WATER-ENERGY NEXUS

HOLISTIC SOLUTIONS FOR CLIMATE CHANGE AND RESILIENCY

PG&E Energy Center

04/24/2019

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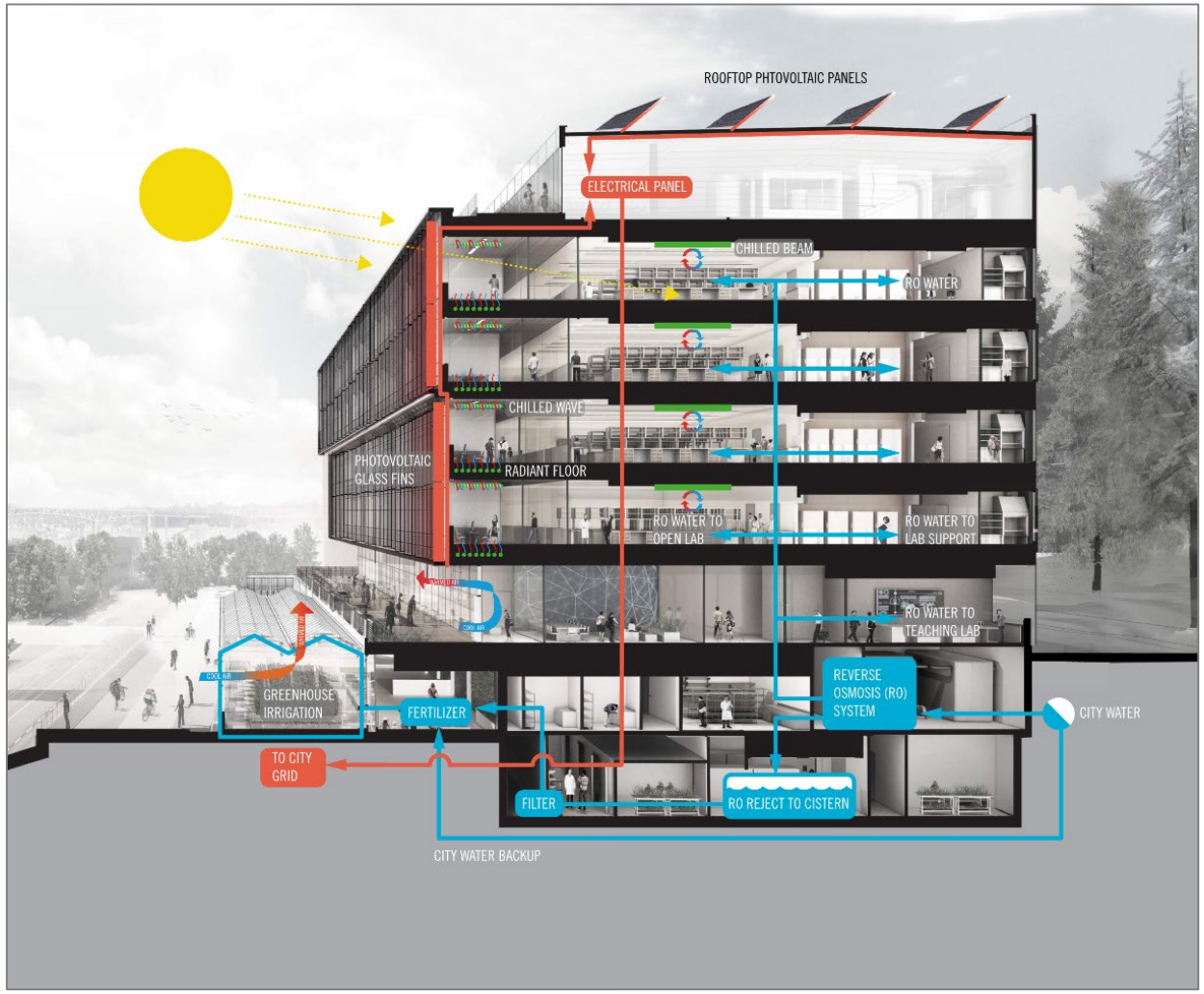
Building Performance Consultant

Agenda

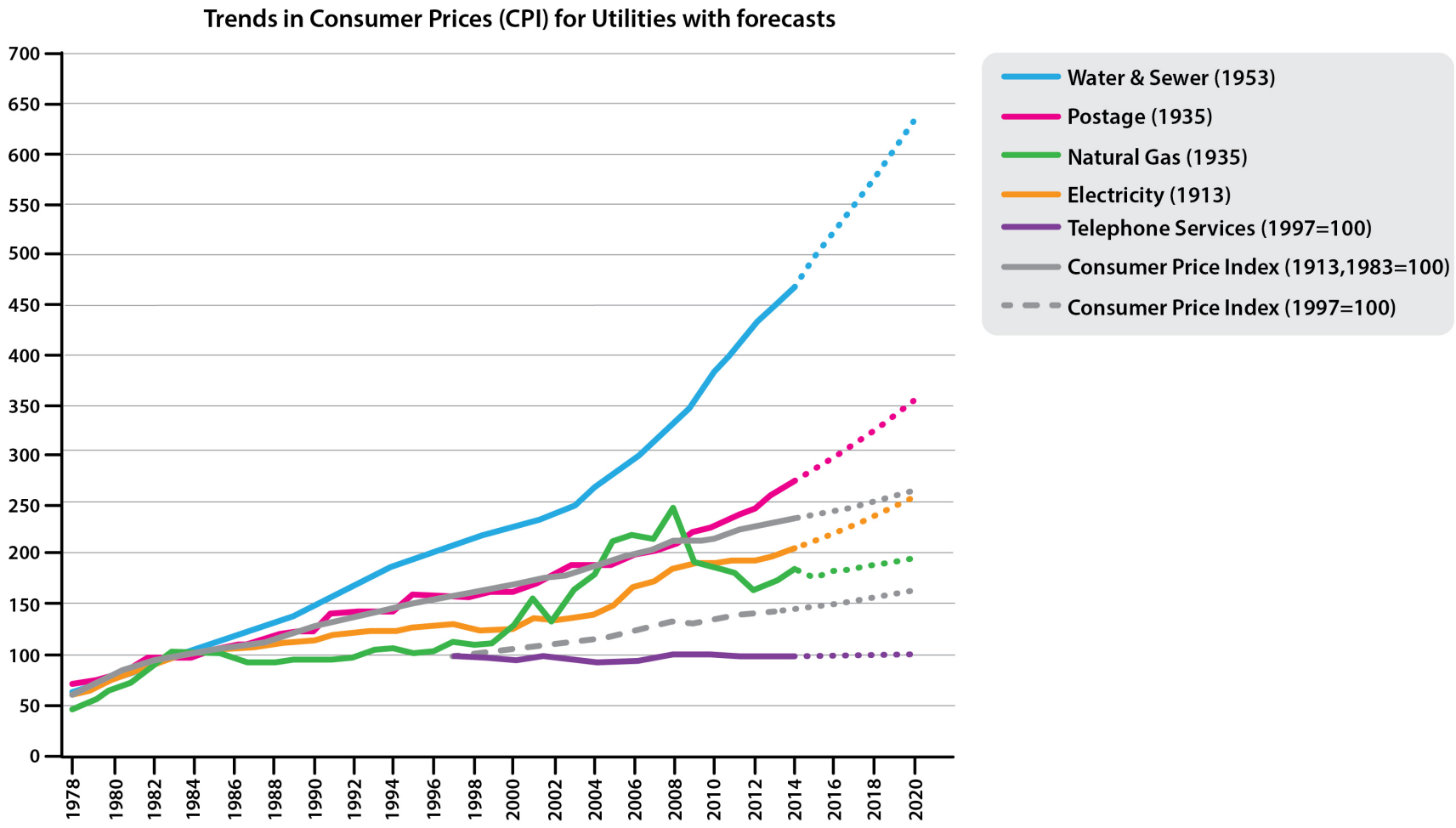
- Drivers for Rapid Water and Sewer Cost Increase
- Understanding the Energy:Water Nexus
- Wholistic Accounting of Energy and Water
- Water Modeling - Challenges & Opportunities



PERKINS+WILL

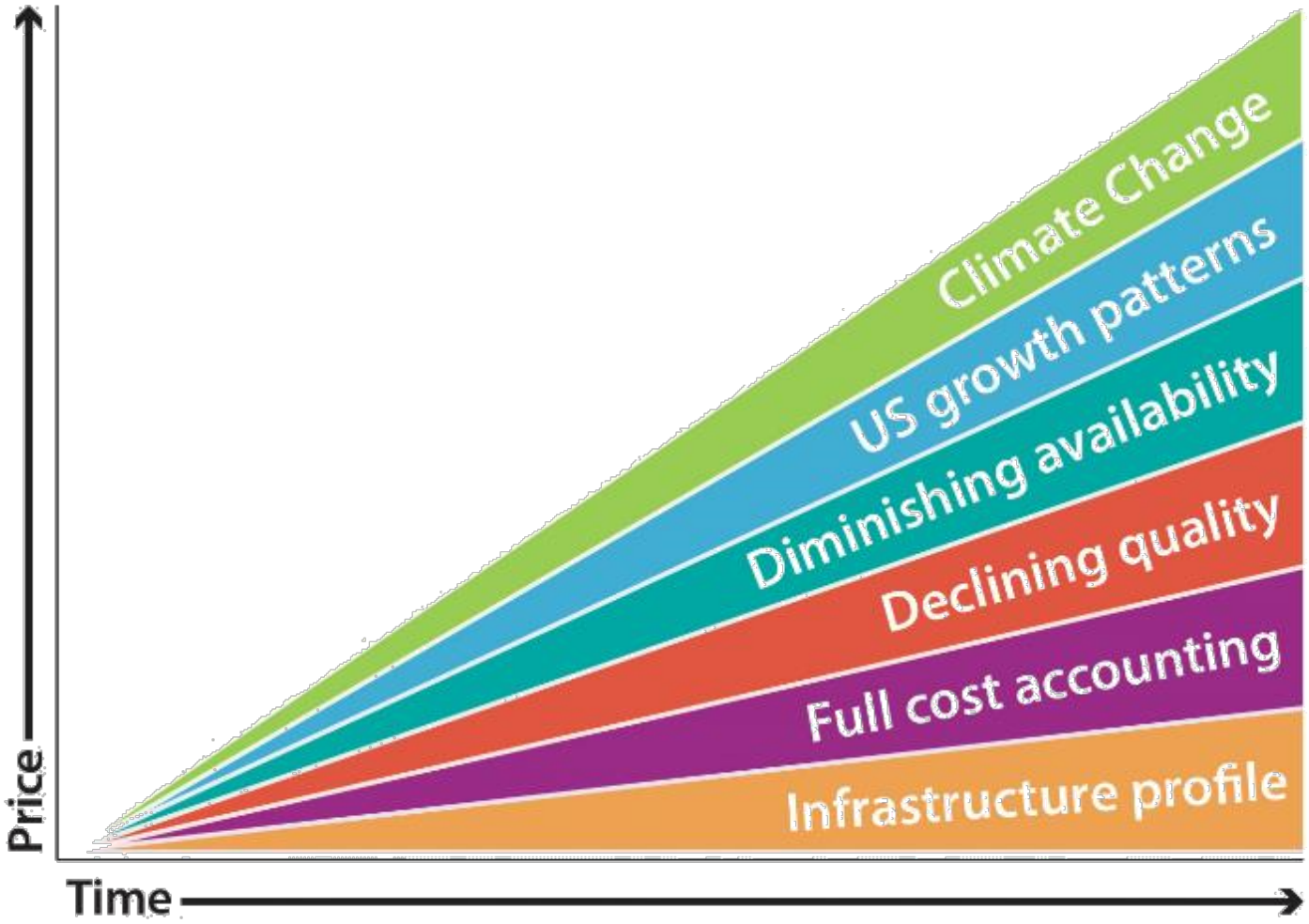
Drivers for Rapid Water & Sewer Cost Increase

Rising Cost of Water & Sewer



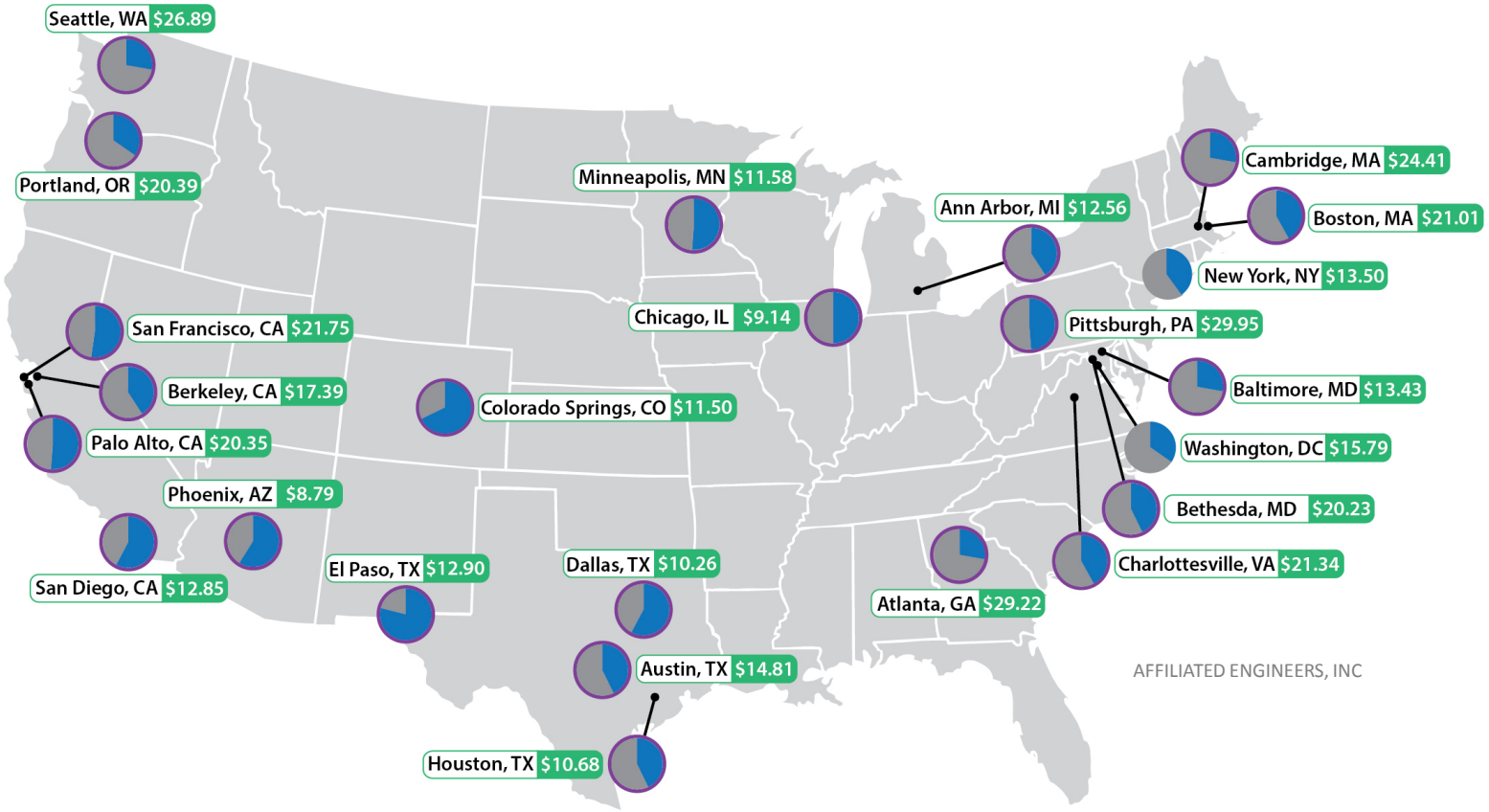
Source: Michigan State University Institute of Public Utilities based on US Bureau of Labor Statistics data.

Drivers for Rapid Cost Increase



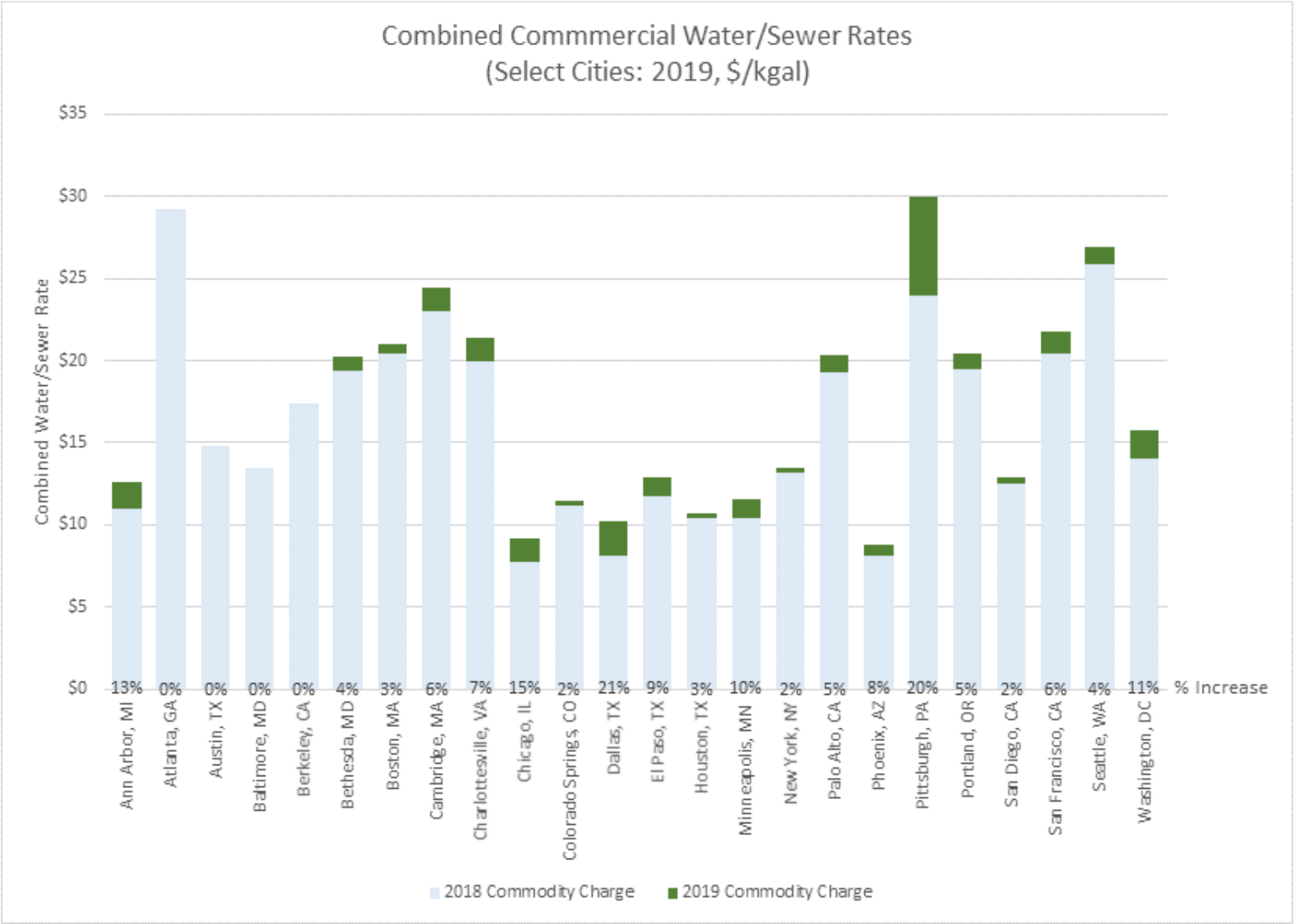
Local Understanding: Results May Vary

2019 Water and Sewer Rates, U.S. Cities

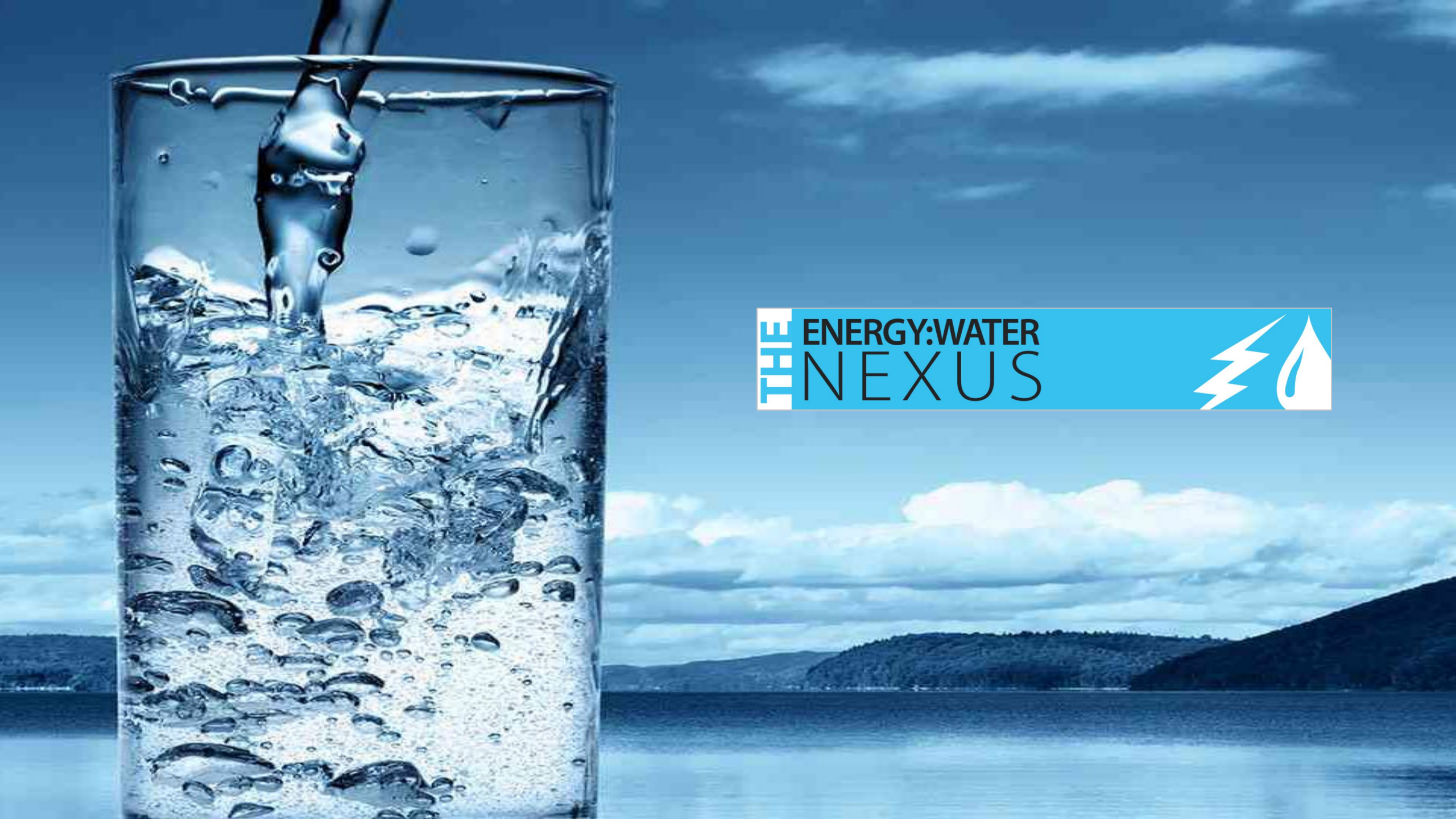


Rates are calculated per 1,000 gallons and are effective as of 1/1/2019.
Water charges are for potable water.
Misc. special charges included, as applicable.
Where rates vary by user size and type, calculations have been made for hospitals over 200,000 sf.
Purple outline indicates location in state that allows for water reuse.
Blue and grey indicate proportion of combined rate for water (blue) and sewer (gray).

Local Understanding: Results May Vary

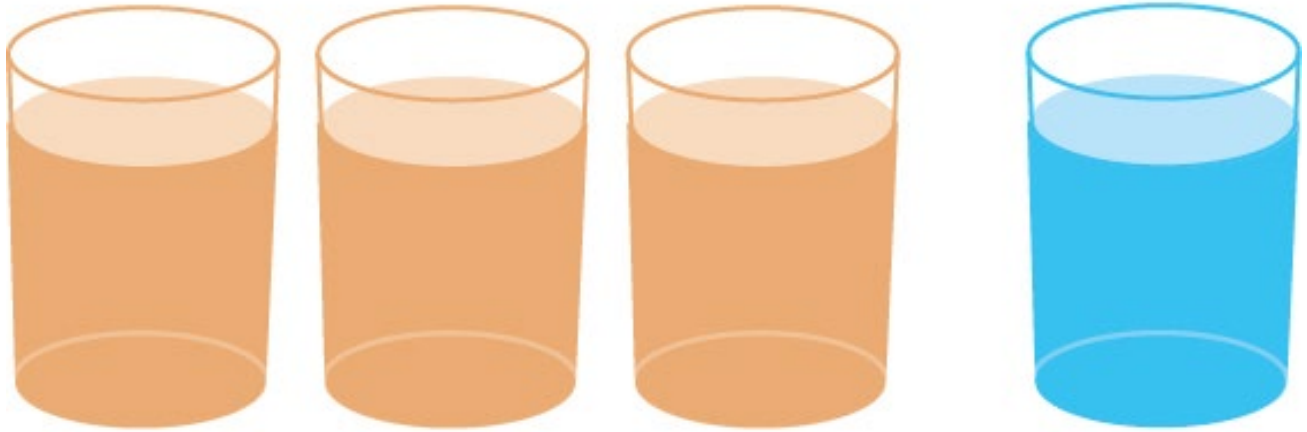


Energy:Water Nexus



THE ENERGY:WATER NEXUS

WATER for ENERGY



U.S. power plants use three times as much fresh water daily – **143** billion gallons – as is used for public water supplies.

* Sandia National Laboratories

WATER for ENERGY

35 gal/kWh[1]

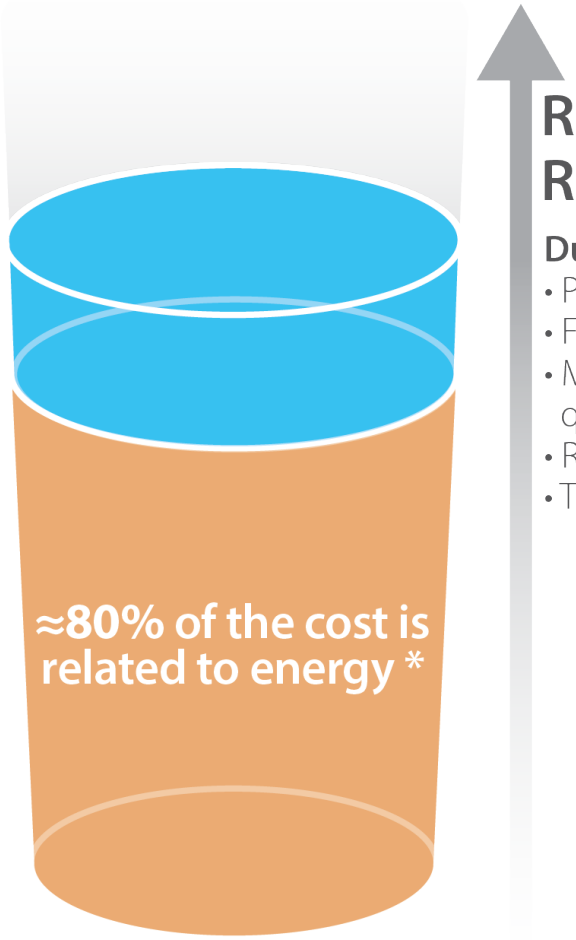
44 gal/kWh[1]

36 gal/kWh[1]

65 gal/kWh[2]

[1] Macknick et al. 2011
[2] UNESCO-IHE 2011

ENERGY for WATER



Rapidly Rising

Due to:

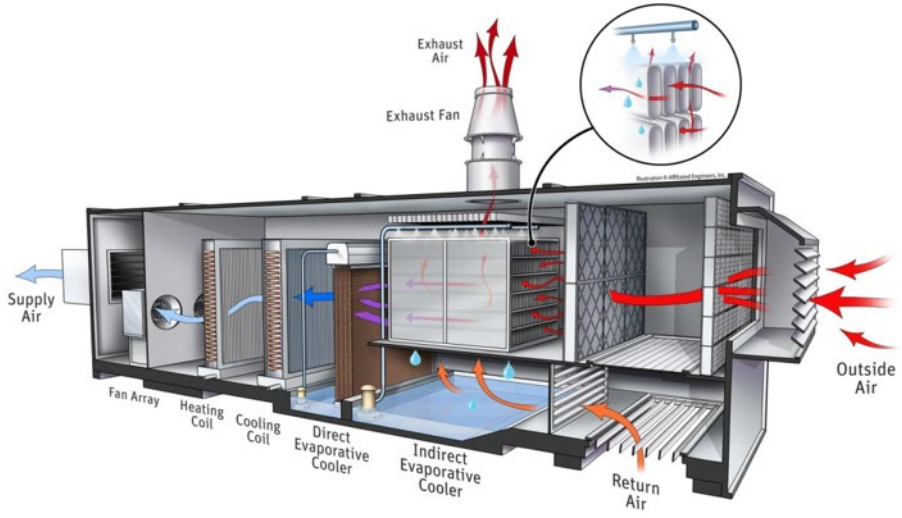
- Population growth
- Failing infrastructure
- More distant, lower quality sources
- Regulatory change
- True cost accounting

* Sandia National Laboratories

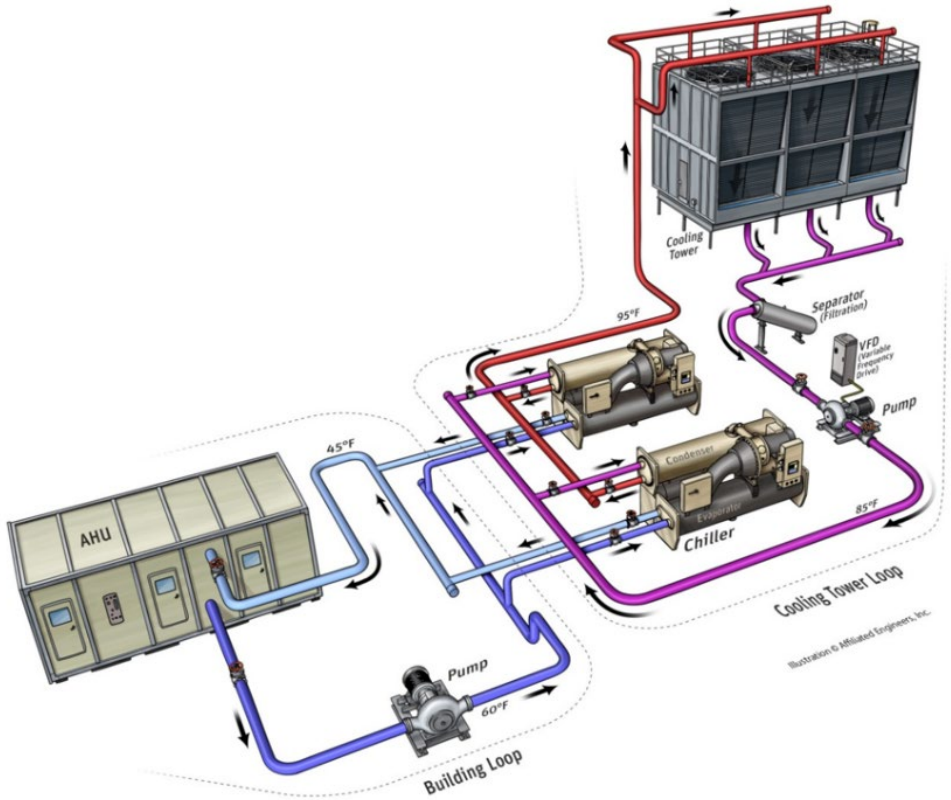
Wholistic Accounting Energy + Water

Wholistic Accounting - Site vs. Source

- Water-cooled chiller VS. evaporative cooling
- Consider both site and source consumption

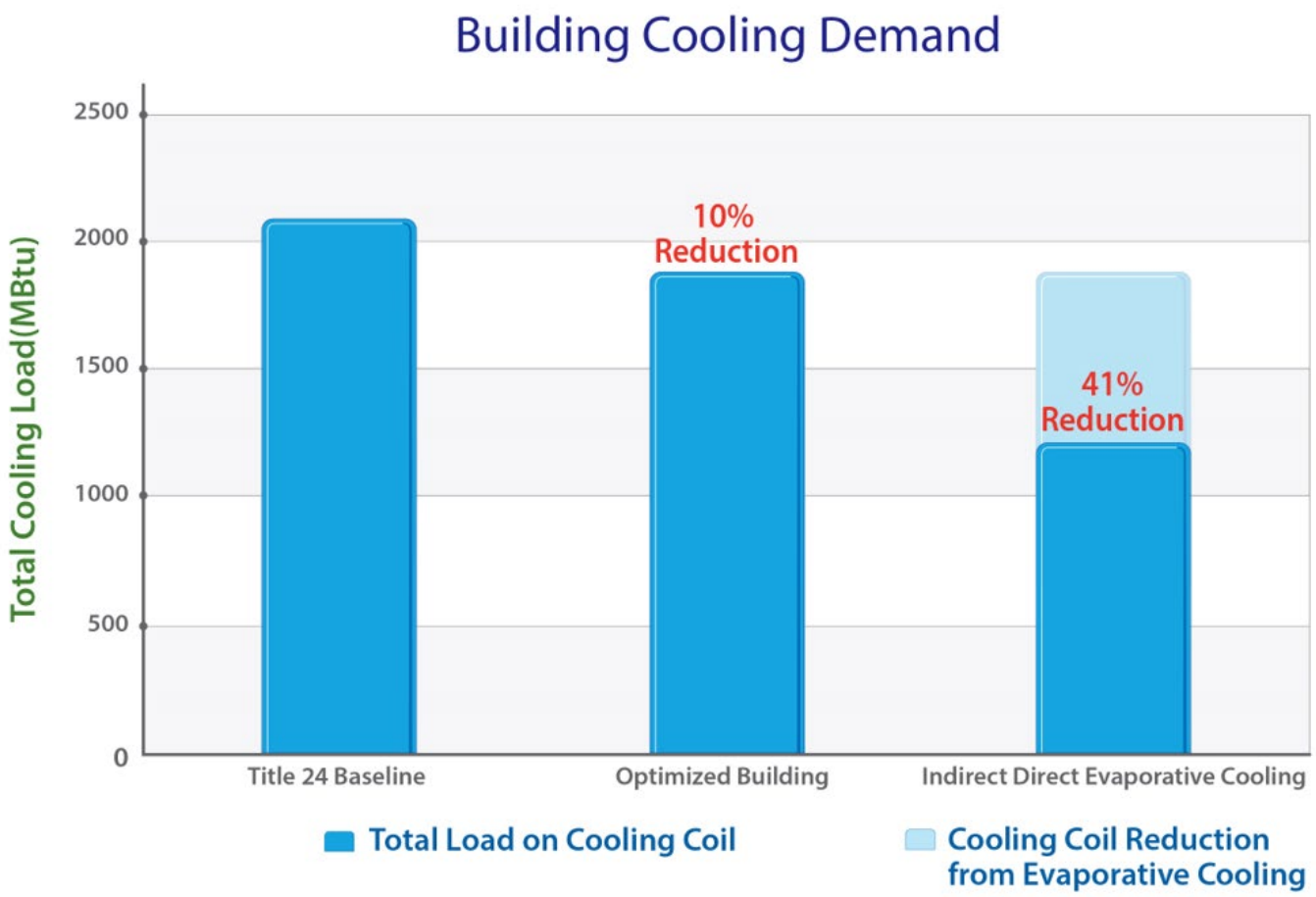


indirect/direct evaporative cooling



water-cooled chiller

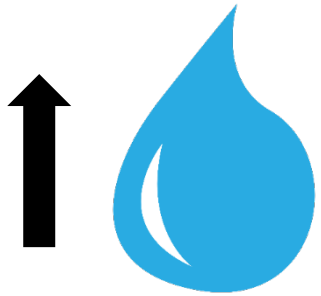
Wholistic Accounting - Site vs. Source



Wholistic Accounting - Site vs. Source

Indirect/direct evaporative cooling saves 38,500 kWh/year

SITE

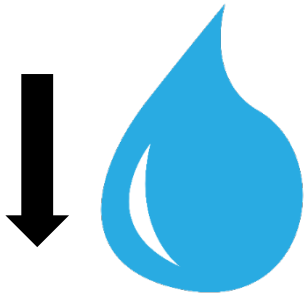


218,000 gal Site Water Increase (evap.)

- 129,500 gal Site Water Decrease (cooling tower)

88,500 gallons
Total Site Water Increase (+)

SOURCE



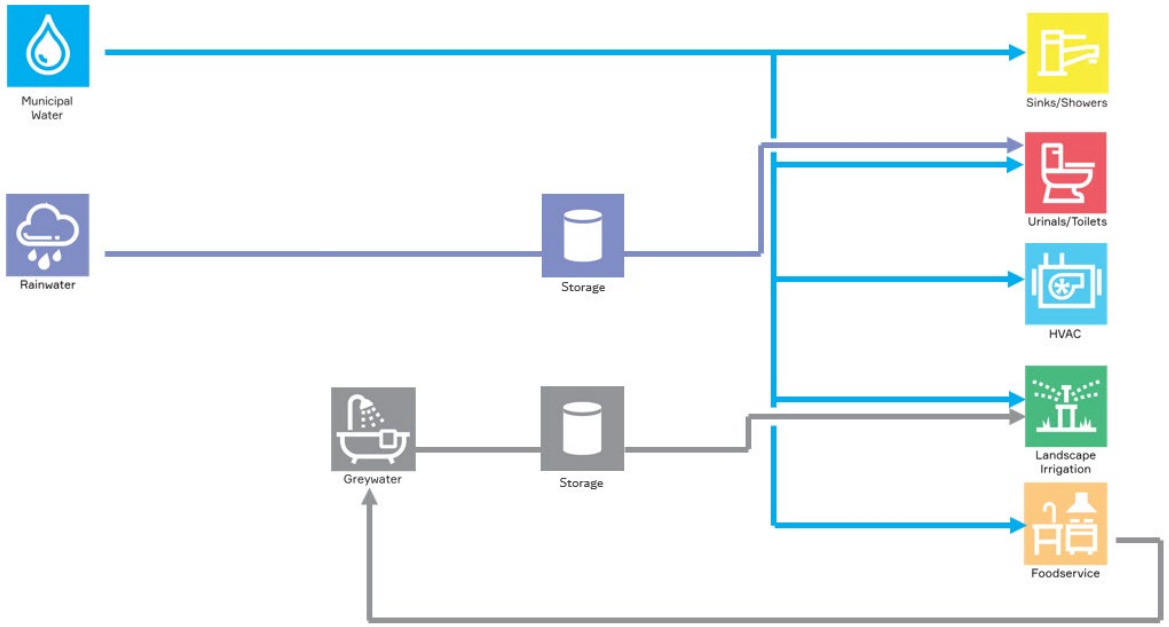
178,500 gallons
Source Water Reduction (-)

- Net electricity savings of 38,500 kWh/year (site)
- Net water savings of 90,000 gallons/year (site + source)

Water Modeling

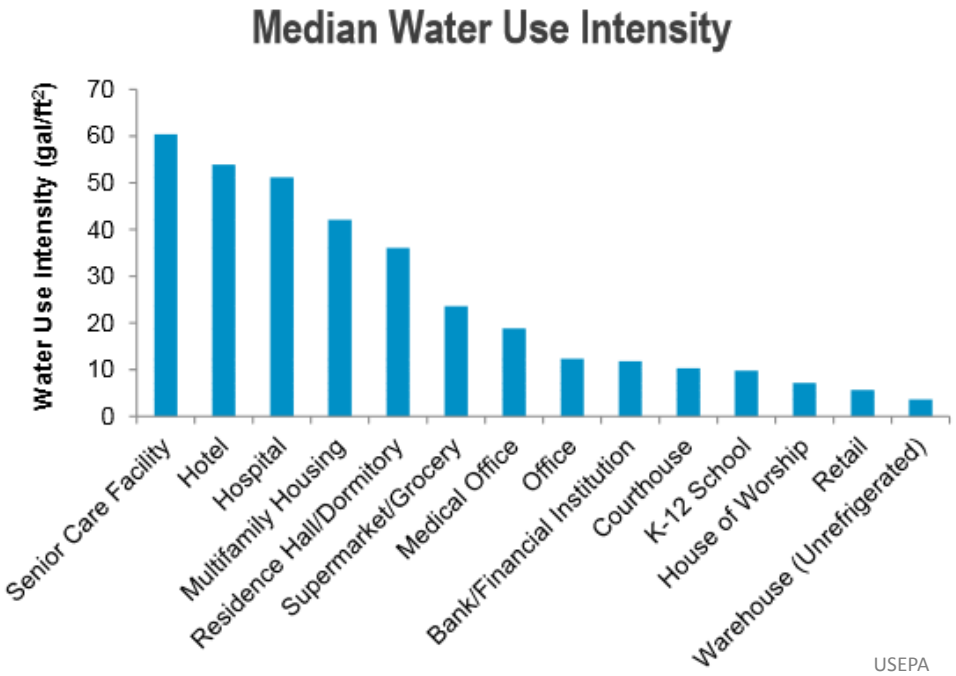
Whole Building Water Modeling

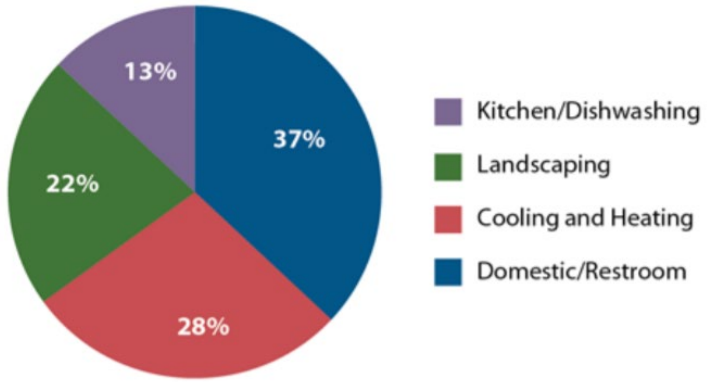
- Benchmark and goal set
- Preliminary water budget, early water balance
- Refine calculations as information and models become available
- Work design alternatives into BOD and design documentation
- Final models and calculations to support compliance



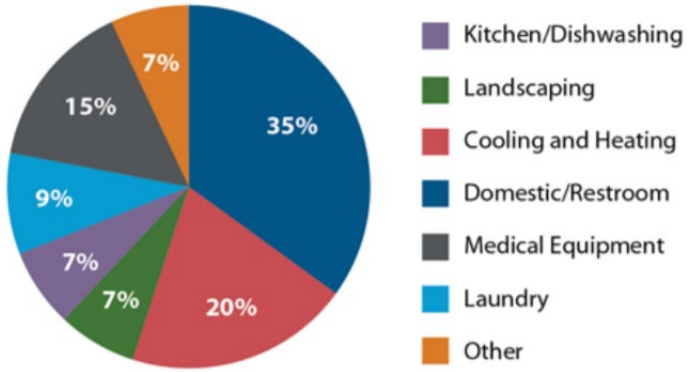
Whole Building Water Modeling

Benchmark and goal set





Created by analyzing data from: New Mexico Office of the State Engineer, American Water Works Association (AWWA), AWWA Research Foundation, and East Bay Municipal Utility District.

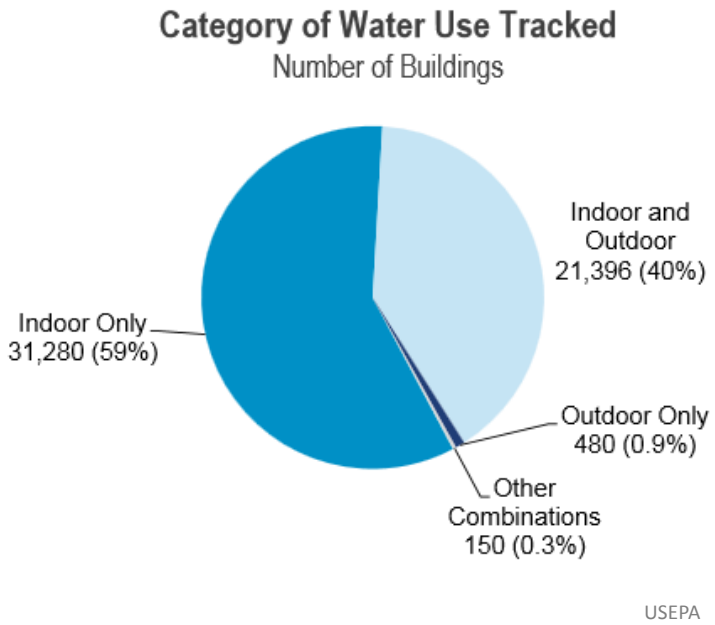


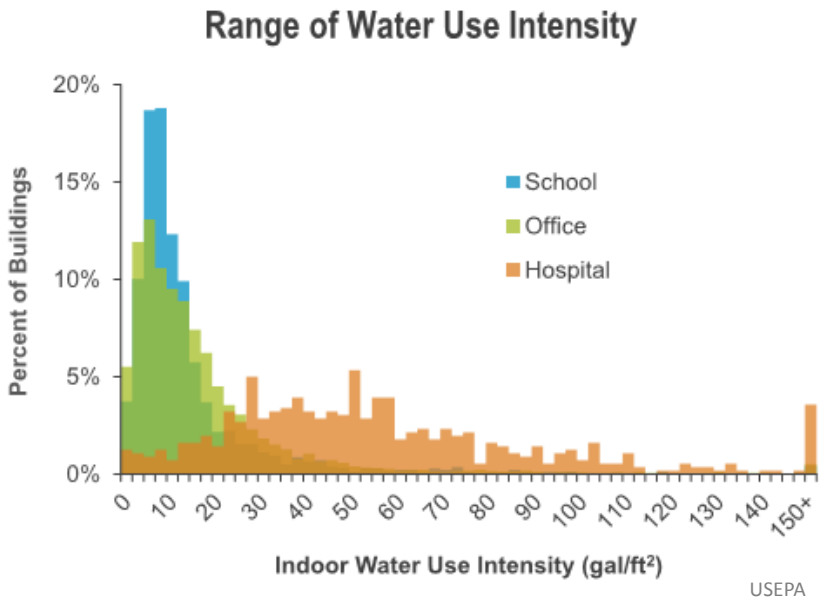
Created by analyzing data from: New Mexico Office of the State Engineer, American Water Works Association (AWWA), AWWA Research Foundation, and East Bay Municipal Utility District.

Whole Building Water Modeling

Benchmark and goal set (challenges)

Data Source	Metric	End-Uses Included
USEPA (14 building types)	Per sf Per customer Per bed Per employee	Varied by program
CBECS (large hospitals)	Per sf Per bed	Building, landscape, central plant
AWWA (11 building types)	Per person/customer	Building, landscape
Pacific Institute (numerous building types)	Per person/employee Per sf	Building, landscape

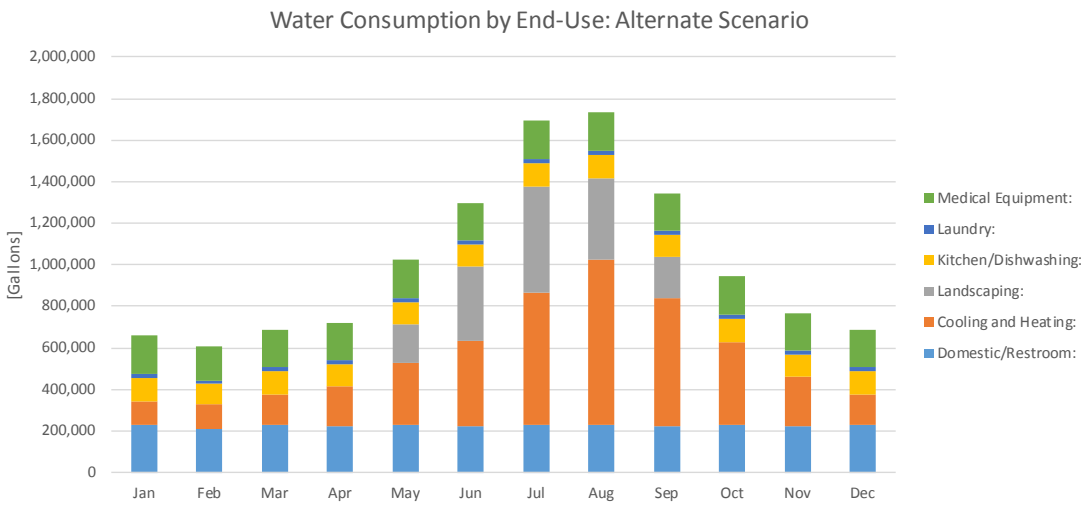


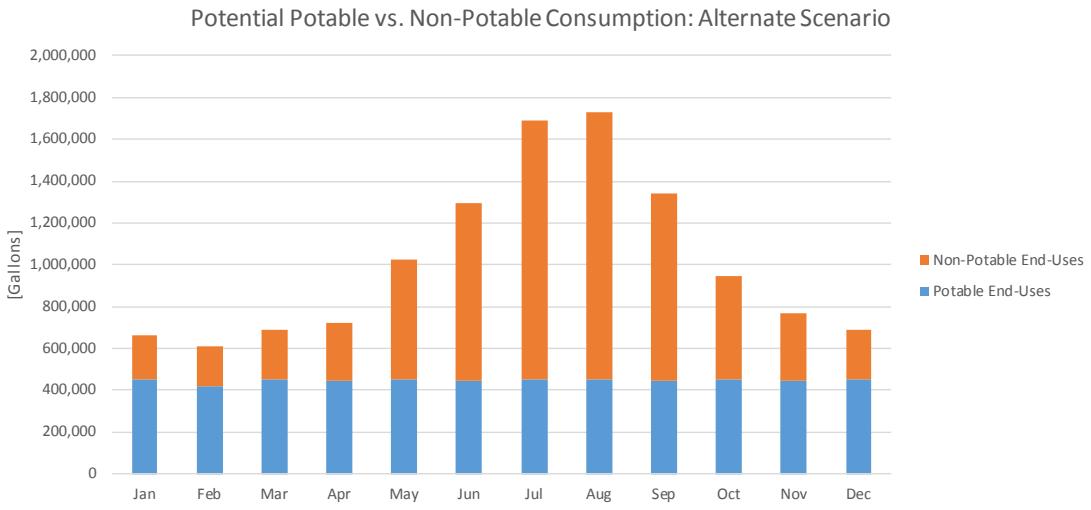


Whole Building Water Modeling

Preliminary water budget, early water balance

- Establish WUI baseline
- Identify water end-uses and develop preliminary water balance
- Consider water use by month, quality requirements, water reuse potential
- Demonstrate savings potential and identify strategies with high impact

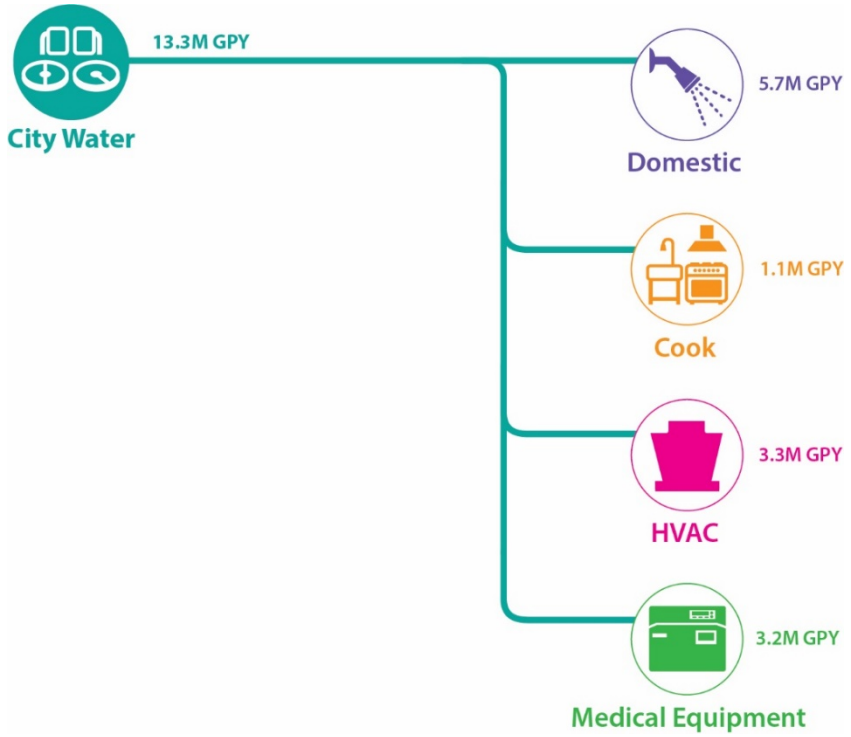


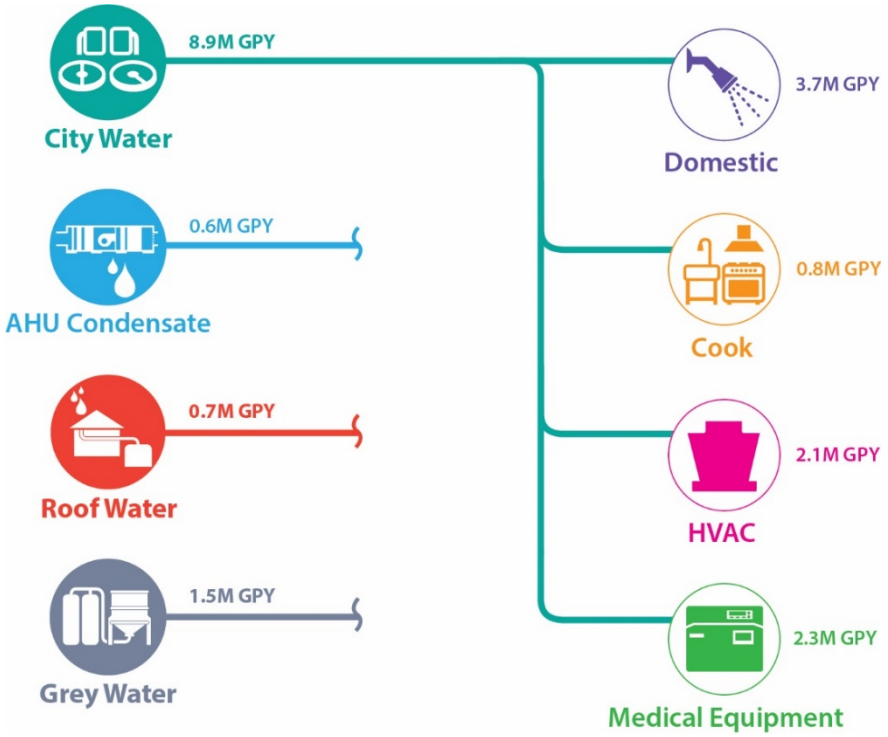


Whole Building Water Modeling

Refine calculations as information and models become available

- Energy Modeling + Water Modeling (detailed hourly modeling)

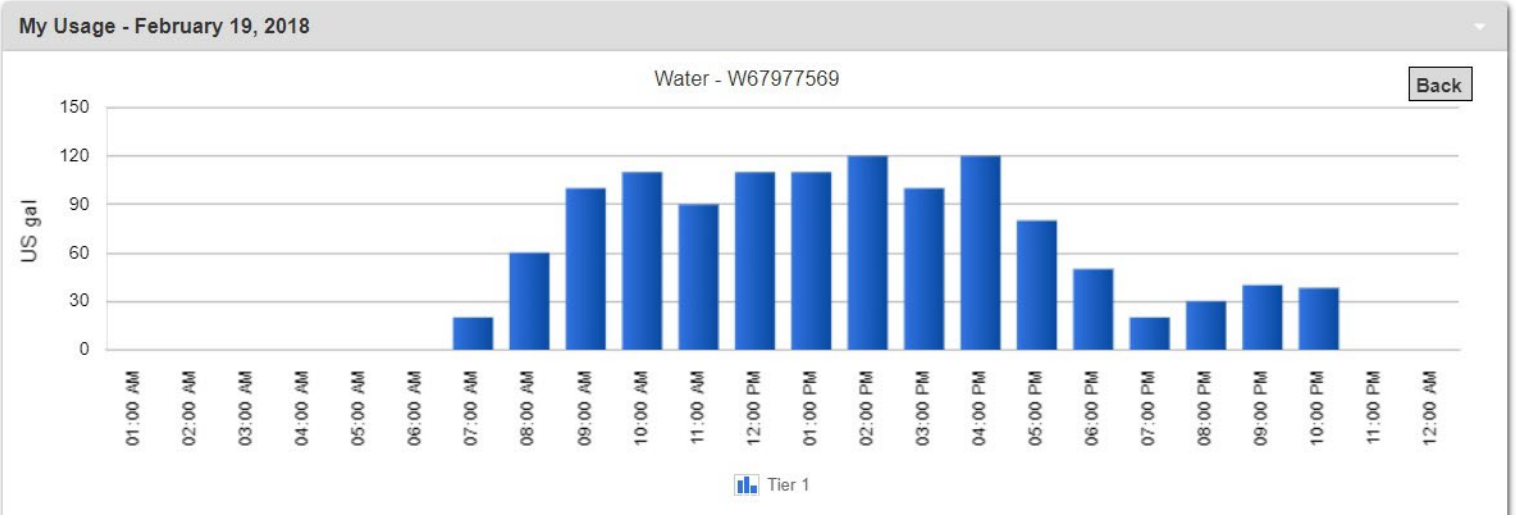




Whole Building Water Modeling

Refine calculations as information and models become available

- Energy Modeling + Water Modeling (detailed hourly modeling)
- Hourly diversity schedules (challenge)

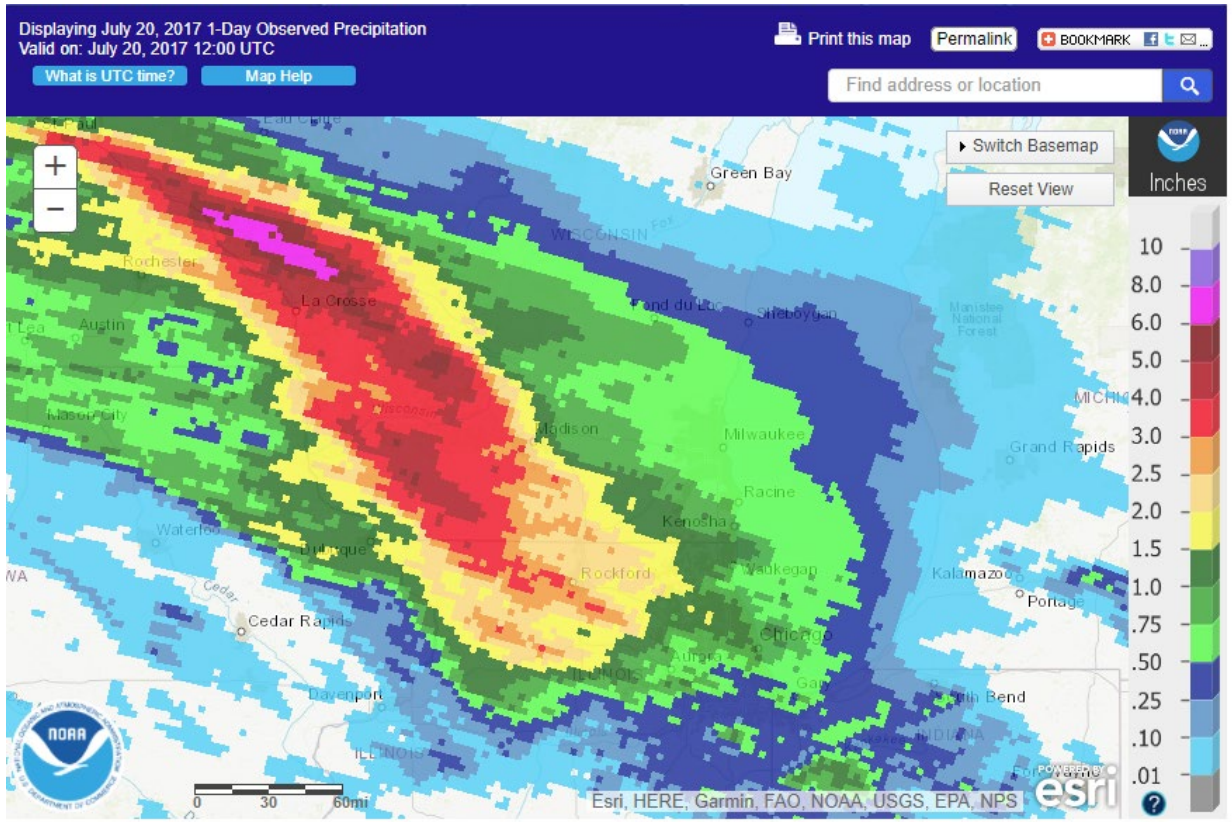


Ref: Madison, WI Water Utility screen shot

Whole Building Water Modeling

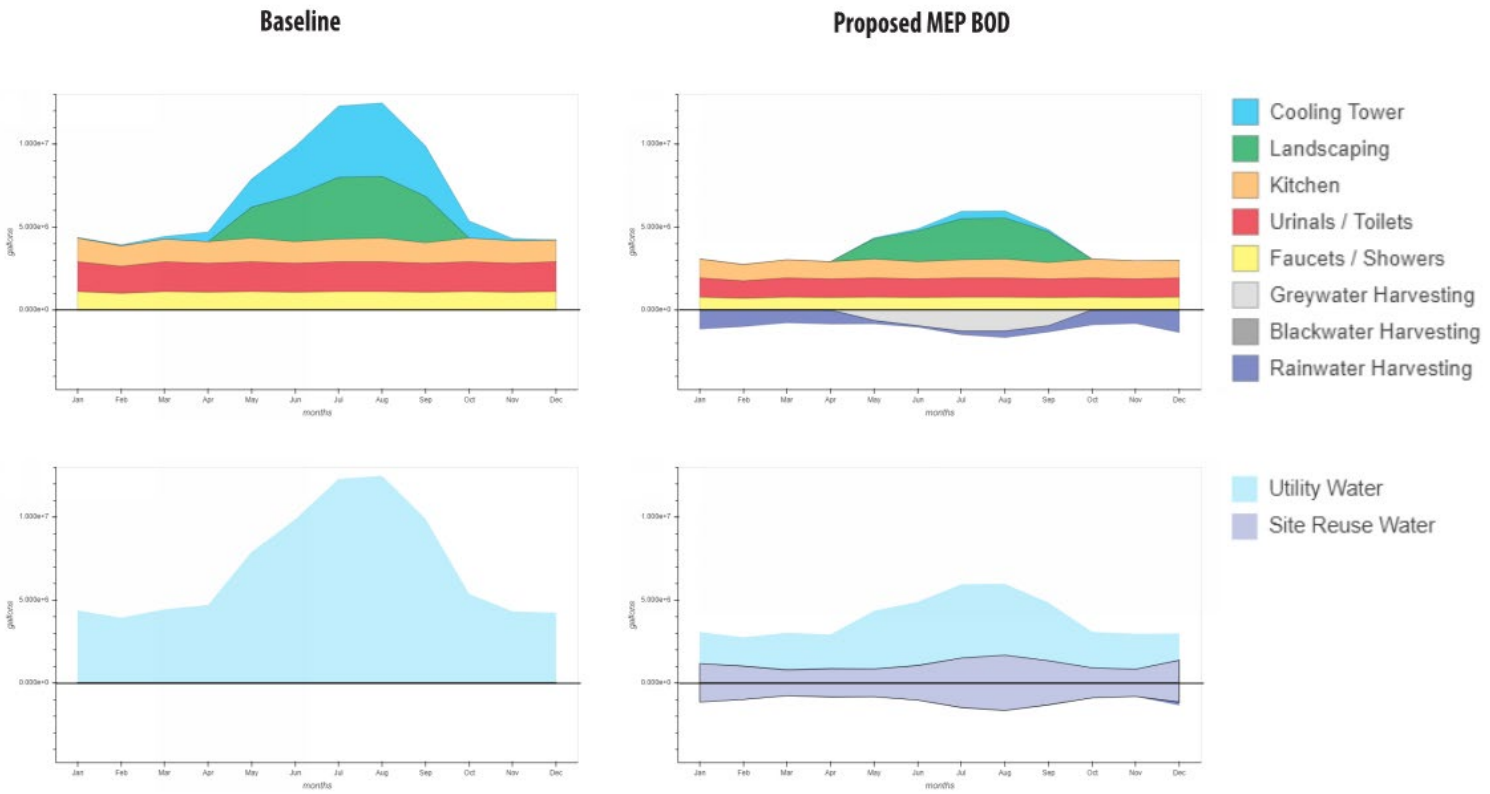
Refine calculations as information and models become available

- Energy Modeling + Water Modeling (detailed hourly modeling)
- Hourly diversity schedules (challenge)
- Precipitation data (challenge)



Whole Building Water Modeling

Final models and calculations to support compliance



ASHRAE STANDARD PROJECT COMMITTEE 191
Standard for the Efficient Use of Water in Building, Site and Mechanical Systems

LEED Pilot Credit Library

Pilot ACP: Whole Project Water Use Reduction

Applicable Rating Systems
This Alternative Compliance Path is available for pilot testing by the following LEED project types:

LEED v4 BD+C
- New Construction
- Core and Shell
- Schools
- Retail
- Healthcare
- Data Centers
- Hospitality
- Warehouses and Distribution Centers

Intent
To reduce indoor and outdoor water consumption of the entire project.

Background
Depending on the building type and use, LEED may not currently address all the water use within the project boundary. This performance pathway for water conservation uses a whole project/ whole campus water budget approach. It allows projects to quantify water use with whole-building water balance modeling, similar to the compliance path for whole-building energy modeling. It also allows projects to include potentially significant water savings that previously went unrecognized, such as process water. This alternative compliance path (ACP) documents overall water consumption reduction and establishes point thresholds based on this performance metric.

QUESTIONS?

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