

Looking over the Horizon at Craft Brew Water Challenges

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Outline

- Challenge of supply reliability and cost of wastewater management
- Looking at the future of supply
- The future of waste stream management
- How much water does the craft brew industry really use in California?
- Conclusion: California a good place to brew beer.



*Special thanks to Ann Spevacek, Pizza Port Brewery
and Joe Williams, Kelly Scott, UC Davis*



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Two fundamental future water challenges for brewers

Reliability of Water Supplies



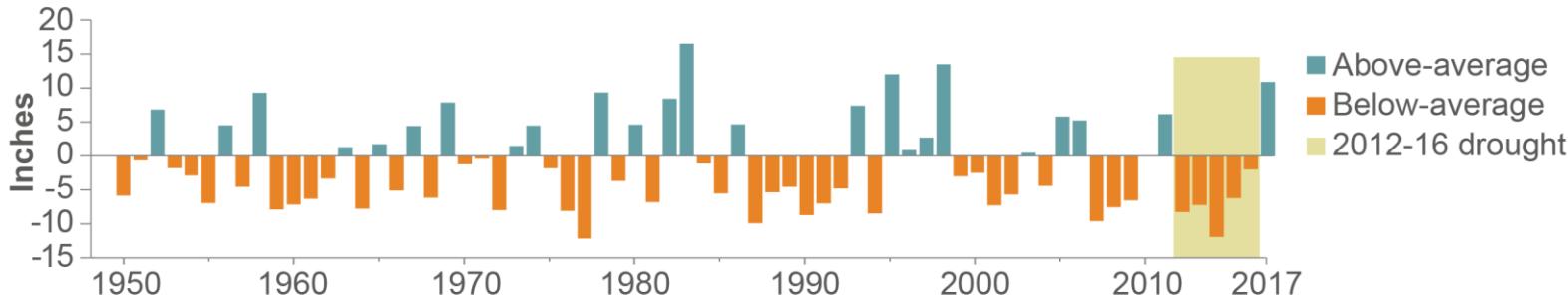
Costs of Wastewater Treatment



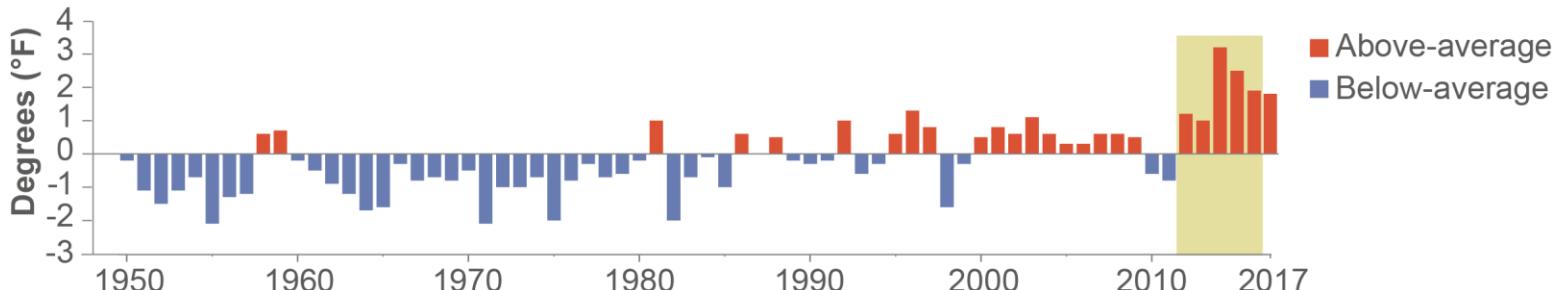
Drought provided a useful test of governance and infrastructure.

2012–16 drought was warmest on record

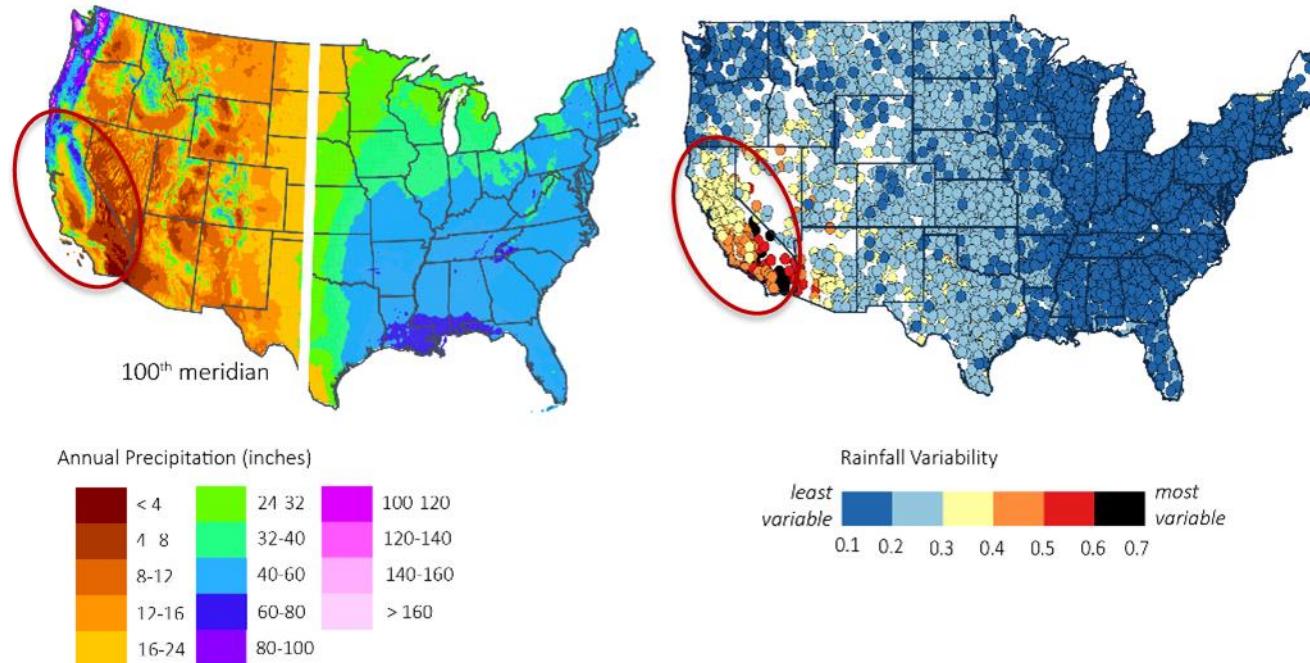
A) Precipitation



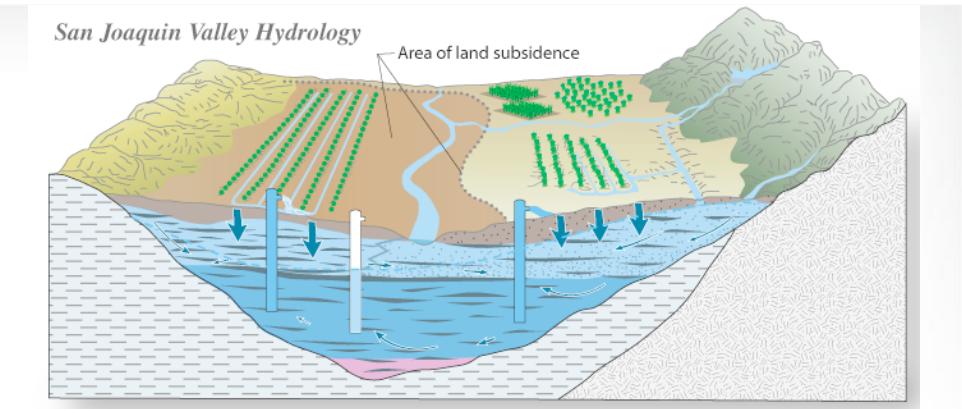
B) Temperature



Reminder: Western US is drier, with more variable precipitation—California is most variable



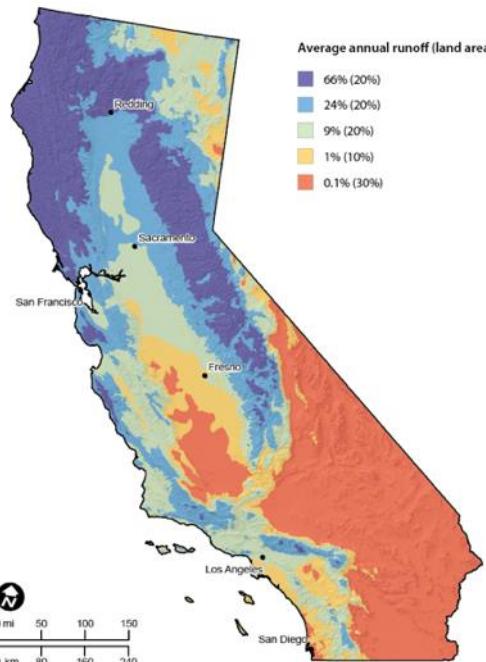
Management relies upon a grid with storage



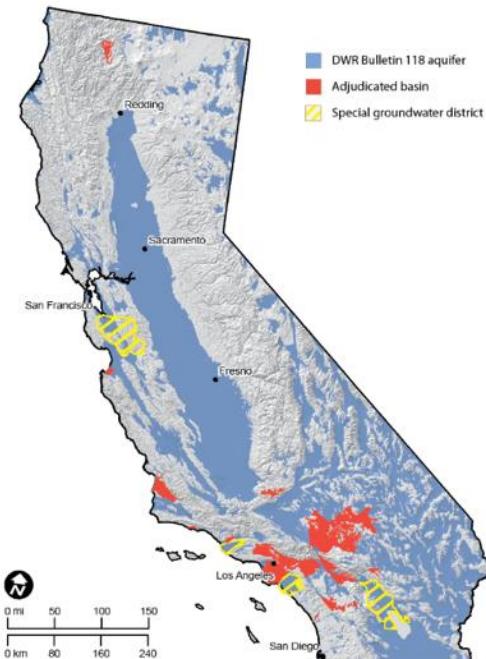
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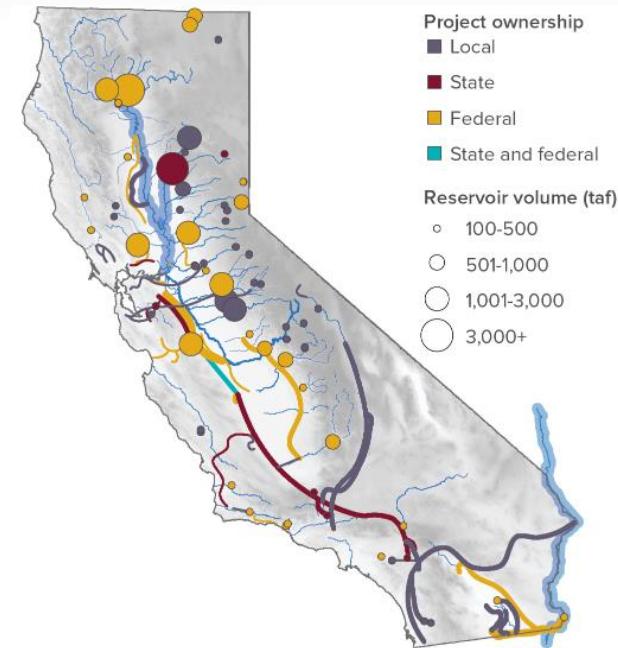
And a grid with conveyance



Rainfall



Groundwater



Grid

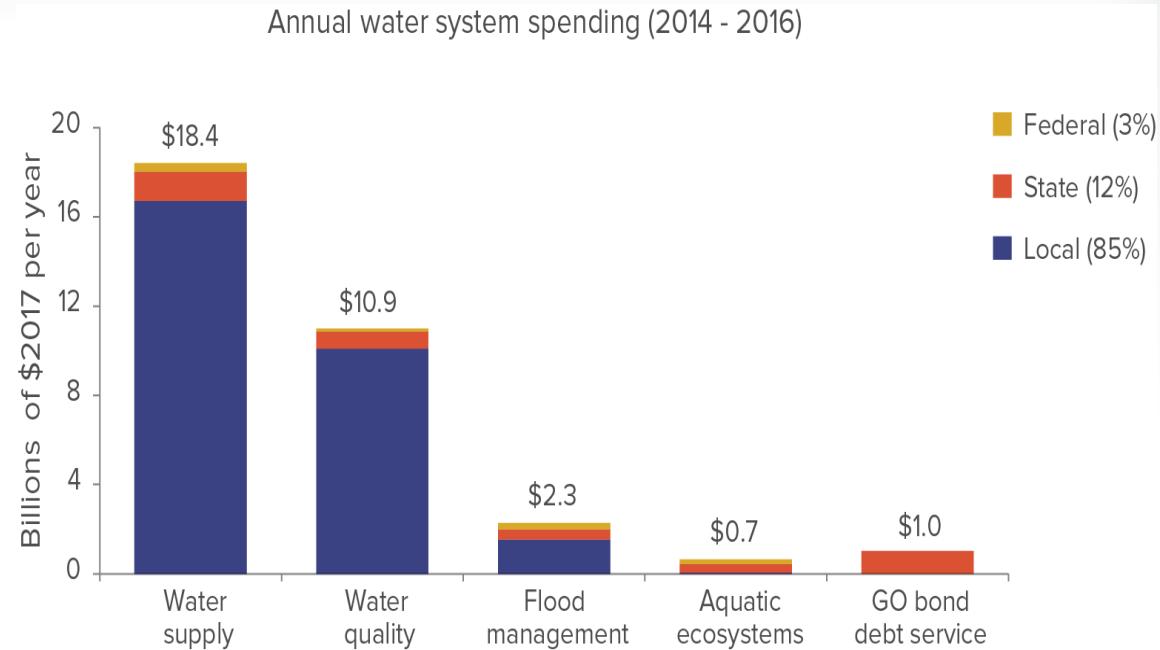
And allocation and trading

- Century-old water rights system specifically designed for scarcity
 - First in time, first in right
 - No waste or unreasonable use
 - Use it or lose it
 - And a whole lot more...
- Water markets and trading



And reliable funding

- Reliable sources of funding are crucial
- Ratepayers the most abundant source
- But there are many fiscal orphans
 - Poor rural communities
 - Flood protection
 - Ecosystems



Looking out over the horizon: impacts of changing climate and population on supply reliability



Sierra snowpack during and after drought



Five climate pressures—reflected in recent drought--will directly or indirectly impact water management



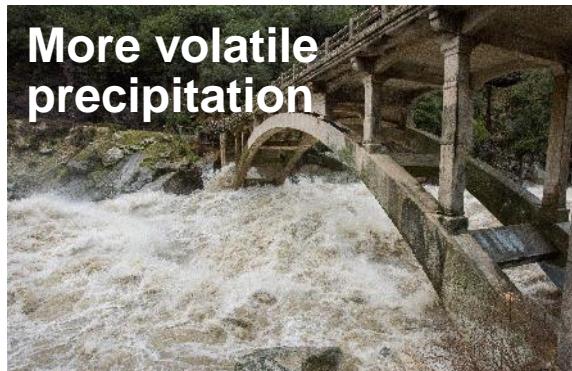
Warming temperatures



Shrinking snowpack



Shorter wet seasons

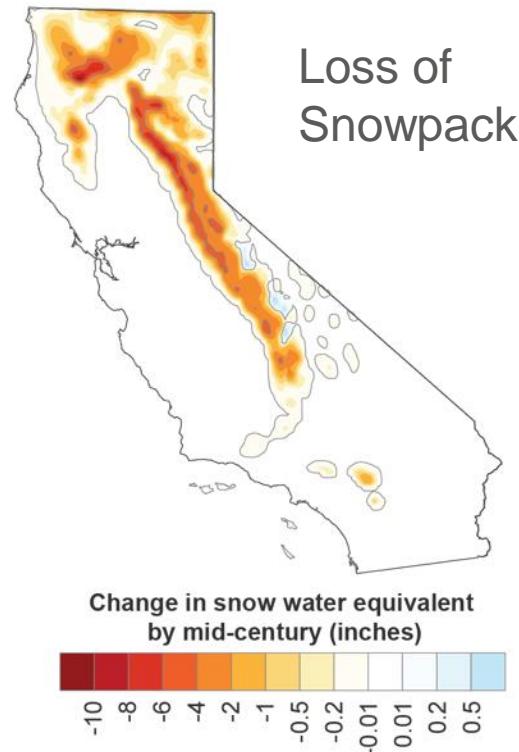
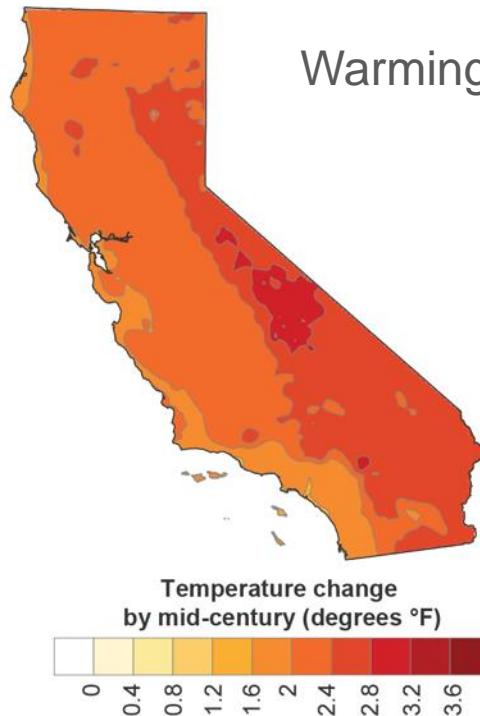


More volatile precipitation

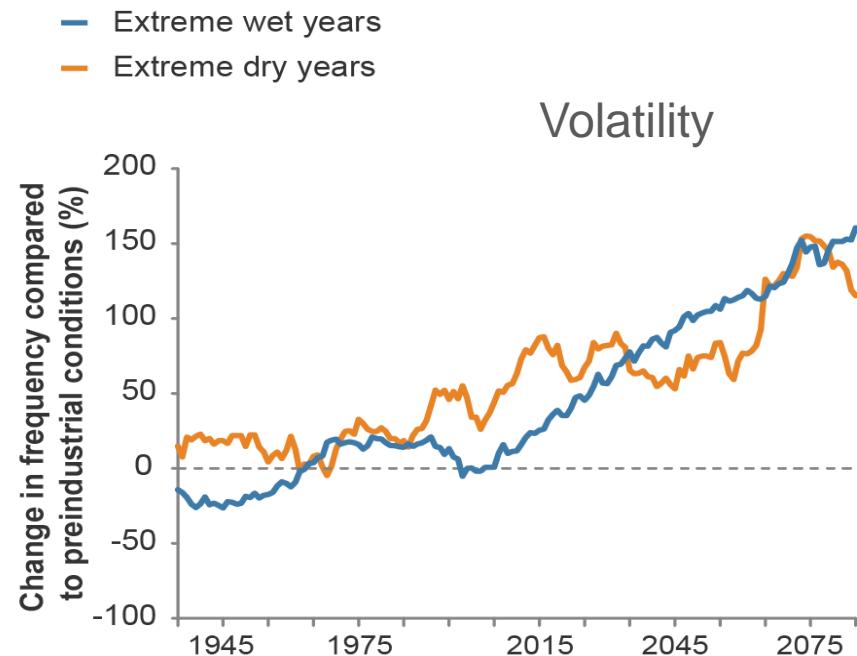
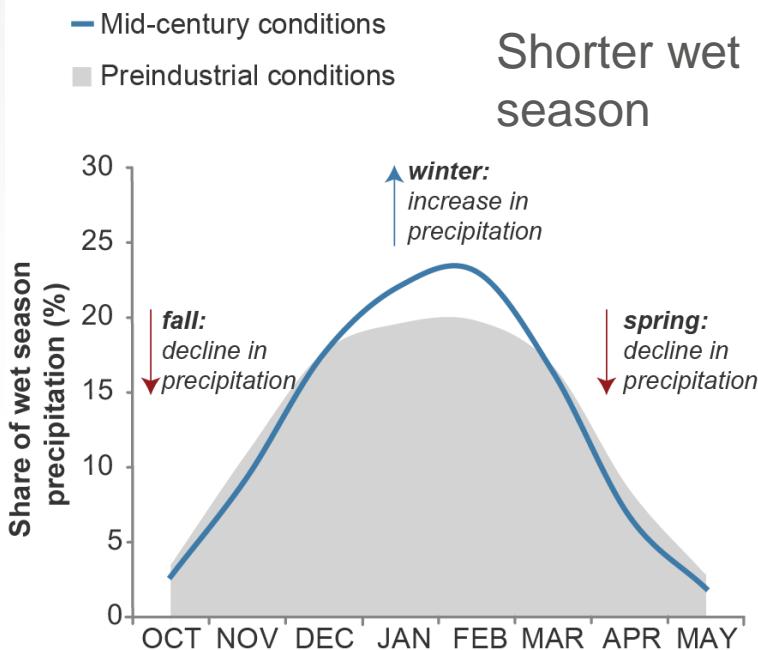


Rising seas

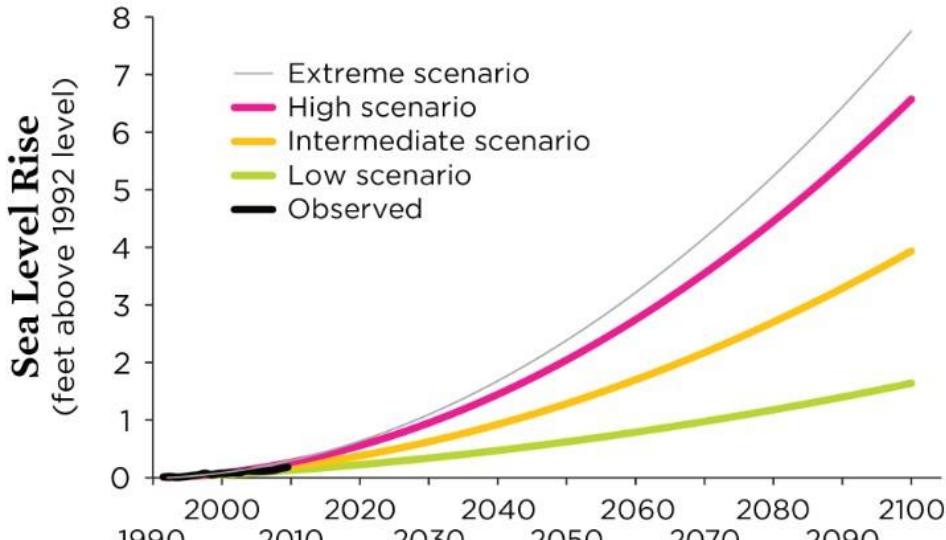
California is warming and snowpack is changing



Shorter wet season and increasing volatility



Continued sea level rise



UNION OF CONCERNED SCIENTISTS

- All five pressures interact to decrease reliability of supply
- Primary adaptation tool is changing operations and upgrading the water grid
- But even in the best case scenario, this points to increasing water scarcity for farms, cities and the environment.

Sea level rise impacts coastal aquifers and Delta



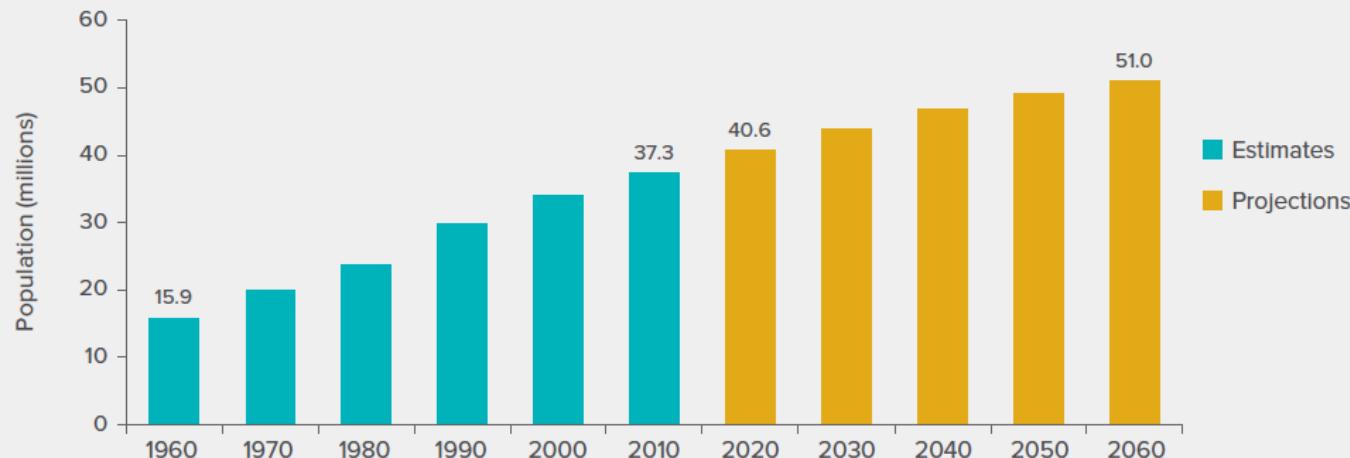
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Population growth will create more pressure

CALIFORNIA'S POPULATION WILL CONTINUE TO GROW

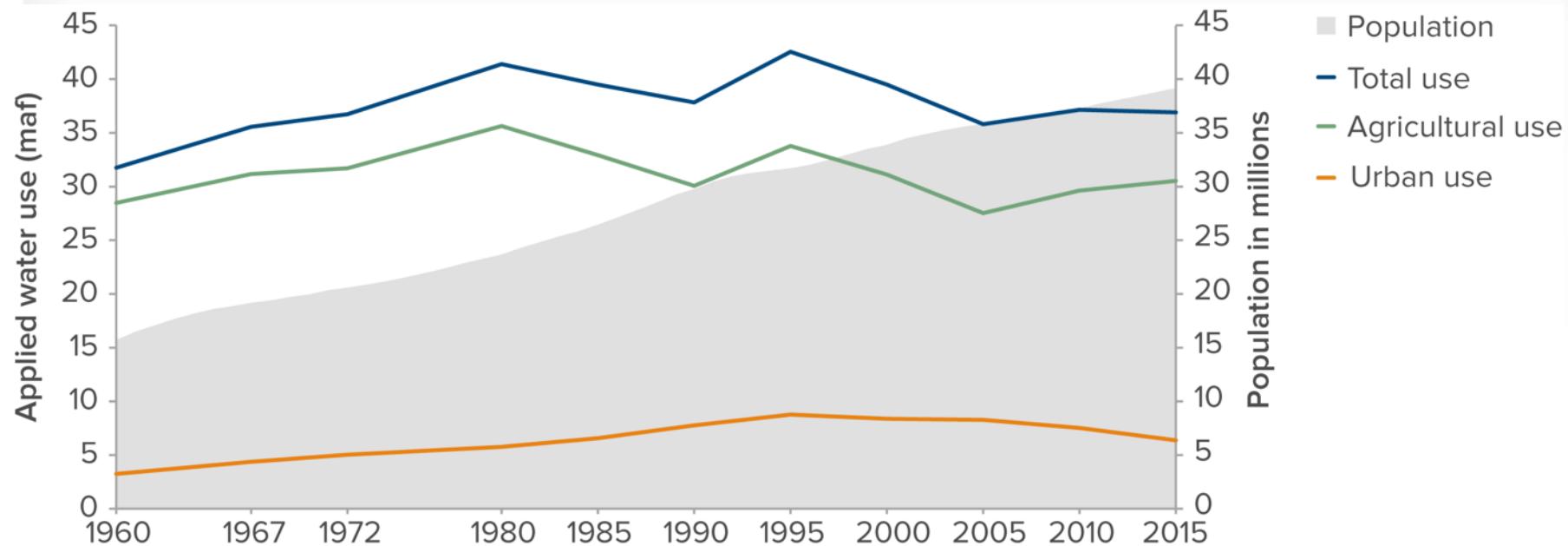


SOURCE: California Department of Finance estimates and 2016 projection series.

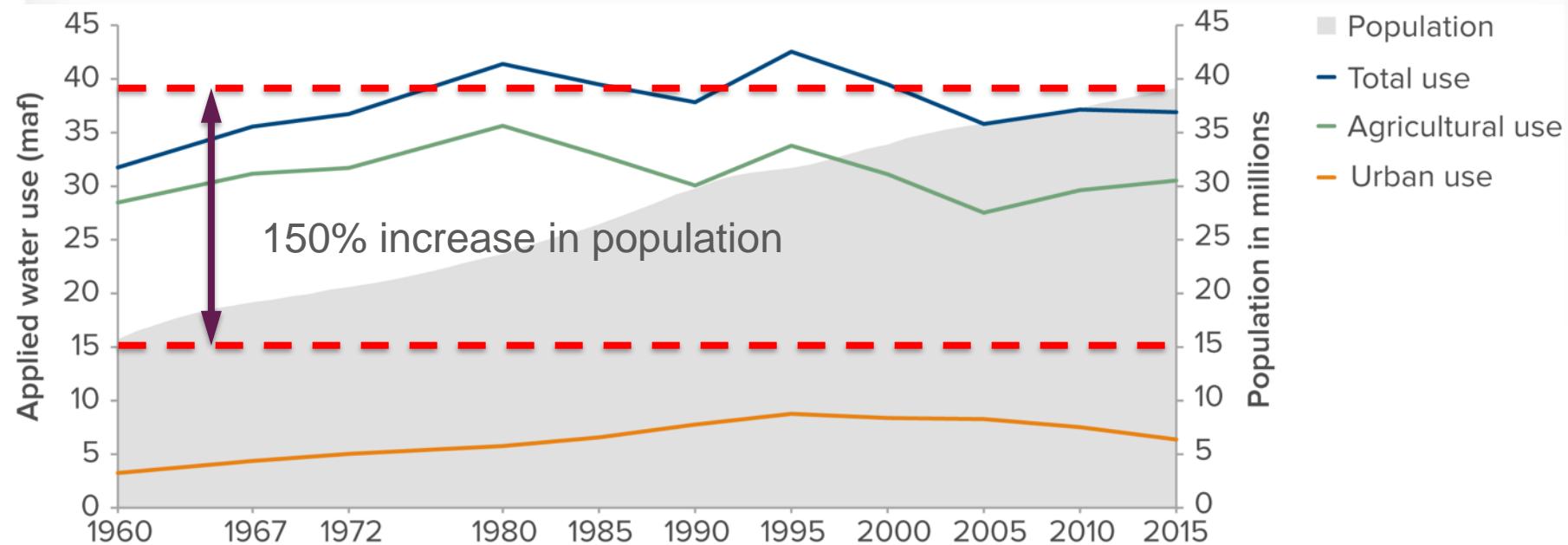
NOTE: Population as of July of each year.



But even with growth, we can adapt...



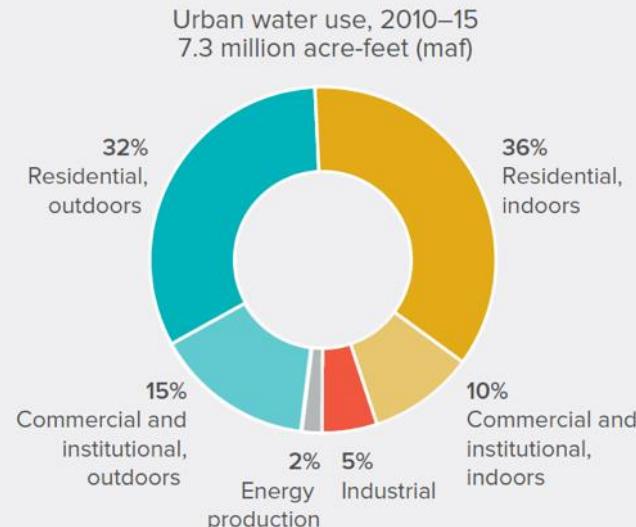
But even with growth, we can adapt...



Key Takeaways about Future Supplies

- 1) Locations that can tap into the statewide grid are likely to have the most secure supplies
- 2) Groundwater-only is high risk
- 3) Urban areas with a diverse portfolio of sources are best
- 4) Climate change and population growth will increase scarcity and related costs
- 5) But based on experience there will be useful adaptation

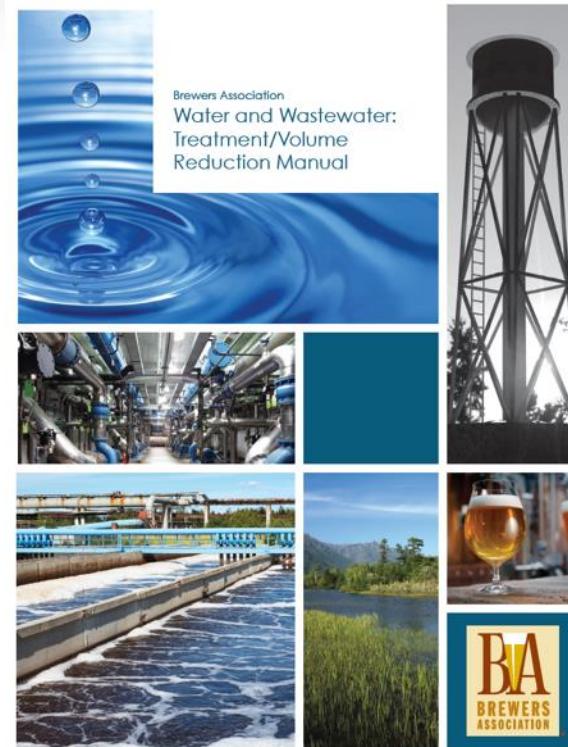
LANDSCAPING IS ROUGHLY HALF OF TOTAL URBAN WATER USE



SOURCE: California Department of Water Resources.

Wastewater treatment challenges lie ahead

- Significant current costs associated with:
 - TSS
 - BOD
 - Total discharge
- Every indication that these costs will increase in the future
- And there are likely to be some surprises



Wastewater Treatment Pressures

- Increasing demand for recycled water
- Increasing concentration of waste streams
- Changing water quality standards, including contaminants of emerging concerns
- Increasing demand for environmental flows
- Aging infrastructure and changing climate (rising sea level)



25 YEARS

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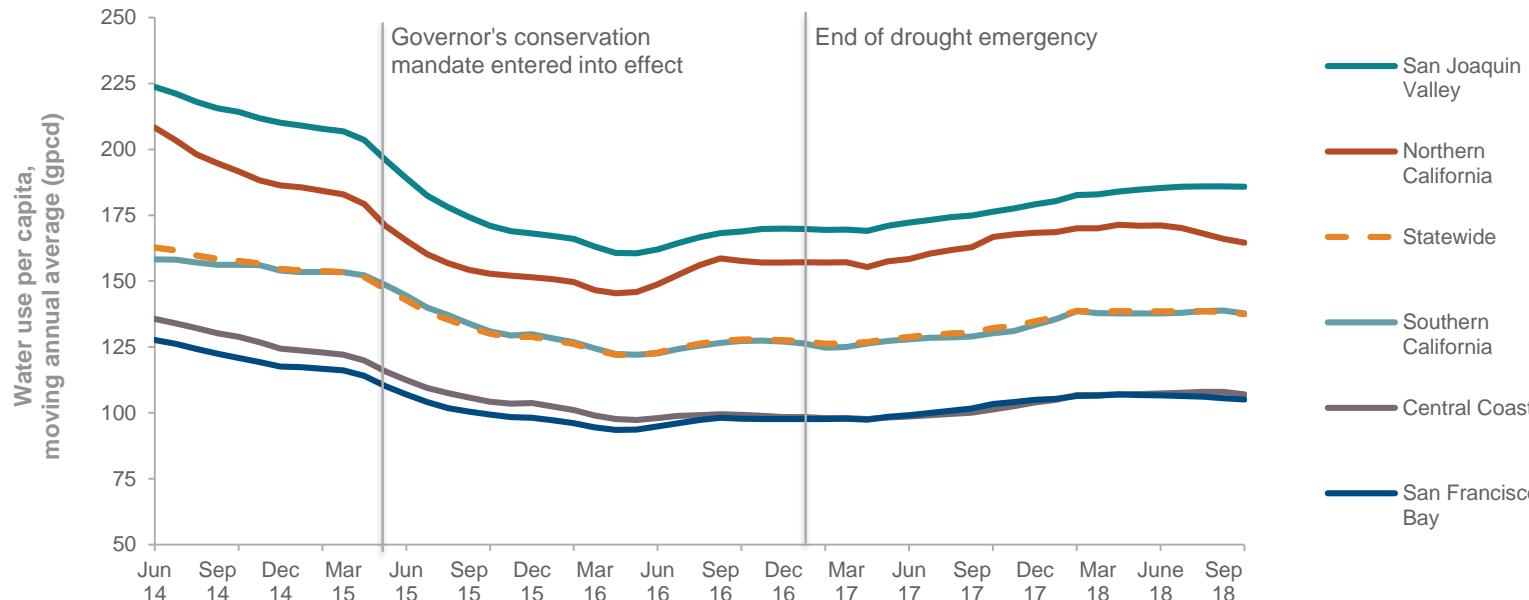
*Supported with funding
from the California
Association of Sanitation
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Managing Wastewater in a Changing Climate

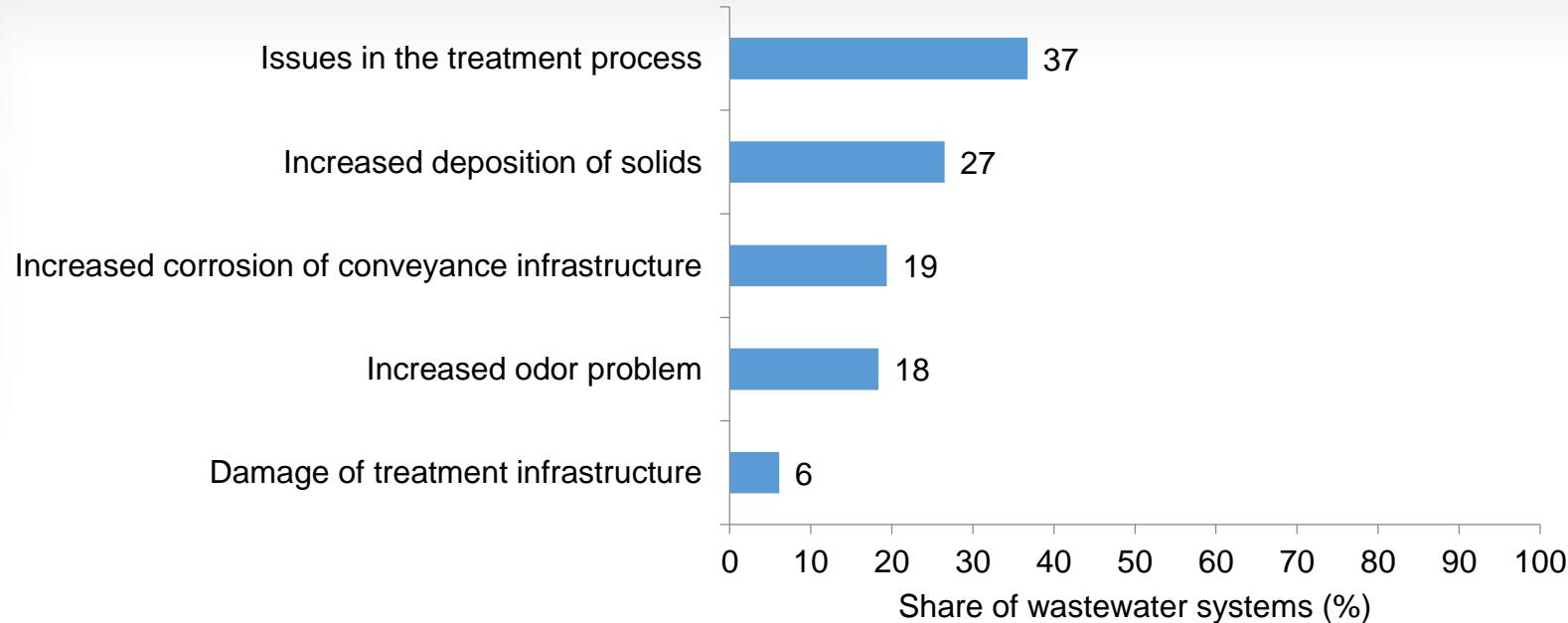


Urban water use during drought

Scarcity translates to conservation and reduced wastewater streams



Wastewater agencies experienced problems with infrastructure and operations during the drought



N = 98

This all occurred when demand for recycled wastewater was rapidly increasing

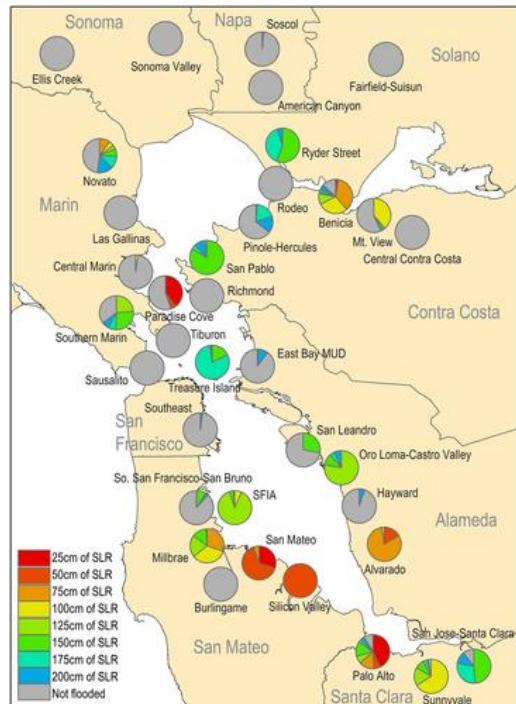
Increasing demand for environmental flows



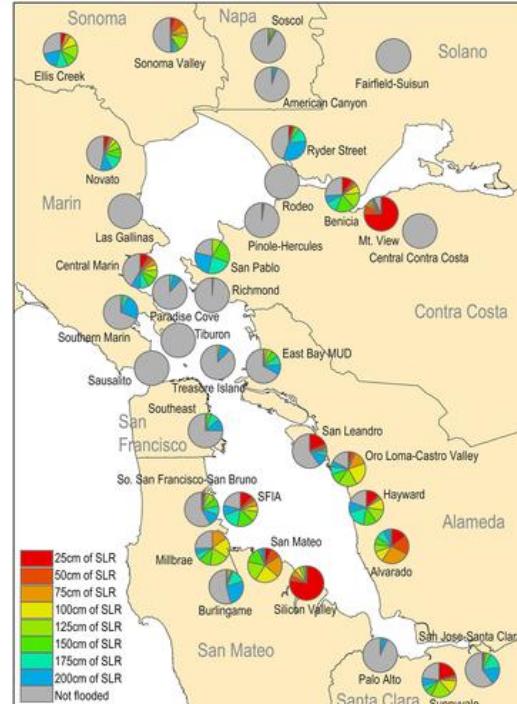
Source: Upper Santa Ana River Habitat Conservation Plan

Sea level rise a major problem for treatment plants: Example of potential flooding in SF Bay Area

Treatment Plants at Risk from Ocean Flooding



Treatment Plants at Risk from Groundwater Flooding



Source: Hummel et al., 2018



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Key Takeaways about Future Wastewater Treatment

Typical Ranges Of Brewery Untreated “End-Of-Pipe” Wastewater Effluent

PARAMETER	TYPICAL RANGE
Water to beer ratio	4 - 10 liter/liter
Wastewater to beer ratio	1. 3 - 2 liter/liter lower than water to beer ratio
Biochemical Oxygen Demand (BOD)	600 - 5,000 ppm
Chemical Oxygen Demand (COD)	1,800 – 5,500 ppm
Nitrogen	30 - 100 ppm
Phosphorus	30 - 100 ppm
pH	3 - 12
Total Suspended Solids (TSS)	200 – 1,500 ppm

Source: Brewer's Association

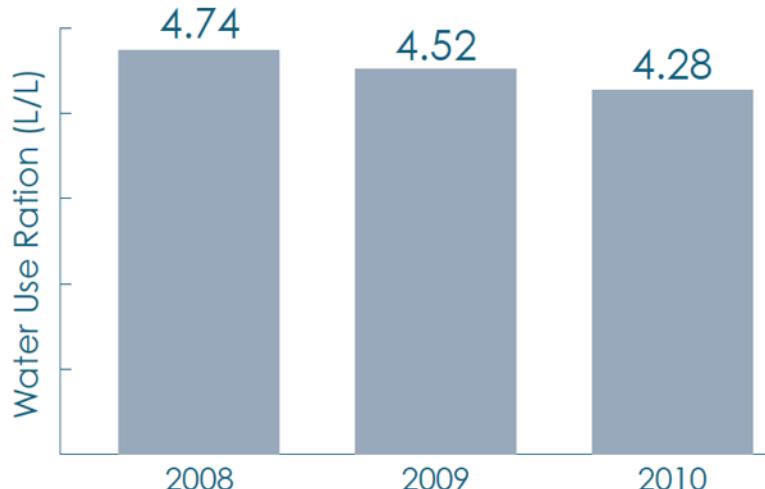
- Larger, newer facilities better able to handle wastewater load
- Expect increasing costs for treatment due to higher facility costs and new regs
- Build into planning that growth will eventually lead to increased demand for on-site treatment of BOD, TSS and total discharge
- Recycling helps with sustainability goals, but...

Finally, how much water are you using?

- Important to understand “applied” vs “consumptive” or “net” use
- Assume for every 5 bbl water, 1 bbl beer, 3 bbl discharge.
- Net on-site water use is < 2 bbl water/1 bbl beer
- Really matters where it goes from there
- And how much “product” gets recycled back into system (?)

BIER Water Use Ratios

N=211
Range (2010) - 3.26 - 7.44 L/L
Improvement = 10%



Finally, how much are you using?

- According to Tom M., **3,421,295** barrels produced in 2018
- Applied water use: 17 M bbl or 536 M gal water
- Assume 7 M bbl or 221 M gal onsite net usage
- Assume 10 M bbl or 315 M gallons of wastewater discharge. Some net, some reused.
- *It all depends on where you are. Also whether you recycle on-site.*



How do you compare with other applied use?

- Some useful examples:
 - about .04% compared to the almond industry (USDA figures)
 - 853,000 hamburgers (European Commission) which is < 4 hours of hamburger production by McDonalds (Financial Times)
 - annual water use of 10,000 southern Californians (150 gal/day) or about 1/4th of Davis' water use



Finally, how do you compare?

BUT if you count hops and barley

- According to Tom M, 55 lbs of barley and 1.3 lbs hops/barrel = 96,310 tons
- Yields/acre = 1 ton; water use = 2 acre-ft/acre (UC Extension)
- 192,620 acre-feet of water to grow hops and barley
- When combined with use on-site, enough water for 1.2 million southern Californians.*
- Watch out for marijuana-infused beer. Could be a big footprint.



Summary of Takeaways

- 1) Do your homework on supply. Grid-connected, large, diversified urban areas do the best. Small, groundwater-dependent rural areas the worst.
- 2) Plan on escalating costs for wastewater treatment, including a mandate for on-site treatment.
- 3) Your industry uses a LOT of water for hops and barley (imported), but a very small amount for production.



Thanks. No, really, I mean it. Thanks.



Photo C. Jeffres

About these slides

These slides were created to accompany a presentation. They do not include full documentation of sources, data samples, methods, and interpretations. To avoid misinterpretations, please contact:

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Thank you for your interest in this work.