Design Opportunities & Business Case for Water Efficient Building Design

University of Minnesota

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Biomedical Discovery District

Research Cluster

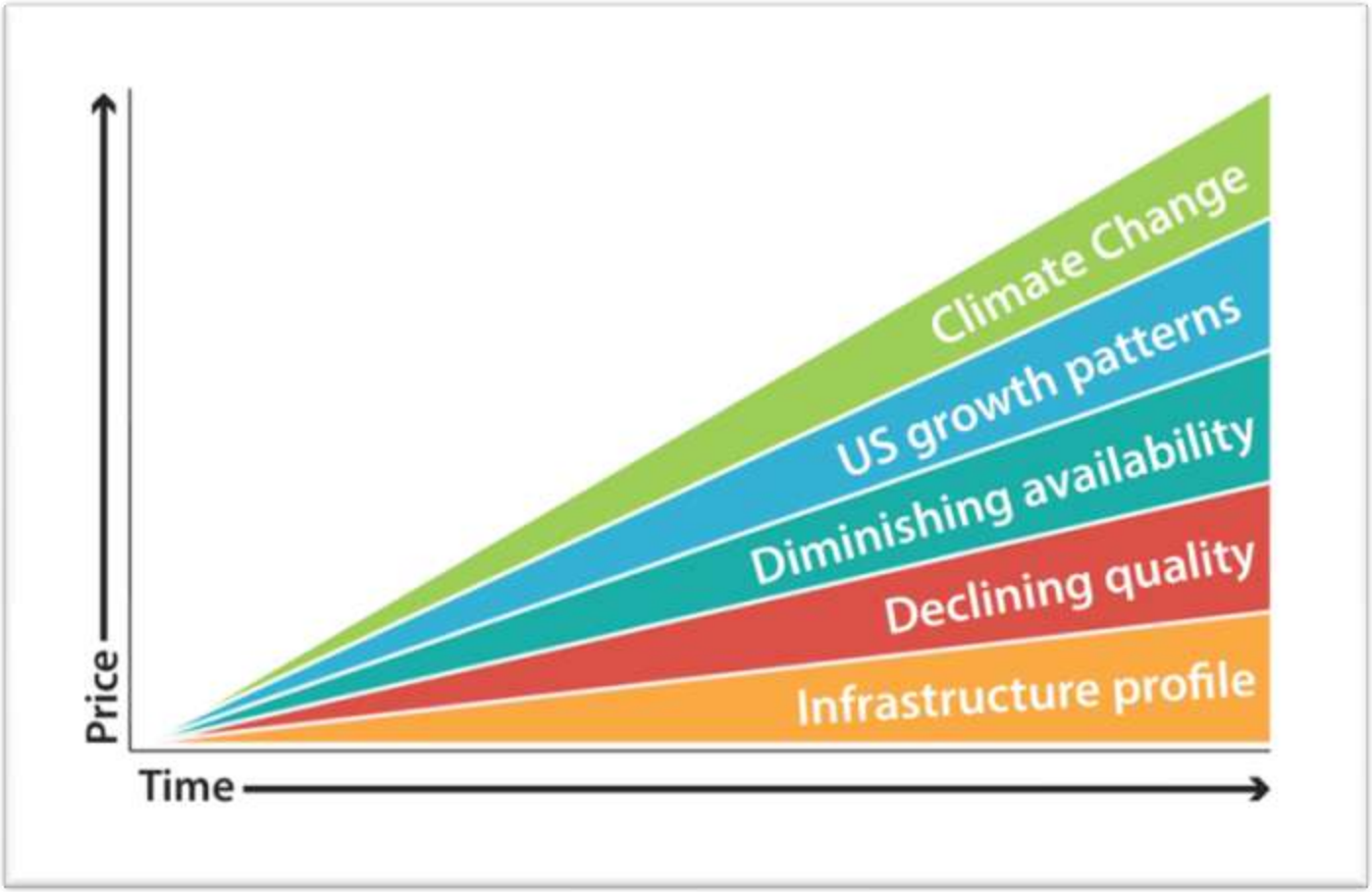
- $282M initiative
- 3 new facilities
- 1 facility expansion
- Reduced energy and water use intensities

Driving Resource Efficiencies

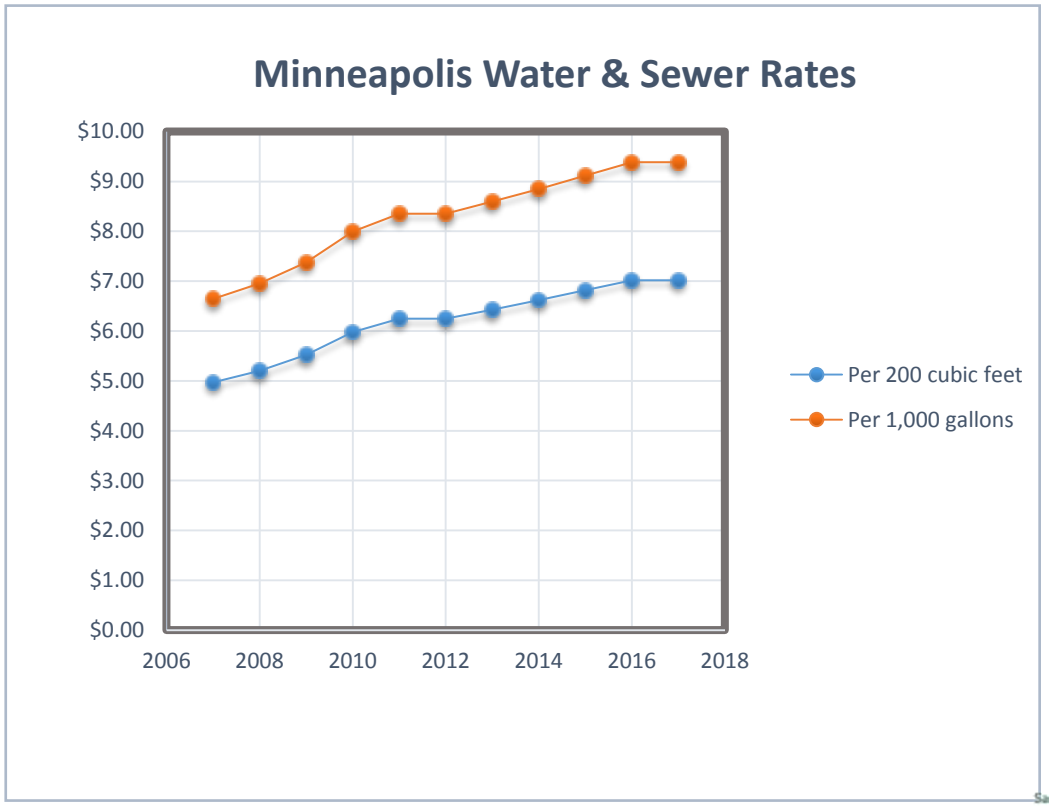
Resource optimized building design – simultaneous reduction of energy demand and water use

THE ENERGY:WATER NEXUS

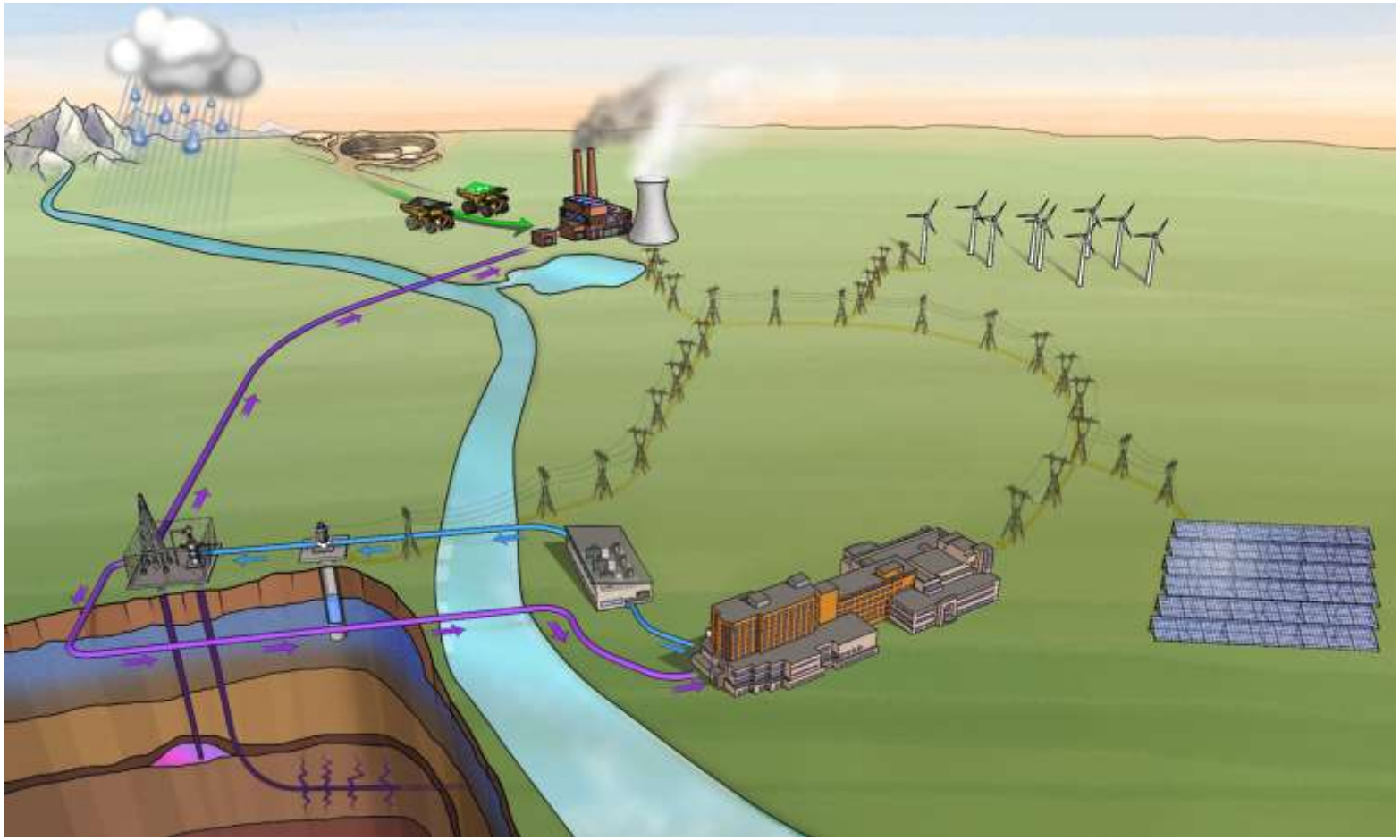
Why Water Efficiency?



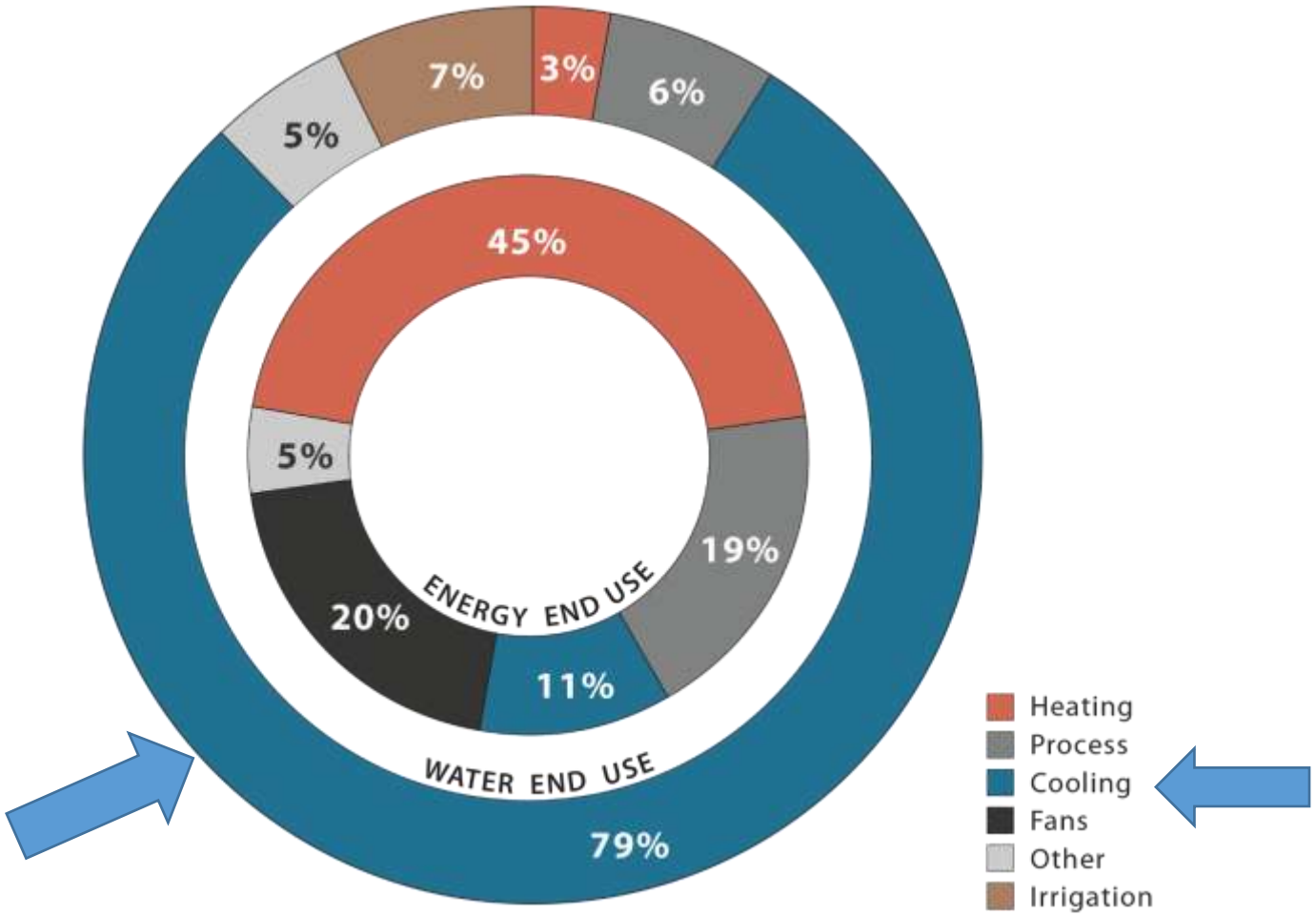
Minneapolis Water/Sewer Rates



Relationship of Energy and Water in Infrastructure



Relationship of Water and Energy in Buildings



CCRB Baseline building calculation

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University of Minnesota Building Requirements

Minnesota's "Buildings, Benchmarks & Beyond" Requirements

- Apply to all state-funded projects
- Follows Architecture 2030 Challenge
- Life cycle investment methodology
- 15 year return-on-investment standard
- 60% energy and CO2 use reduction (compared to state inventory)
- 30% building water use reduction compared to base design
- 50% irrigation reduction compared to base design

Water is recognized as a means of energy conservation

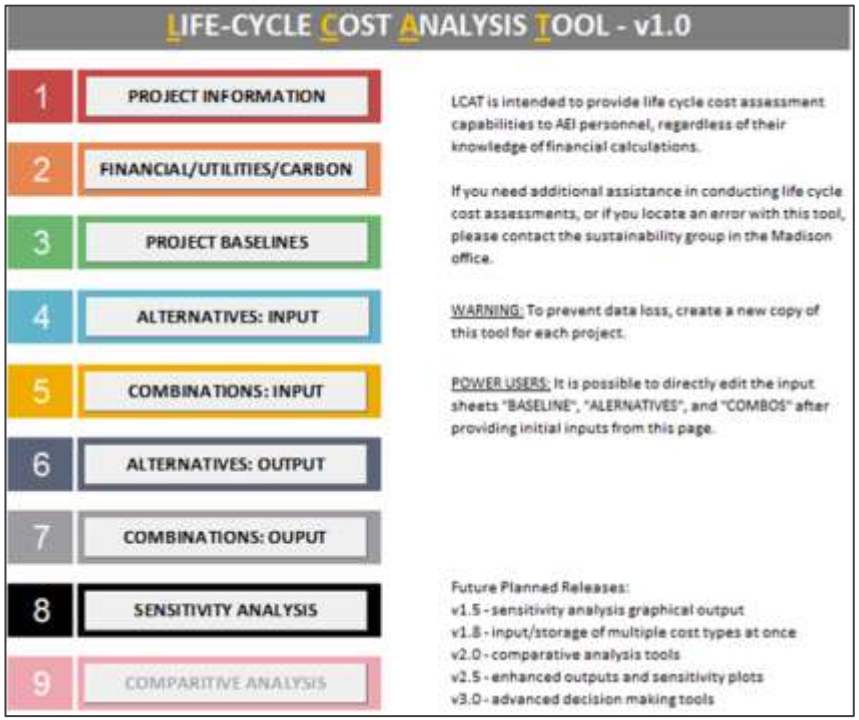
Cancer & Cardiovascular Research Building

- 280,000 sf research building
- Houses research on the role of chemical carcinogens in causing cancer and new cancer treatments
- A collaboration of the Masonic Cancer Center, the Lillehei Heart Institute and the Department of Biology and Physiology
- 25 research teams with an ambitious growth trajectory

Decision Criteria for Cost Analysis

Which to use, and when?

- First cost, short payback
- Obvious, “no brainers”
- Life cycle justified
- Address project financial goals
- Address project environmental goals
- Other



First Cost, Short Payback Elements

- Reduced flow water closets and urinals
- Water efficient glassware washers
- Reduced outside air
- Cooling coil condensate collection

First Cost Justified Outside Air

Animal Space Design Criteria:

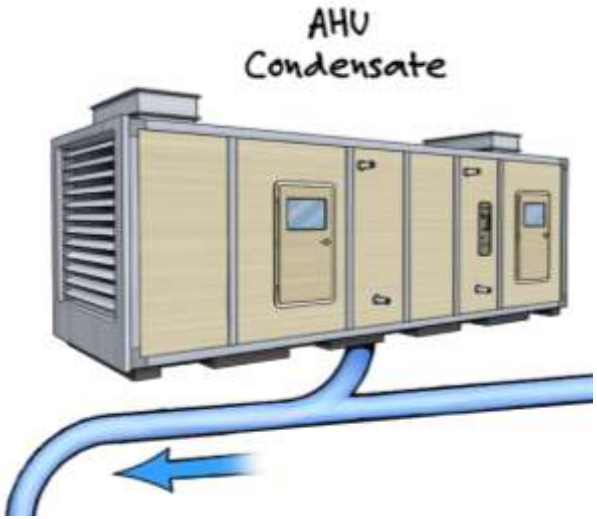
- Initial -- macroenvironment (*Guide for the Care and Use of Laboratory Animals)*
- Final -- individually ventilated racks to improve microenvironment

Parameters	Initial	Final
Air changes per hour	15	10
Design temperature	70 F	70 F
Humidity requirements	30% RH	30% RH

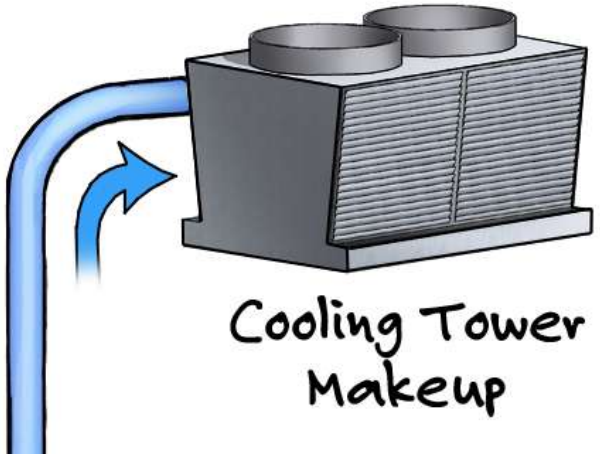
Outcome -- 33% reduction in outside air with reduced:

- first cost
- water use for humidification, cooling and cooling tower evaporation
- energy demand

First Cost Justified Cooling Coil Condensate



- 320,000 cfm design load
- Calculated condensate: **1.38m gpy**

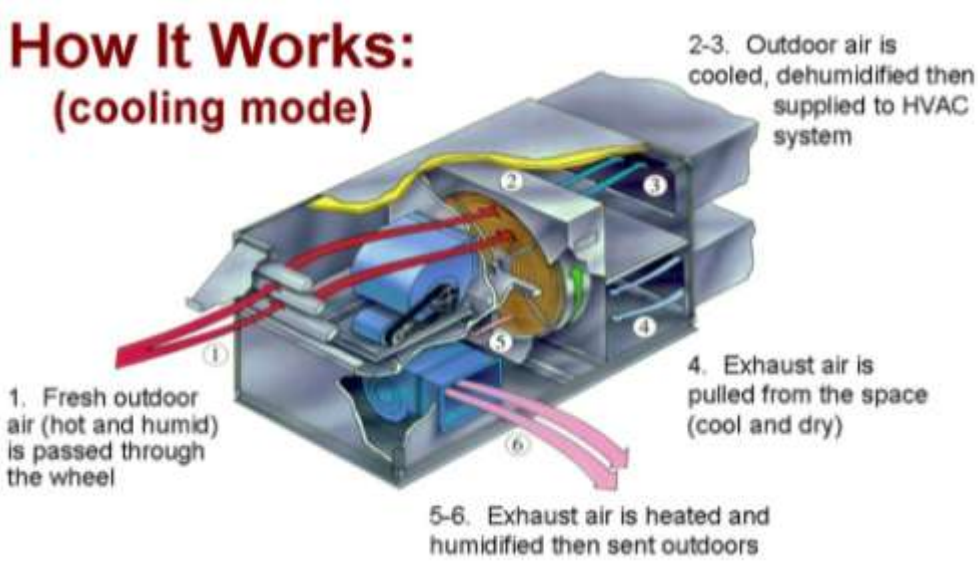


- 4.5 m gallons annual anticipated make-up
- **30+/-% make-up from condensate collection**

Life Cycle Justified Total Energy Recovery Wheel

Sensible, latent heat recovery:

- Reduce summer cooling load to lower cooling tower consumption
- Reduce humidification by transferring latent energy through the wheel



Life Cycle Justified Vivarium Equipment

Equipment	Sustainable Options	Water savings per cycle	Energy Impact
Large Sterilizer	Chilled water cooled discharge	≈ 200 gallons	8.3 tons of cooling per cycle
Medium Sterilizer	Chilled water cooled discharge	≈ 160 gallons	8.0 tons of cooling per cycle
Cage & Rack Washer	Pre-wash re-uses final rinse water, side tank drain discharge tank	40 gallons 15-20 gallons	No additional energy impact
Tunnel Washer	No options selected	-	-

Life Cycle Tested Adiabatic Humidification System

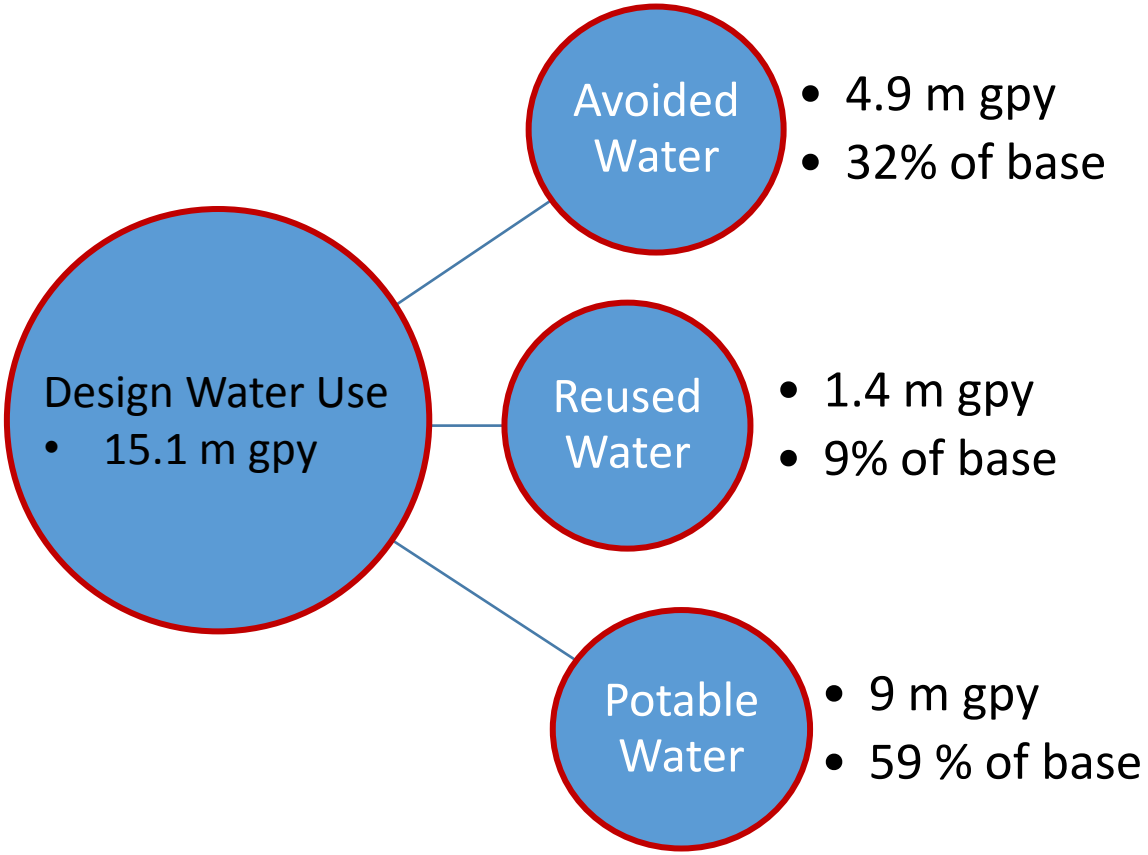
Advantages:

- Energy savings -- no steam required
- Takes advantage of pre-heat from energy recovery wheel

Disadvantages:

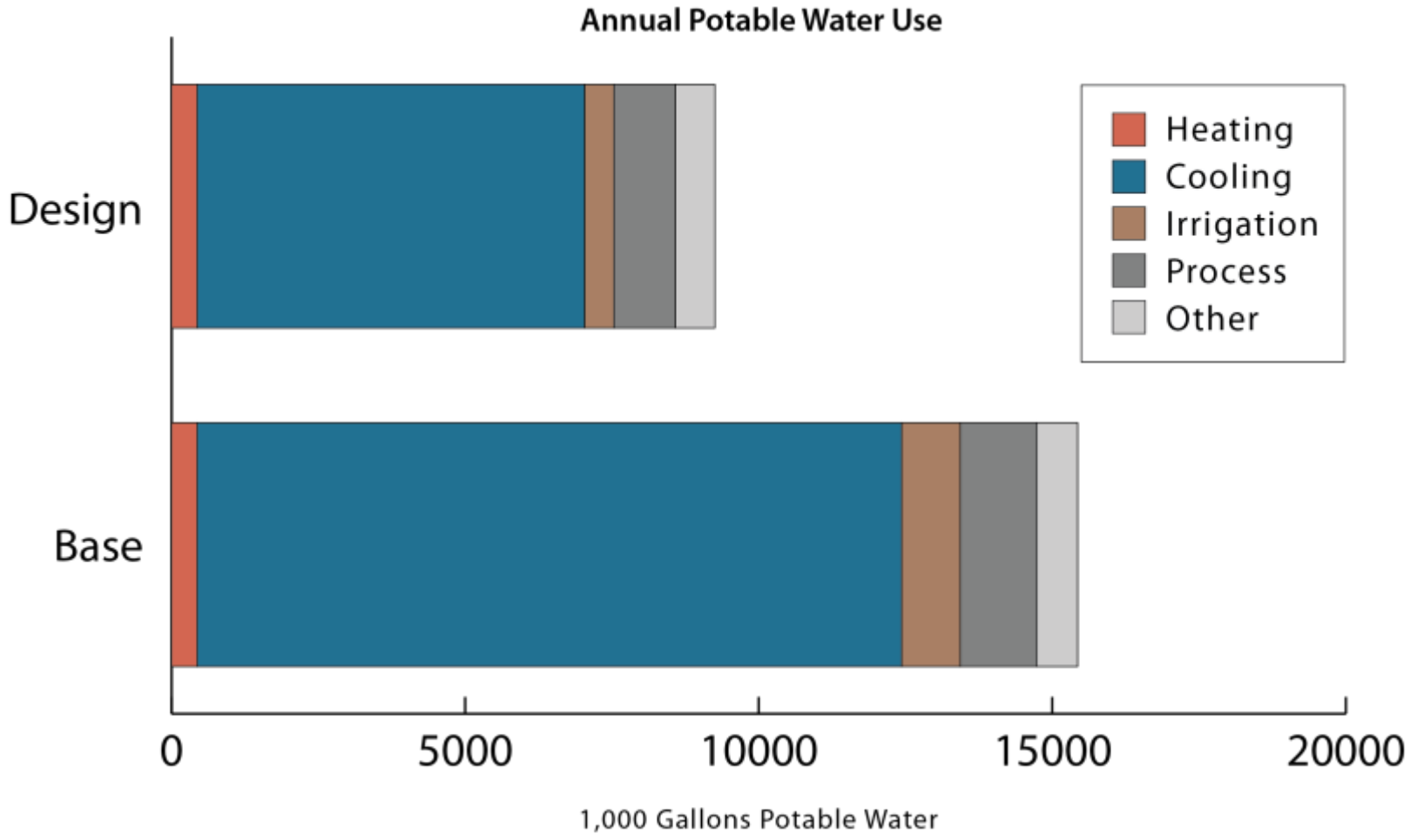
- Only 70% of the water injected is adsorbed, leaving 30% discharged to drain
- Required reverse osmosis water discharging reject water to drain

Design: Water Use



Design compared to baseline

Design: Potable Water Use



Design compared to baseline

Peer Comparison

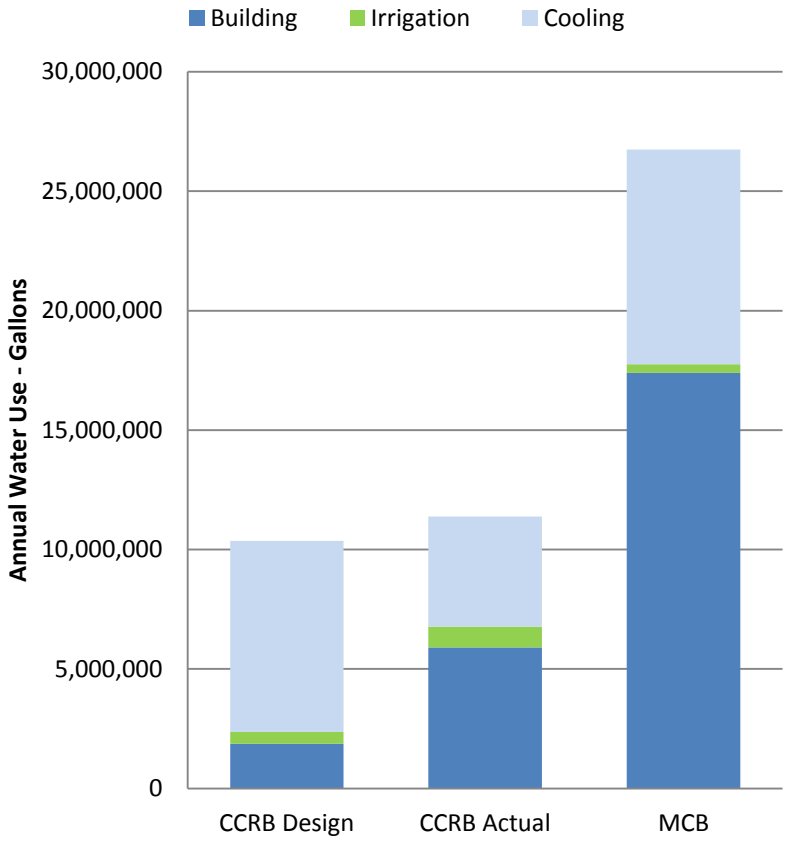
CCRB Facility (2013)

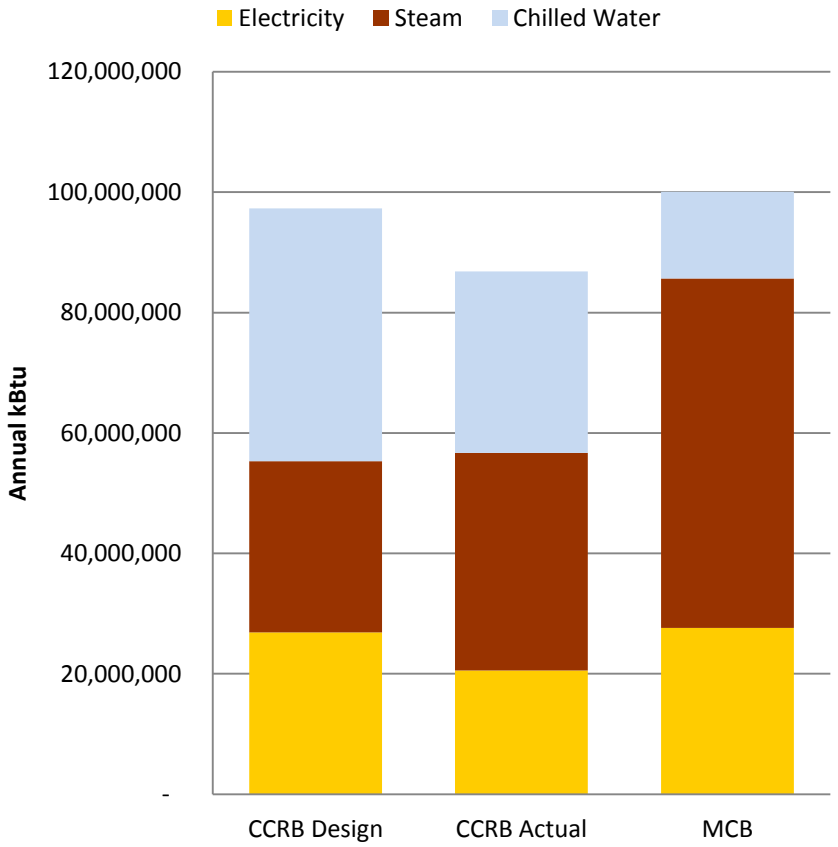
- 280,387 GSF
- Satellite district cooling plant (2700 tons)
- 60% occupied

MCB Facility (2002)

- 259,757 GSF
- Satellite district cooling plant (3900 tons)
- 100% occupied

Energy and Water: Design, Actual, and Peer

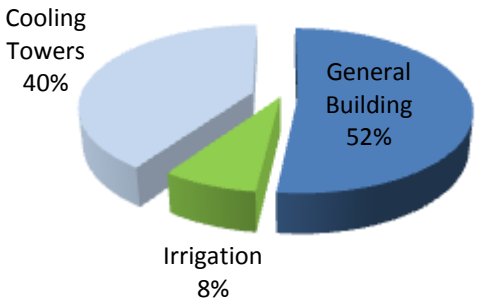




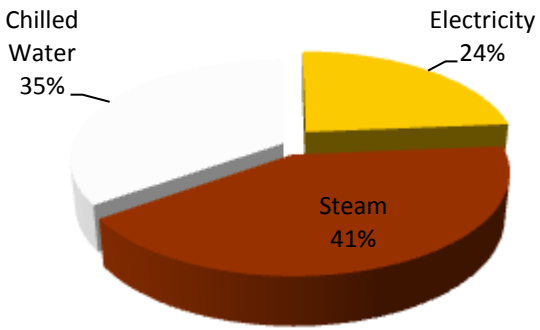
Actuals based on 2013 data

Energy and Water Use Intensities

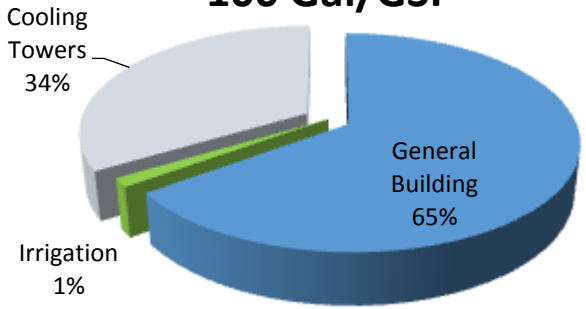
CCRB WUI
32 Gal/GSF (projected)



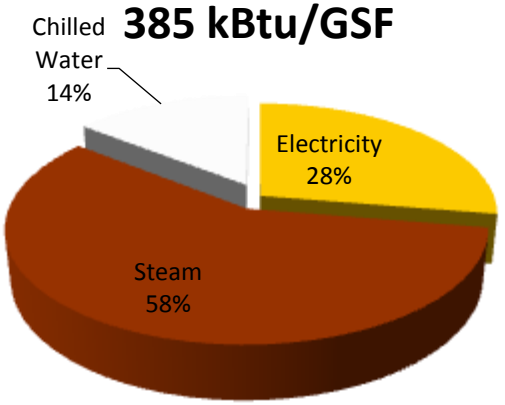
CCRB EUI
310 kBtu/GSF (projected)



MCB WUI
100 Gal/GSF



MCB EUI
385 kBtu/GSF



2013 calculations

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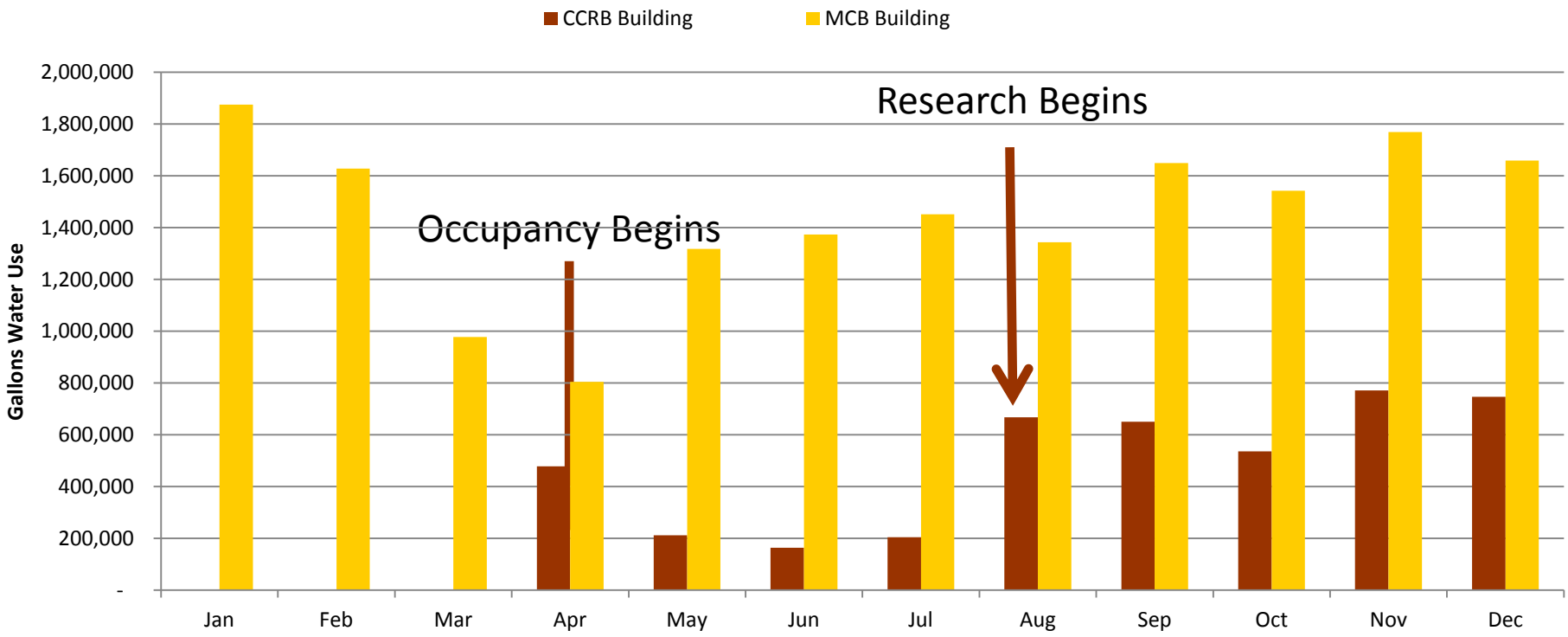
Building Water Use Comparison

MCB Actual metered building use – 17.4 m gallons

CCRB projected building use – 5.9 m gallons



2013 Data, excluding cooling and irrigation

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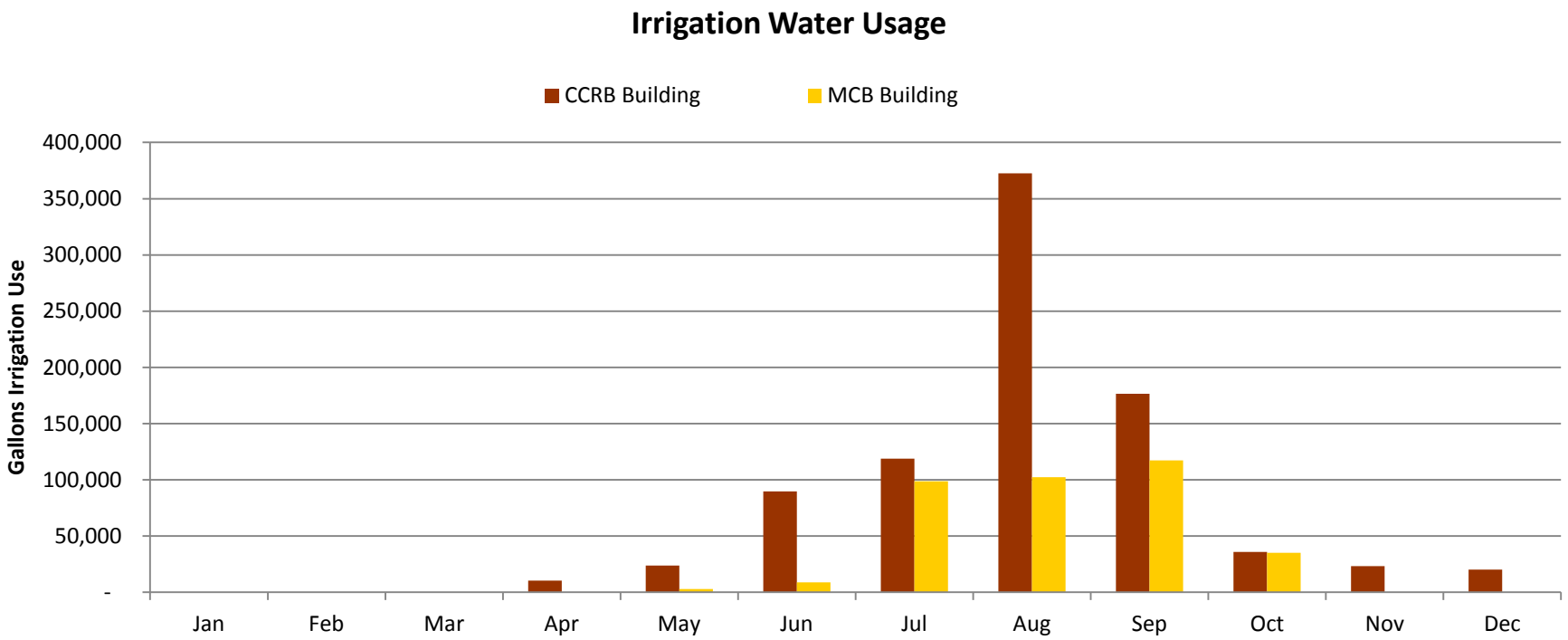
Irrigation Comparison

MCB
- 8.3 gallons/sf green space

CCRB
- 11.3 gallons/sf green space



2013 data, CCRB includes plant establishment

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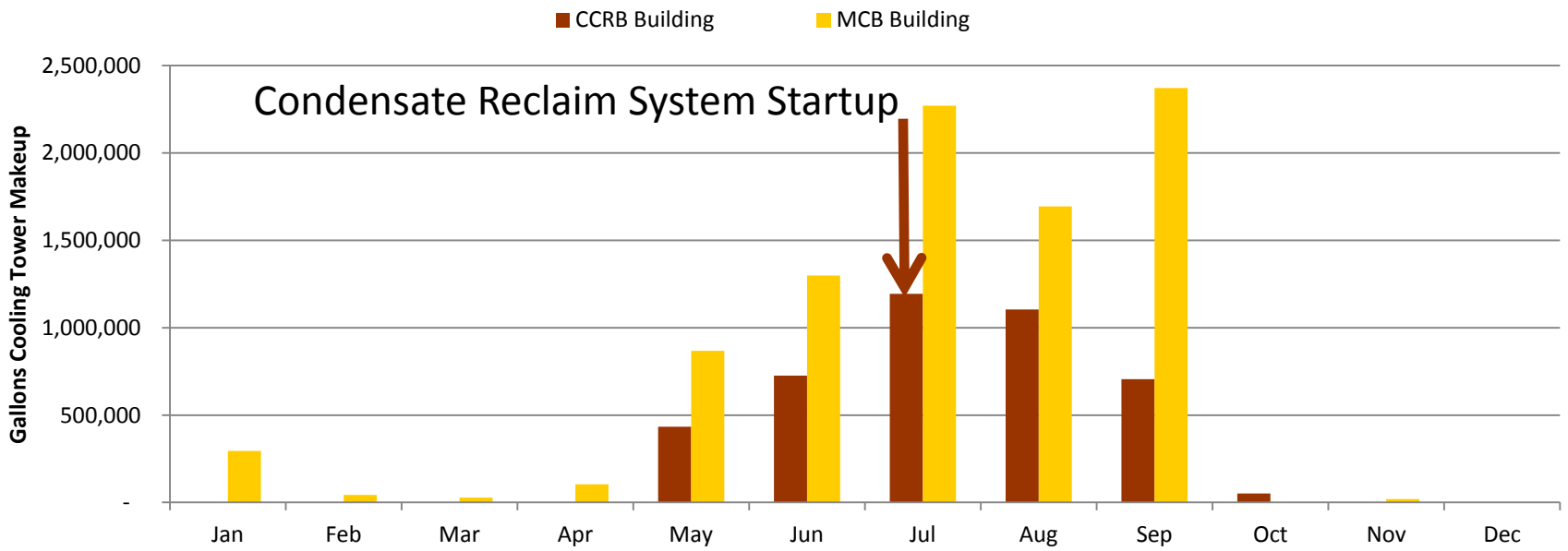
Cooling Tower Water Use Comparison

Tower water consumption $\propto$ tower load

Condensate $\propto$ cooling load

- To date -- 400,000 gallons ***reclaimed***
- Annual projection – 800,000 gallons ***reclaimed***



2013 calculations

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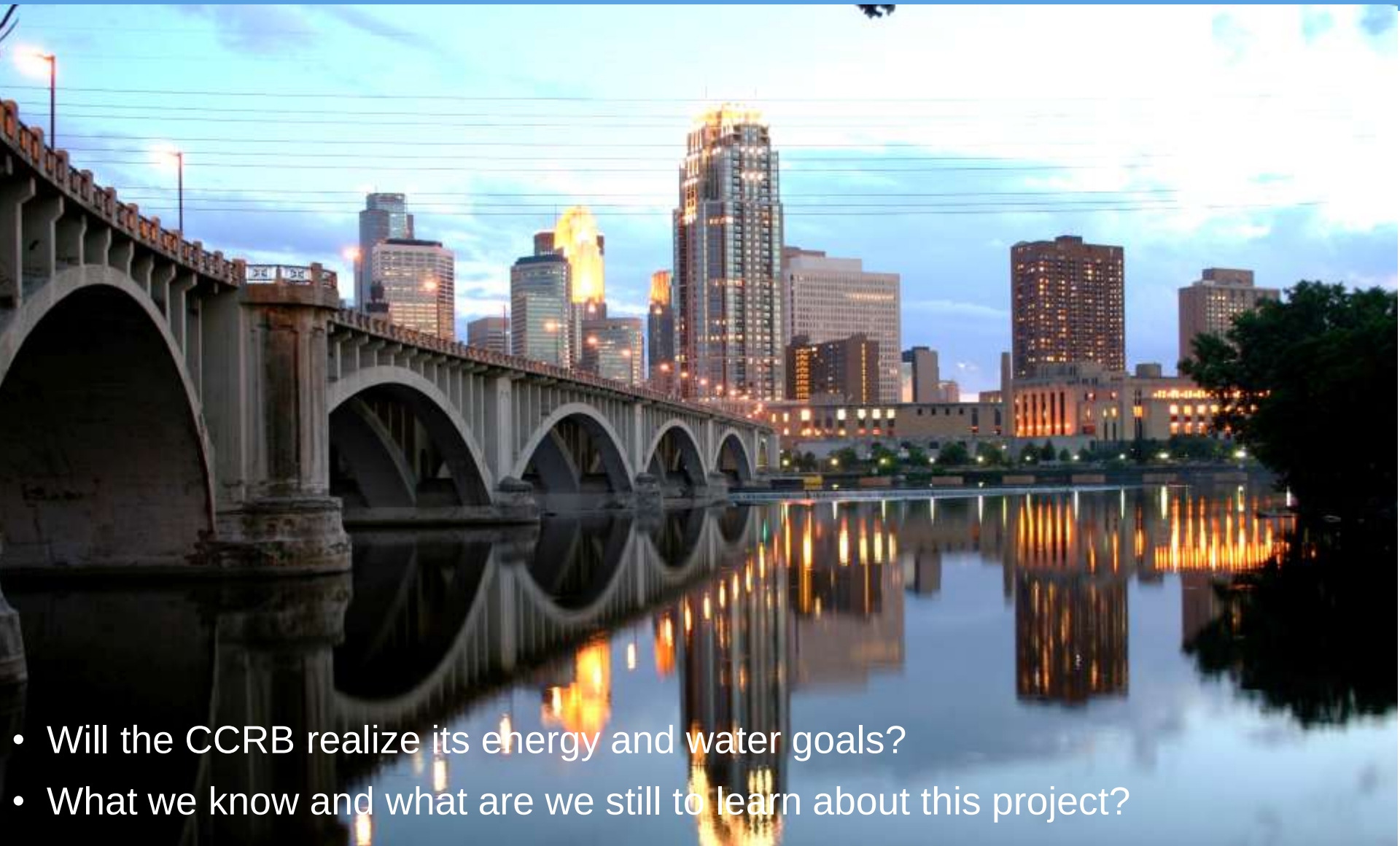
Take Aways



- Will the CCRB realize its energy and water goals?
- What we know and what are we still to learn about this project?