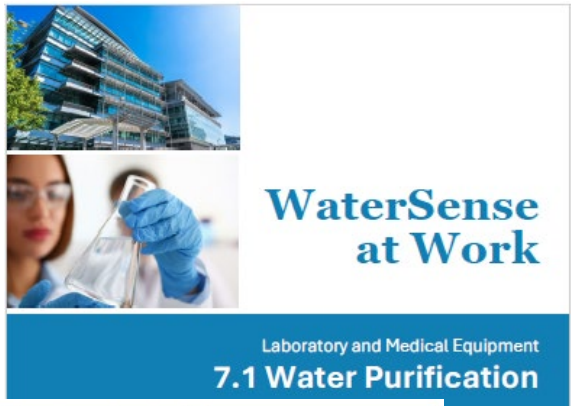
- Irrigation
- Cooling tower or boiler make-up
- Tempering water
- Fume hood scrubbers
- Other laboratory processes not requiring potable water



Resources on Lab Water Use

Other equipment in *WaterSense at Work* and/or the I2SL Best Practices Guide

- Water purification
- Vacuum pumps
- Cage, rack, and bottle washers (vivarium equipment)
- Animal watering systems
- Humidifiers
- Photographic and X-ray equipment
- Products/systems not specific to labs (e.g., cooling towers, plumbing products, commercial kitchen equipment, and more)



www.i2sl.org/best-practices

www.epa.gov/watersense/best-management-practices

Additional WaterSense Resources

- Water use information by facility type
- Best management practices
- Water-saving tips
- Assessment tools
- Worksheets and checklists
- Live and recorded training webinars
- Case studies and more!

www.epa.gov/watersense/tools-ci-facilities

Questions?

Robbie Pickering: robert.pickering@erg.com

WaterSense

www.epa.gov/watersense

www.facebook.com/epawatersense

www.twitter.com/epawatersense

Email: watersense@epa.gov

Helpline: (866) WTR-SENS (987-7367)

UBC's waterless condenser lending program

Kate Andrews, Green Labs Program Lead

THE UNIVERSITY OF BRITISH COLUMBIA
sustainability

UBC's campuses are located on the traditional, ancestral and unceded territories of the xʷməθkʷəy̓əm (Musqueam) and Syilx peoples.

Agenda

1. Background & context
2. Water metering & equipment lending
3. Lessons learned & next steps

Water at UBC

Water condensers use between 60-240 L/hr of fresh water that runs through the condenser and down the drain.

Water metering

4167m3

in projected annual water savings from 55 condensers.

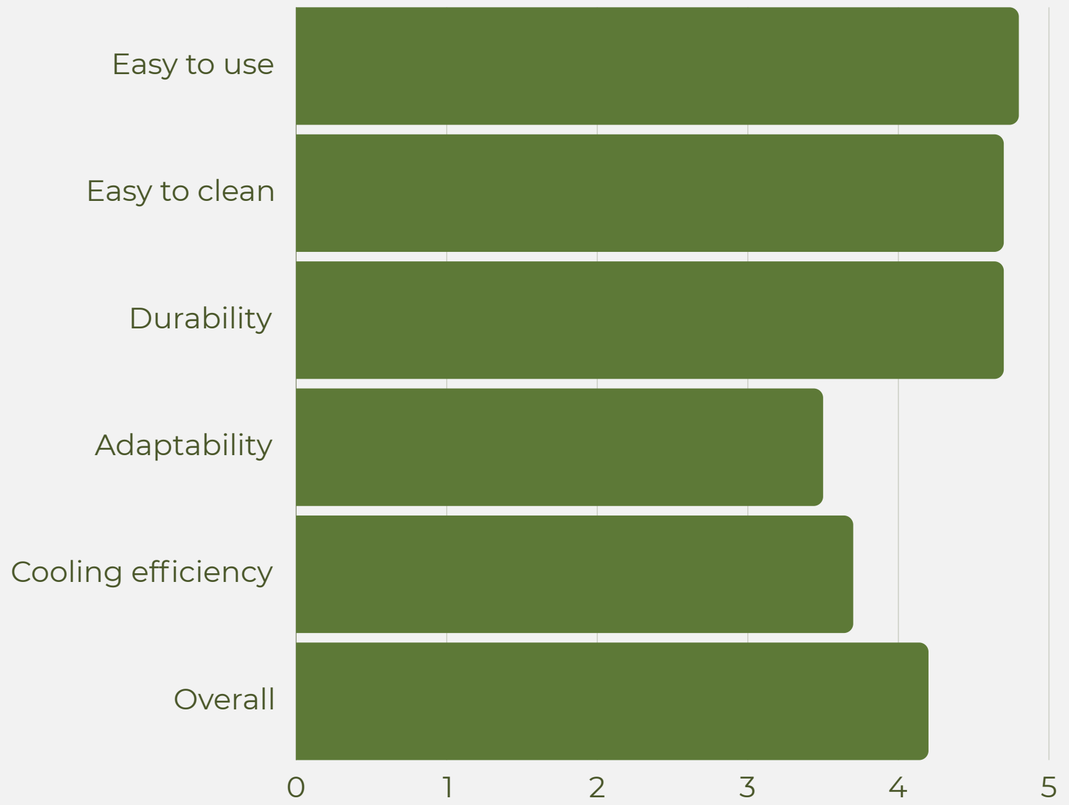
Asynt CondenSyn

Image: https://www.asynt.com/product/asynt-condensyn-mini/

Radleys Findenser

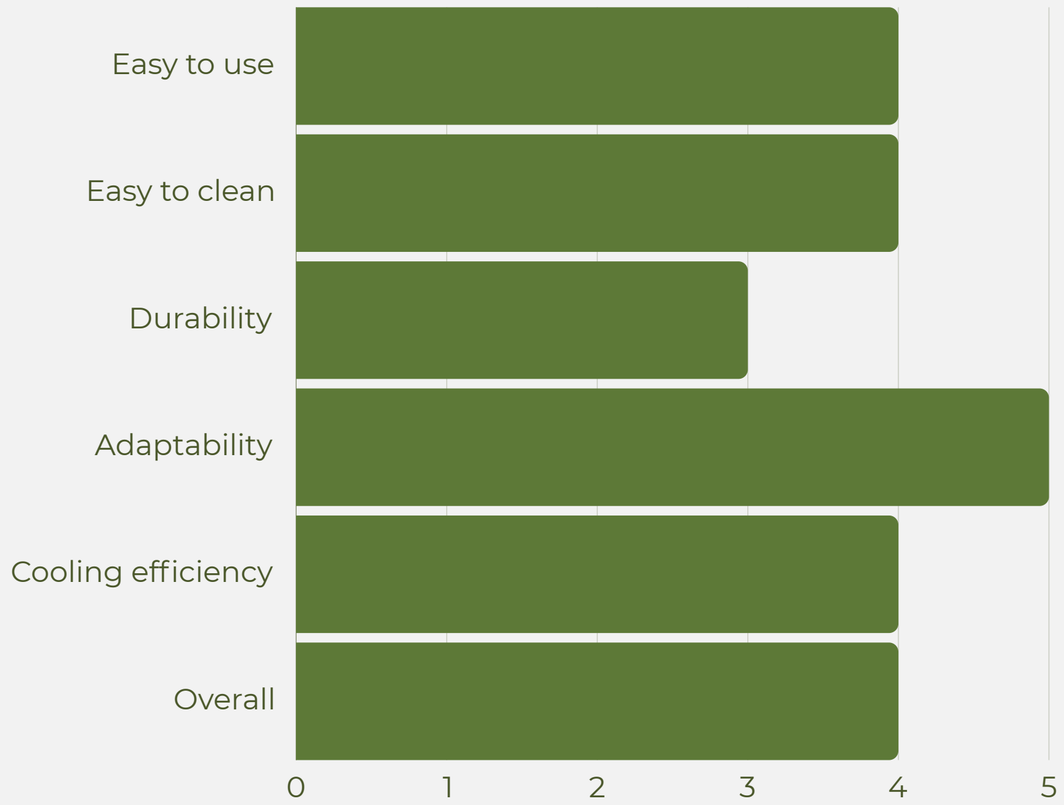
Image: https://www.radleys.com/range/findenser-super-air-condenser/

Two-month checkpoint survey: CondenSyn



User ratings

Two-month checkpoint survey: Findenser



User ratings

Two-month checkpoint survey: both

Importance of water conservation

Thank you!

kate.andrews@ubc.ca

Autoclave Management: A UGA Case Study

Star Scott, UGA Green Labs

I2SL CoP Forum: Water Reduction and Use in Labs

March 2024

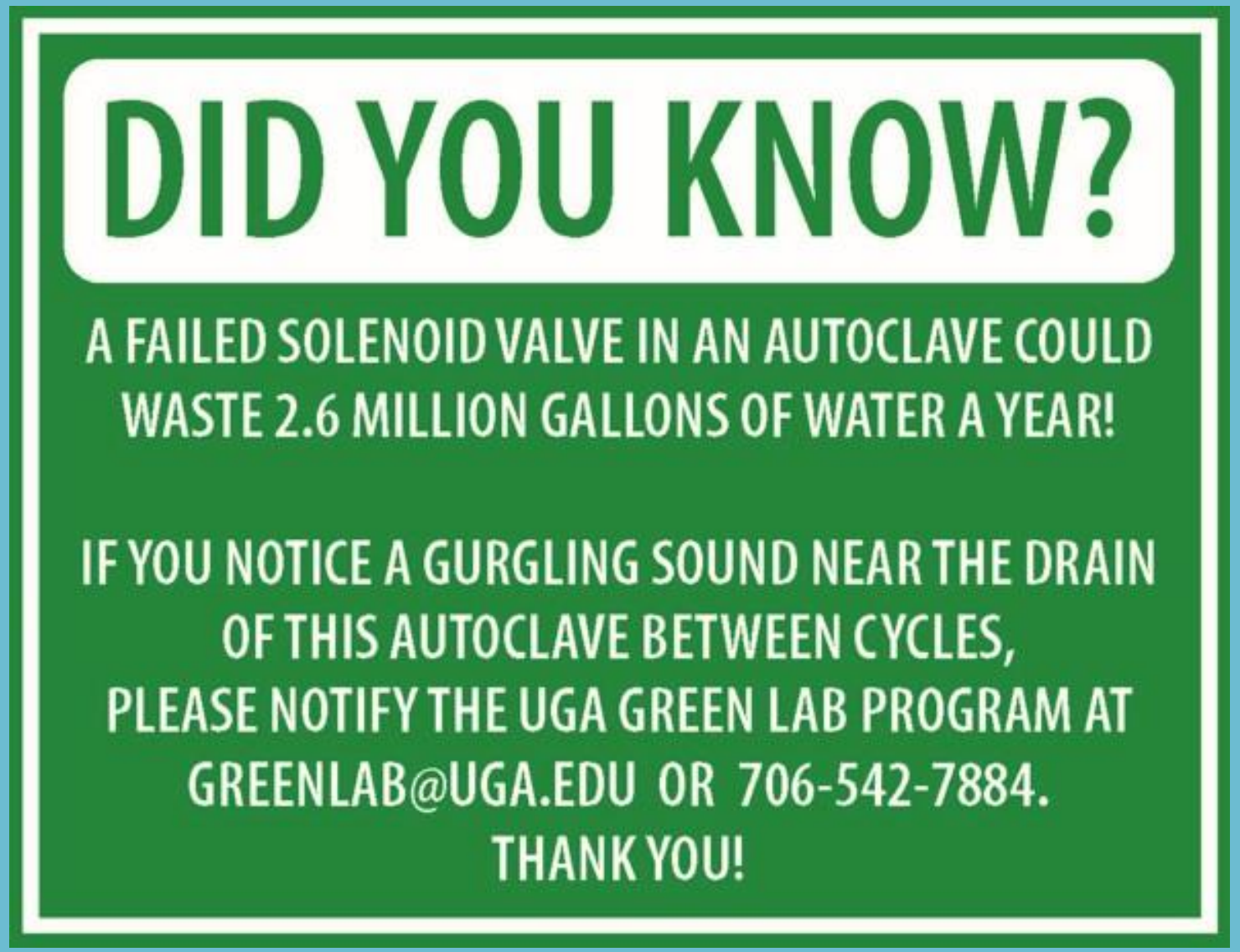
UNIVERSITY OF GEORGIA

I2SL International Institute for Sustainable Laboratories

=

Solenoid Valve

- Autoclave discharge is VERY hot and must be tempered to meet code
- Cold water lines are connected to cool discharge (drain-water tempering)
- Solenoid valves allow cold water lines to turn on and off
- Solenoid Valves have a life-span and fail open



Found 3 failed valves in the first week, saving potentially 7.8 M gallons of water per year!

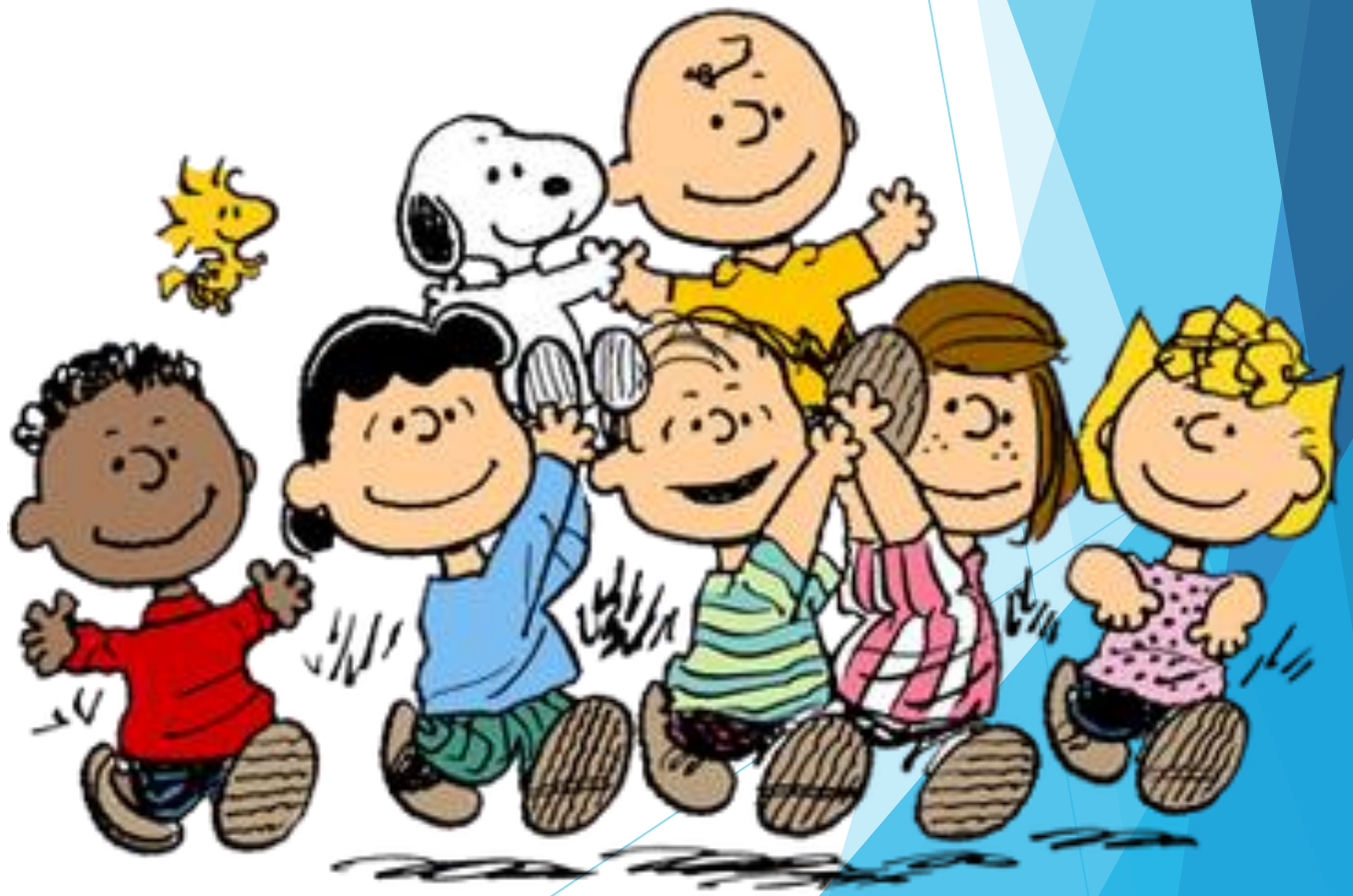

CONTRACT
Sign

- FMD not part of contracts
- Unable to conduct PM without potentially compromising contracts

UGA Multi-Stakeholder Team for Autoclave Management

- Utility and Energy Management
- Green Labs
- Office of Research, Research Facilities Management
- Vendor
- End-users

- Since inception, 8 failed valves have been replaced (~20.8 M gallons)
- Functional process, though overarching institutional contract would be even more efficient



Thank you!
Questions?

Star Scott
starscot@uga.edu
greenlab@uga.edu

Health Science Technology

Lehigh University I Bethlehem, PA

Architectural Engineering Institute
Professional Project Award 2023

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Data-Driven Design

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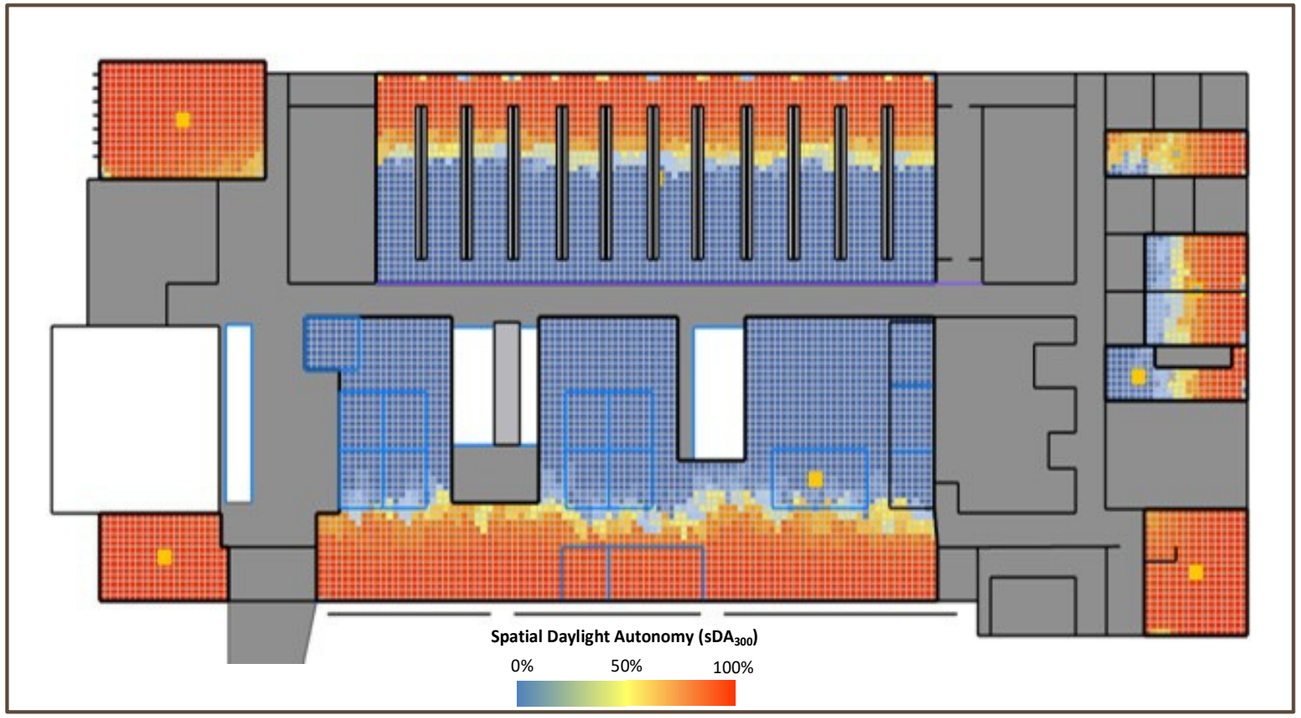


Daylight modeling, energy modeling, and water modeling informed design decisions and optimized performance.

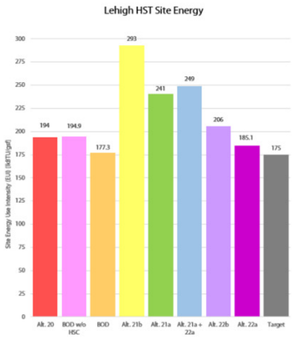
The design team used innovative technologies to achieve success with Revit and BIM360 shared 3D design models informed by energy and water modeling (eQuest and Excel), daylight modeling (DIVA & Grasshopper), and lifecycle carbon modeling (Athena). Virtual reality was used to prototype ideas during site, landscaping, and constructability workshops. Laser scanning provided accurate site measurements for fabrication. Energy and water are extensively metered throughout HST, for whole-building and end uses, reported and stored at the Building Management System (BMS).

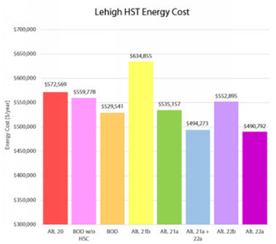
Schematic Energy Analysis

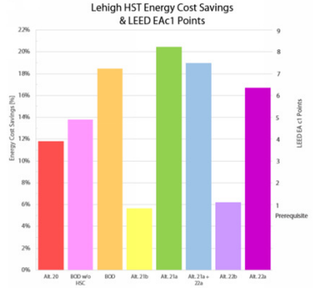
Energy Model Iteration Results

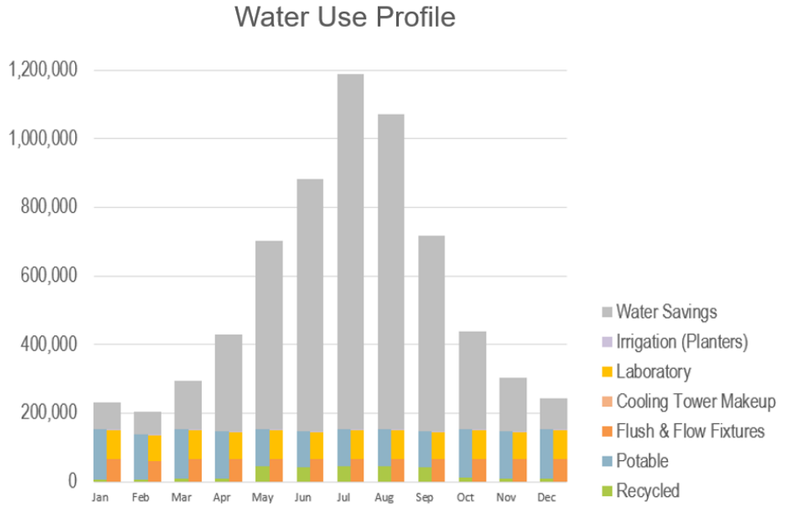
Baseline Heat Source →	Purchased Campus Steam					Onsite Boilers		
Baseline Cooling Source →	Onsite Chiller			Purchased Campus Chilled Water		Onsite Chiller		
Result | Alternate →	Alt. 20	BOD w/o HSC	BOD	Alt. 21b	Alt. 21a	Alt. 21a + 22a	Alt. 22b	Alt. 22a
Baseline EUI (kBTU/sf-yr)	241			310		359	289	
Baseline Energy Cost ($/yr)	$649,354			$672,931		$610,061	$589,394	
Design pEUI (kBTU/sf-yr)	194	195	177	293	241	249	206	185
Energy Savings	19.4%	19.0%	26.3%	5.5%	22.3%	30.6%	28.6%	35.8%
Design Energy Cost ($/yr)	$572,569	$559,778	$529,541	$634,855	$535,157	$494,273	$552,895	$490,792
Energy Cost Savings	11.8%	13.8%	18.5%	5.7%	20.5%	19.0%	6.2%	16.7%
LEED EAc1 Points*	3	4	7	0	8	7	1	6

* - Estimated LEED EAc1 points, subject to change as design becomes more detailed.









Wellness & Biophilic Design

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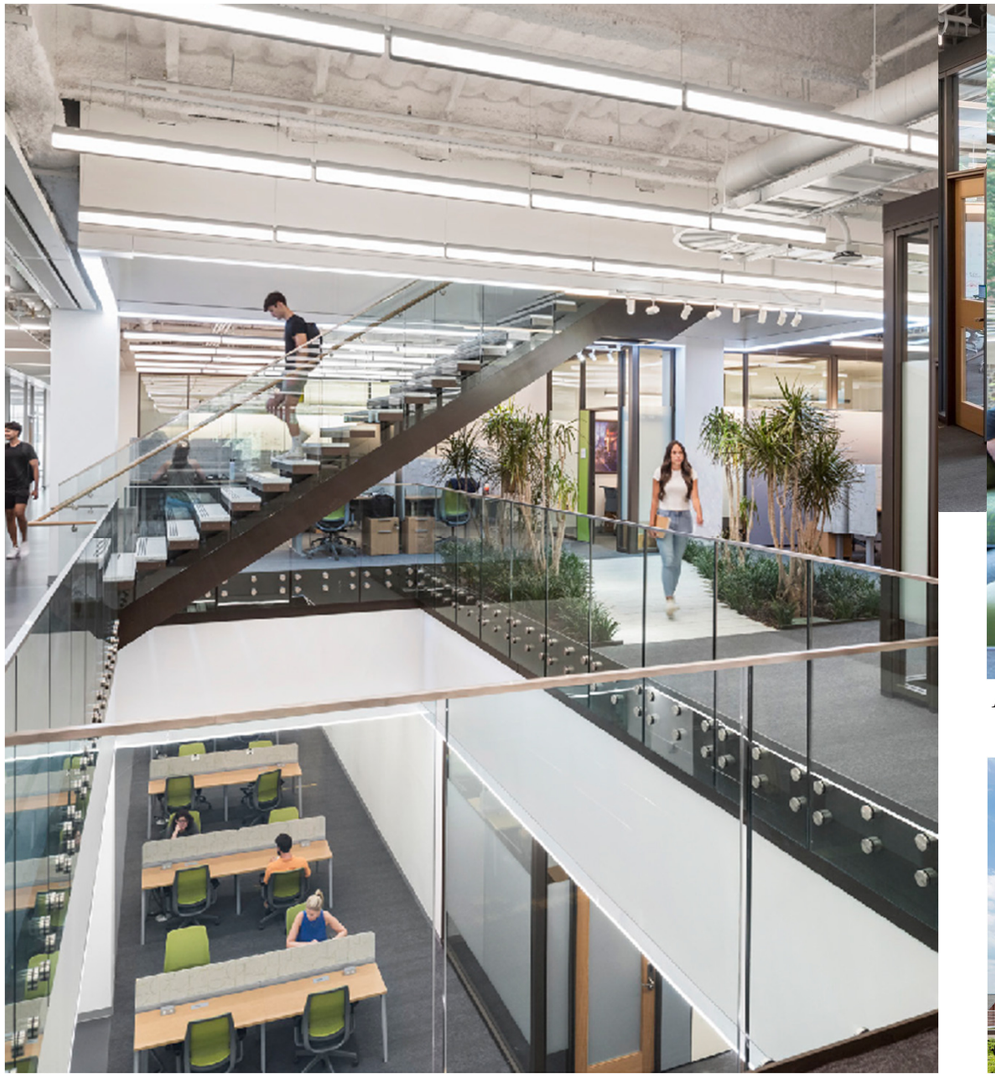

Full-spectrum LED lights and circadian controls simulate the spectral distribution of daylight for people and plants.

From the first project meeting, the team infused sustainability and wellness into the design. Stairs like this would not have been possible without early planning.

Solar shades mocked up by the architect resemble plant cell structures filter sunlight like the canopy of a forest..

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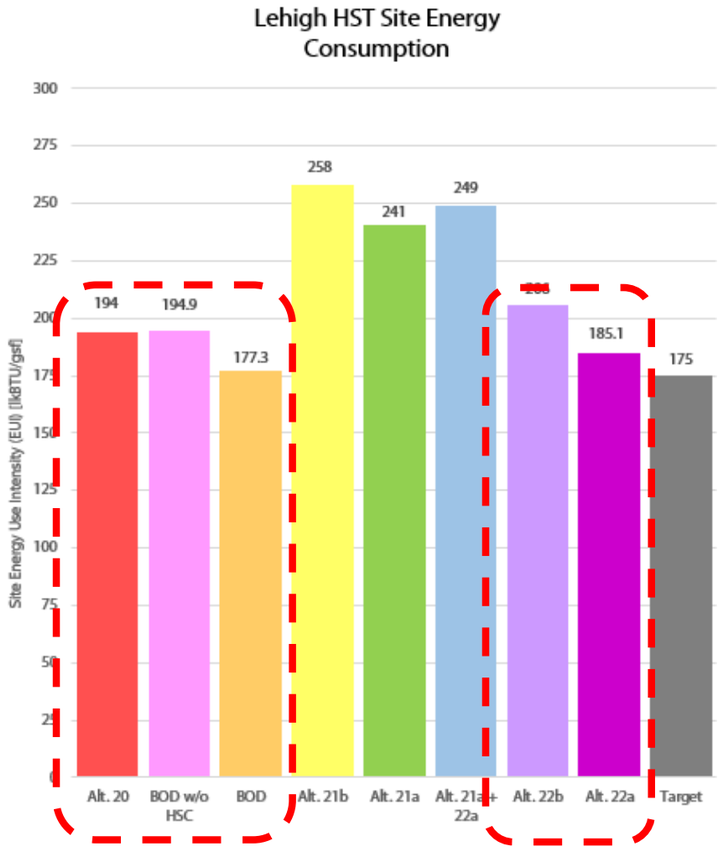
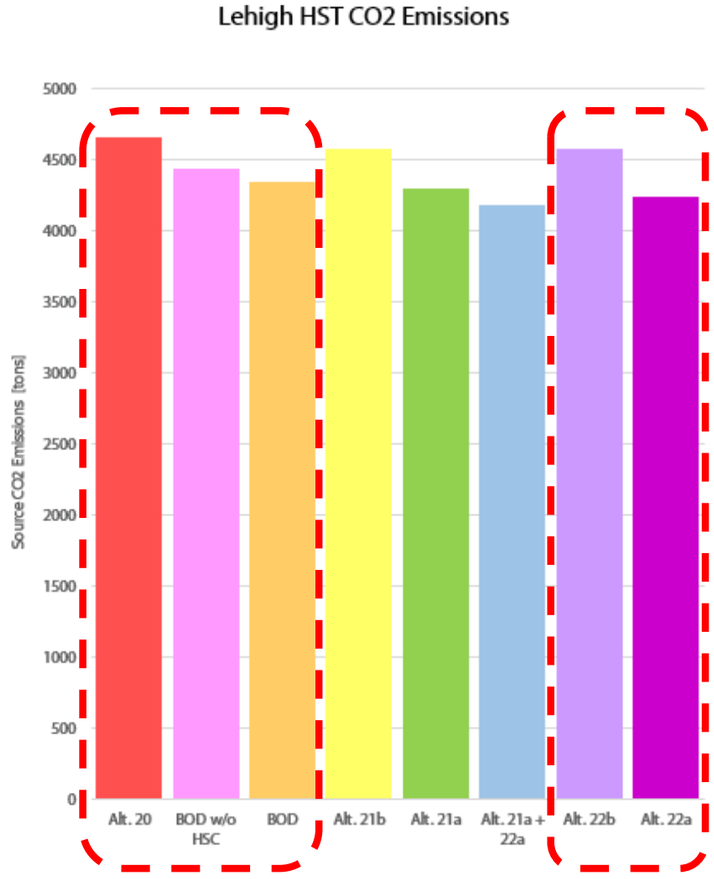
Energy Model Iteration Variables								
Baseline Heat Source →	Purchased Campus Steam					Onsite Boilers		
Baseline Cooling Source →	Onsite Chiller			Purchased Campus Chilled Water		Onsite Chiller		
Variable ↓ Alternate →	Alt. 20	BOD w/o HSC	BOD	Alt. 21b	Alt. 21a	Alt. 21a + 22a	Alt. 22b	Alt. 22a
Purchased Steam	X	X	X	X	X			
Condensing Boilers						X	X	X
All-Air VAV	X			X			X	
Neutral Air Chilled Beams		X	X		X	X		X
Heat Shift Chiller	X		X	X	X	X	X	X
Air-Cooled Chiller	X	X	X				X	X
Campus Chilled Water				X	X	X		





NO Mechanical Water Consumption

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Water Savings Approach

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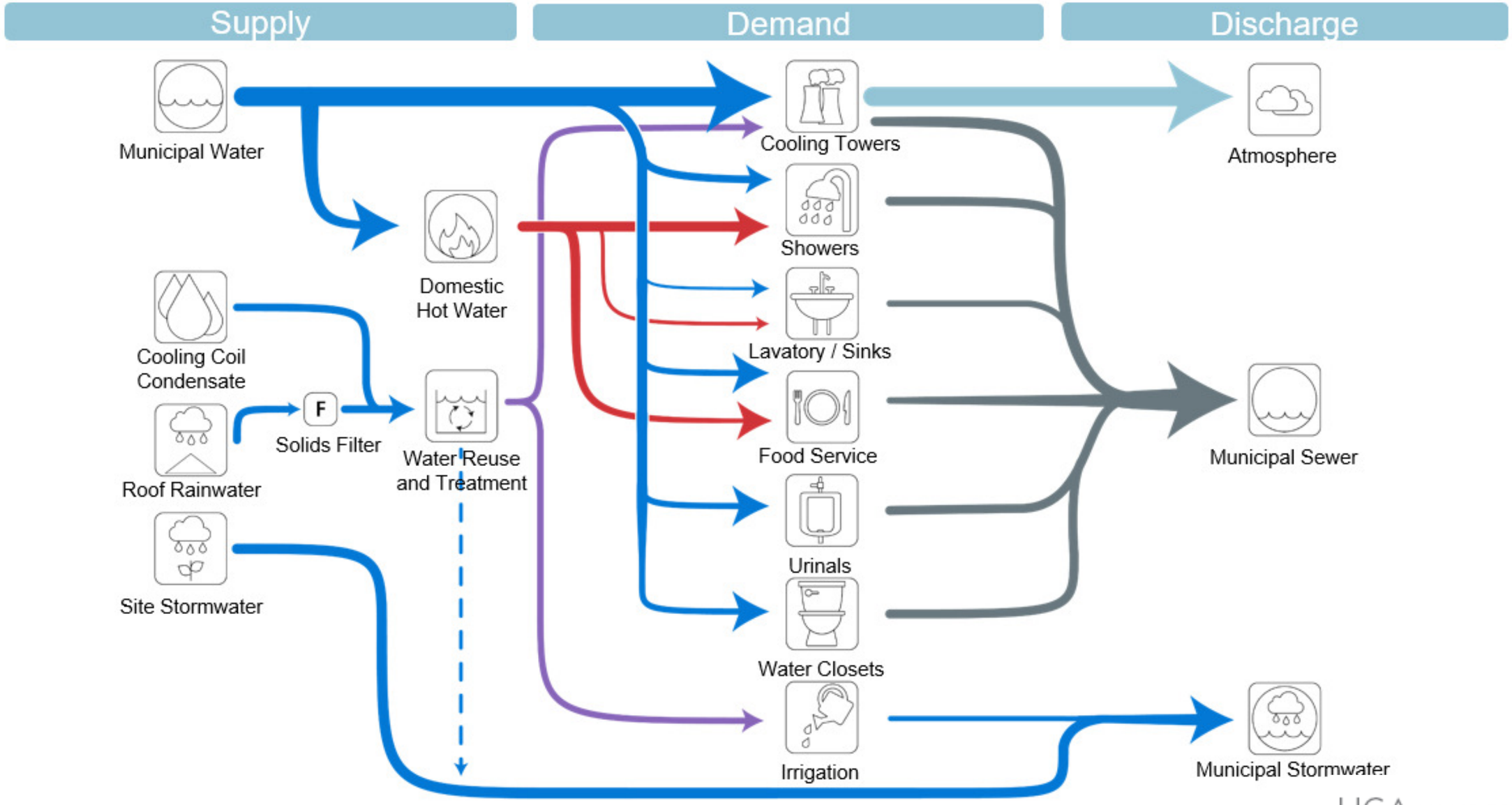

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Water Savings Approach

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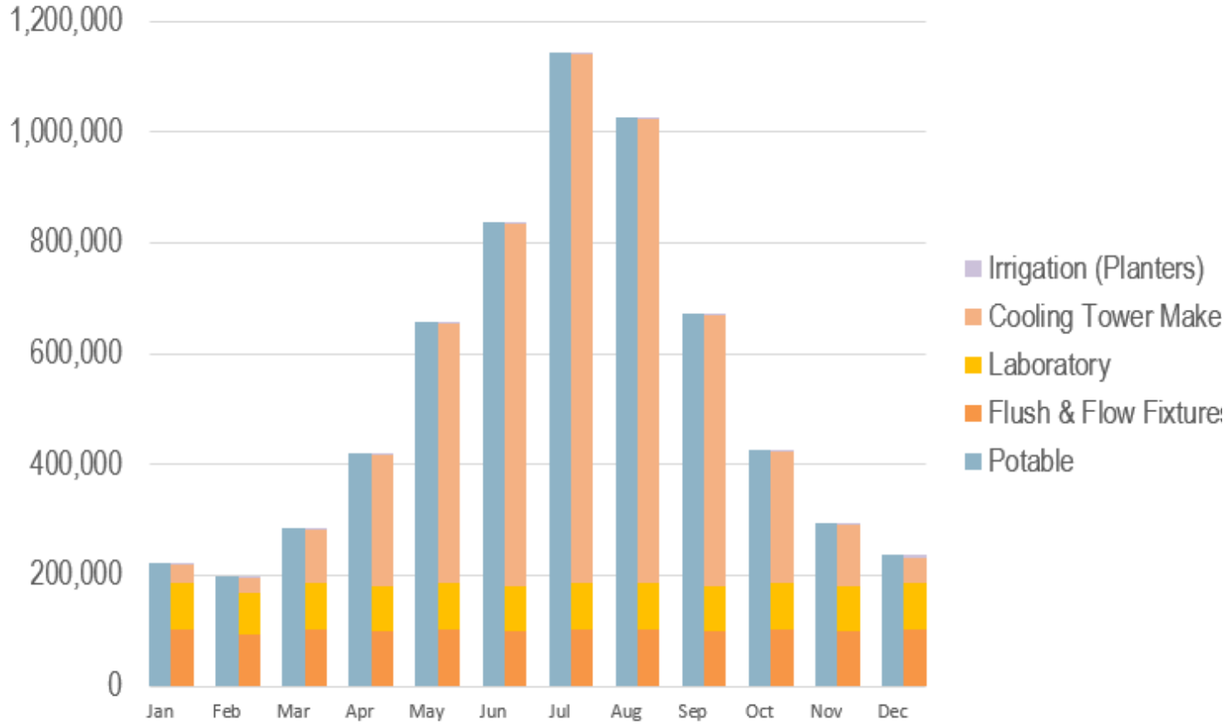
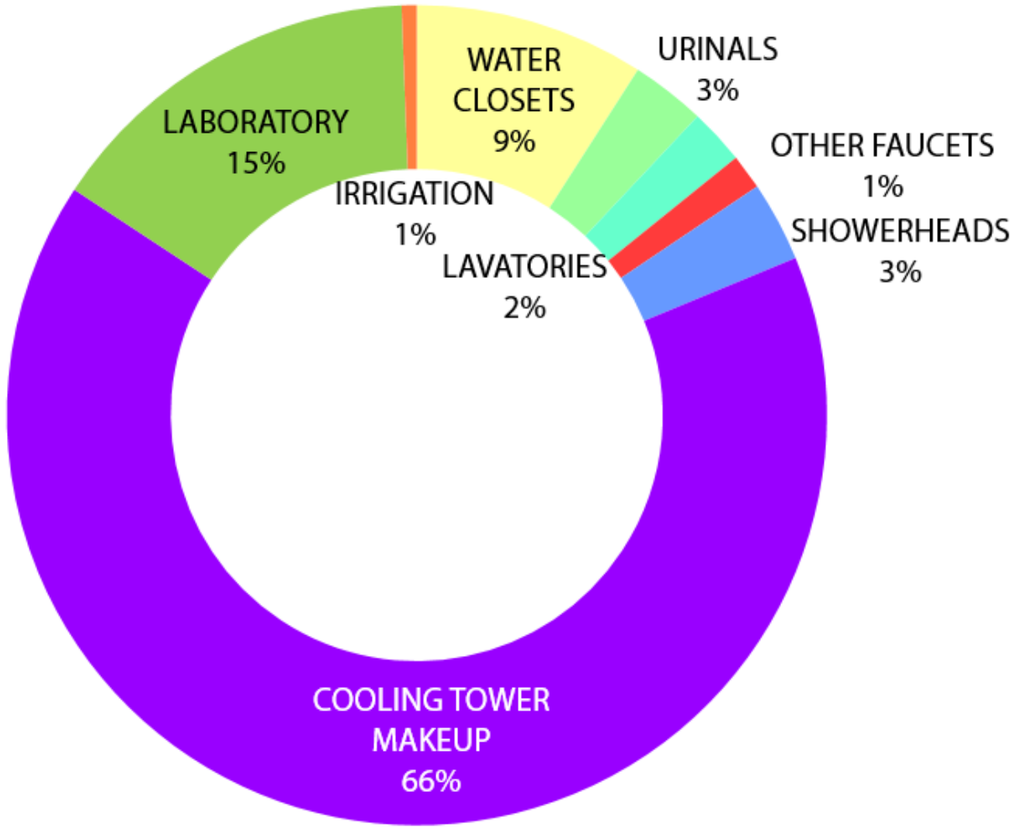
LEED Baseline (Gallons):





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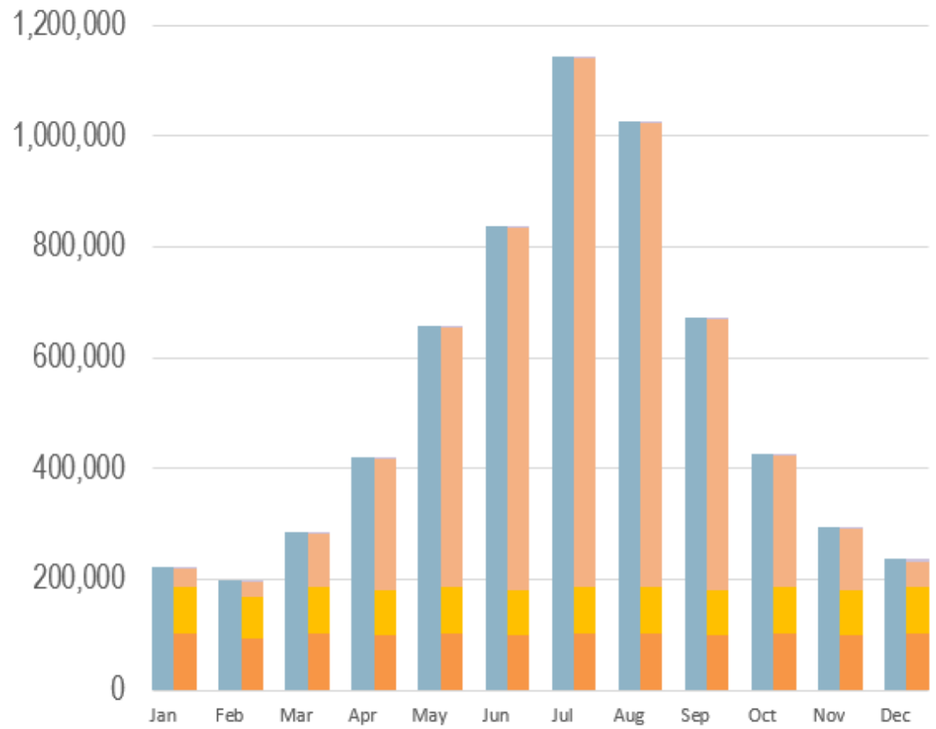
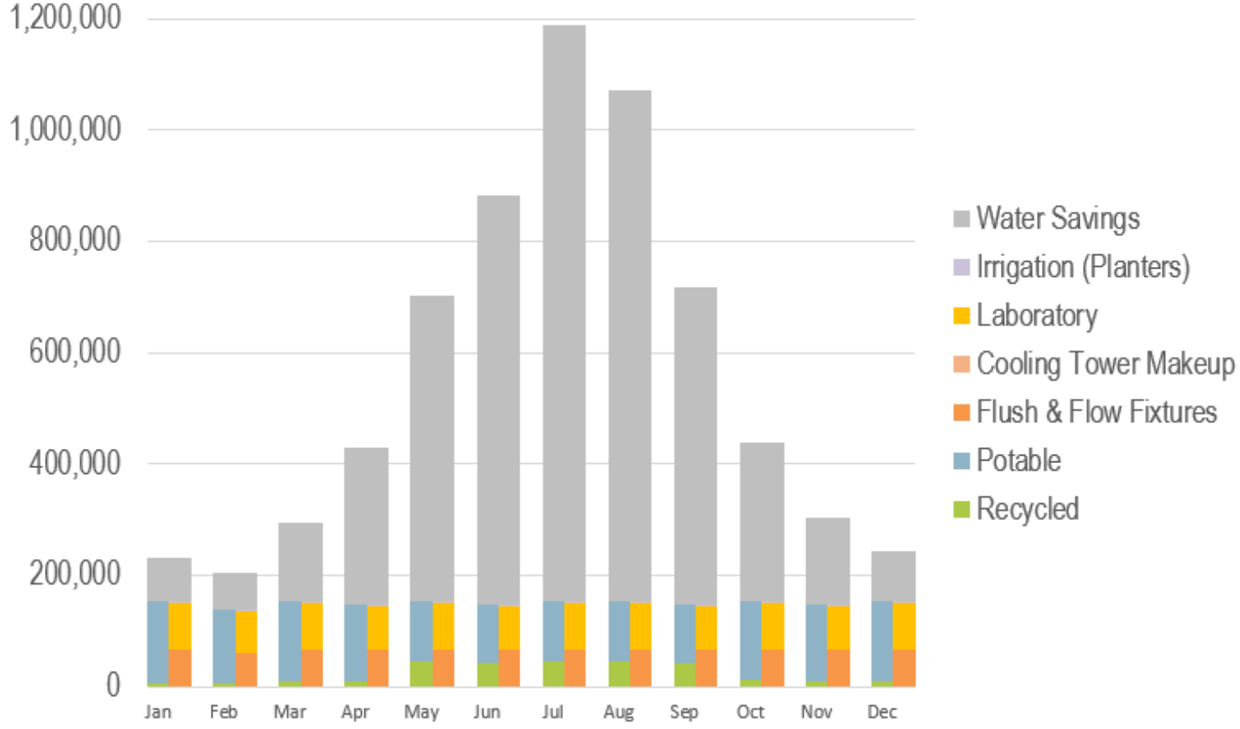
Water Savings Approach

HST

LEED Baseline (Gallons):



Design (Gallons):



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Water Savings Approach

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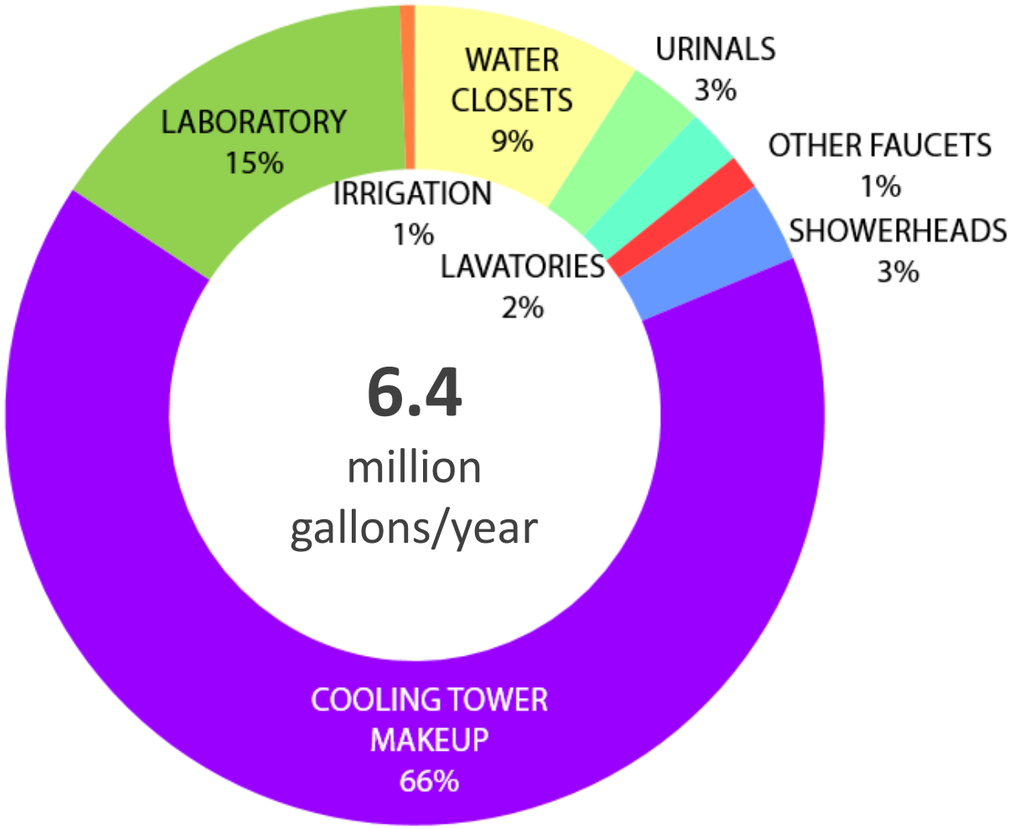

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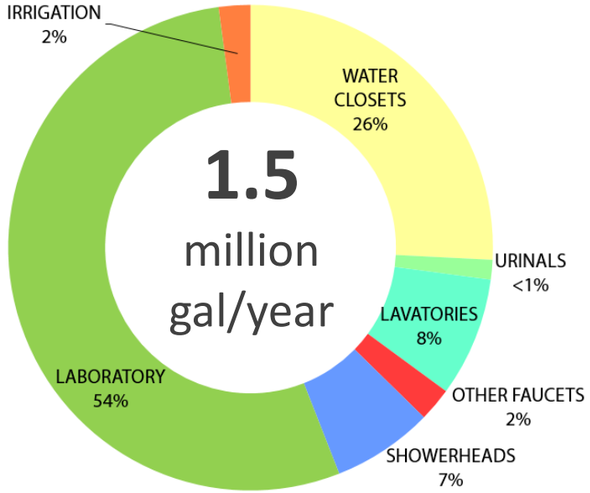

Savings would fill NCAA Swimming Pool

30 times/year

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All images are © HGA.

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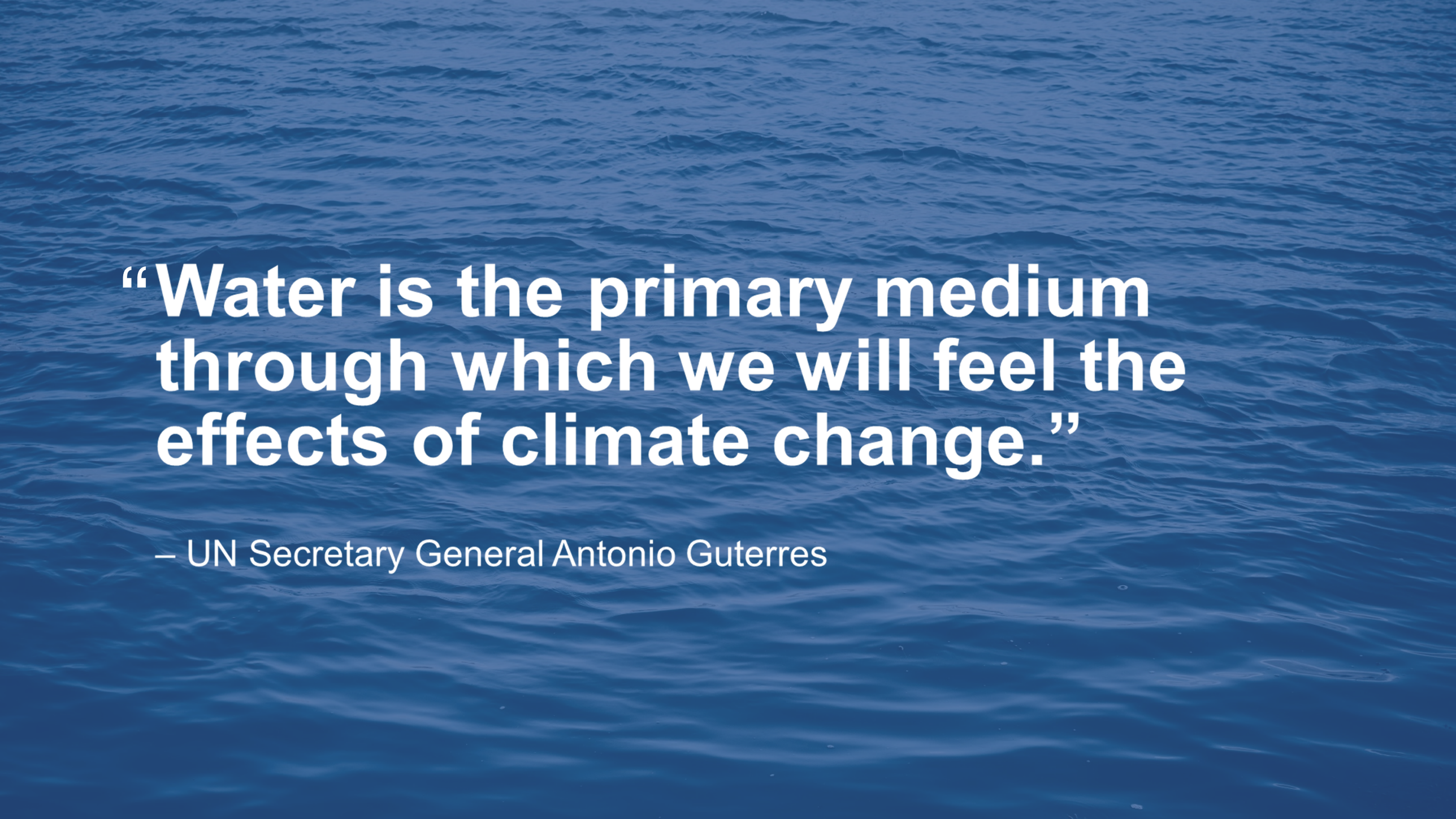
“Water is the primary medium through which we will feel the effects of climate change.”
– UN Secretary General Antonio Guterres

ONE WATER

“One Water is a transformative way of viewing, valuing, and managing water.”

-US Water Alliance