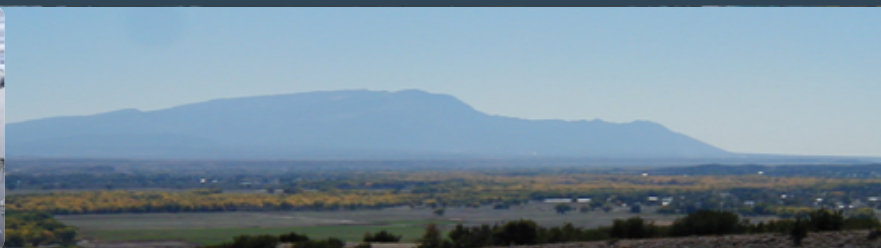




The Energy Water Nexus



PRESENTED BY Tom Lowry, Sandia National Laboratories
I-WEST
June 14, 2022



Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Objective

- Introduce the Energy-Water nexus - what is it and why should we care?
- Develop an understanding for the “interconnectedness” of water to everything else
- Lay the foundation for further dialogue in this workshop and beyond



Key Points

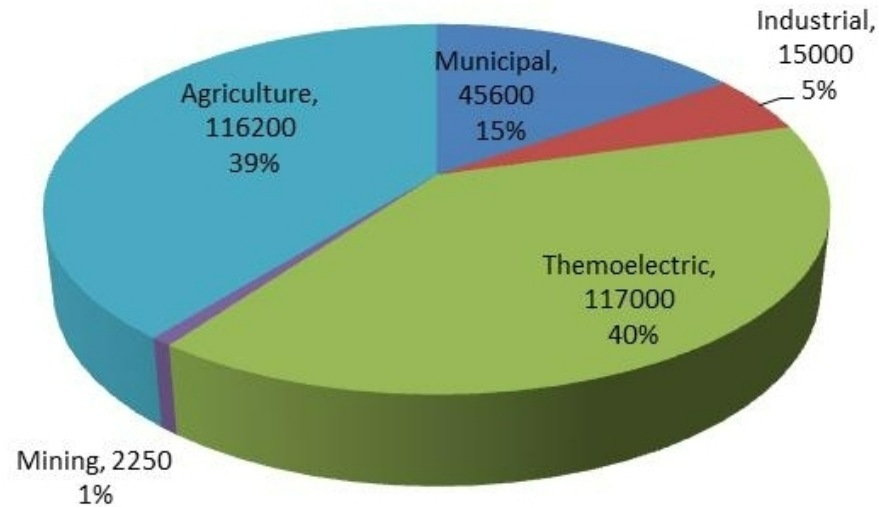
- Energy-Water-Climate issues are affecting energy production today
- Without attention these issues will intensify
- Moderating impacts requires adaptation
 - Changing energy portfolios
 - Changing water portfolios
- A carbon neutral future needs a systems perspective to limit unintended consequences to E-W, the environment, other infrastructure, and humans (social equality and justice)
 - All these systems are linked with multiple feedback loops



Lake Powell, 6/10/2022

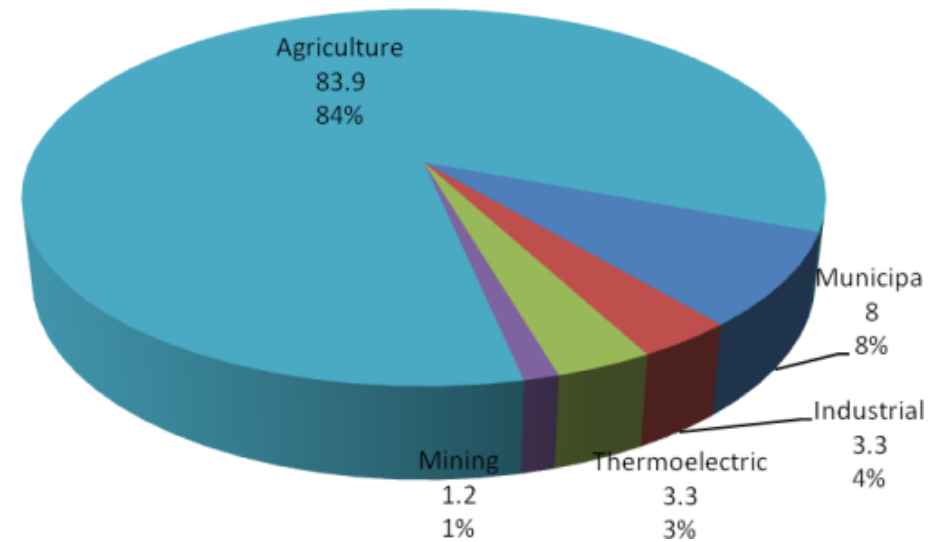
Water for Energy

Water Withdrawal (BGD)



Source: USGS 1995, 2014

Water Consumption (BGD) 1995



Estimated at ~2.6 BGD consumed in mining and fuel processing

Energy for Water



Source: Wisconsin Department of Natural Resources 2014



Source: Green Prophet 2014

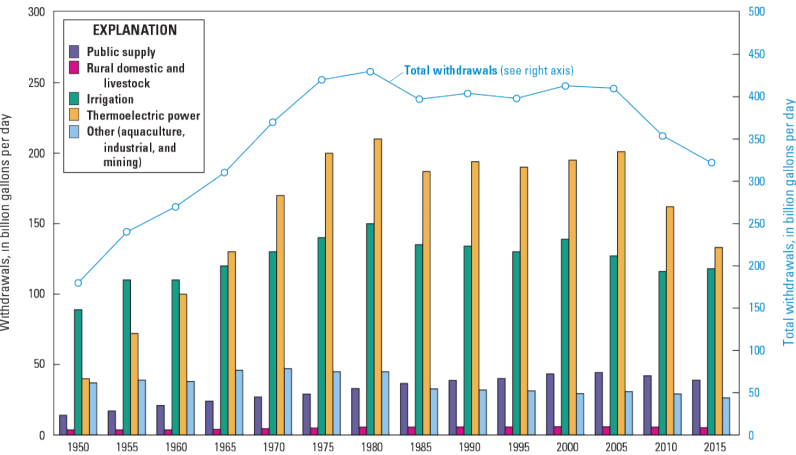
**Water Sector Represents 4-8% of
Total U.S. Energy Consumption**



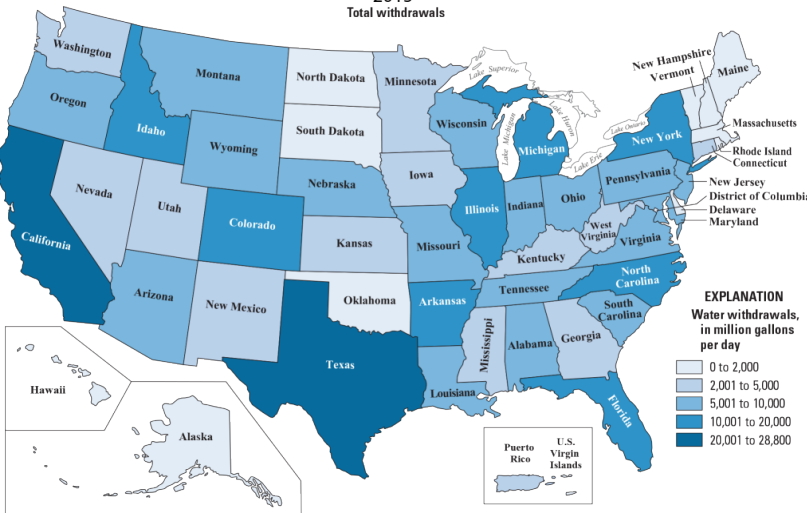
Source: Circle of Blue 2015

Water is Place-Based

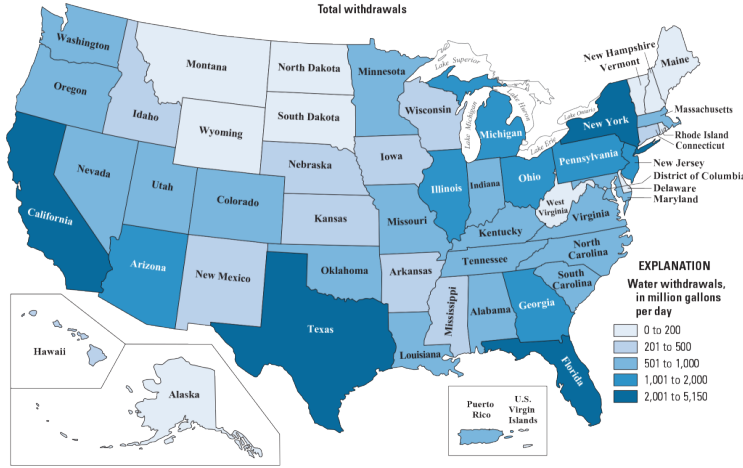
Trends in total water withdrawals by water-use category, 1950-2015



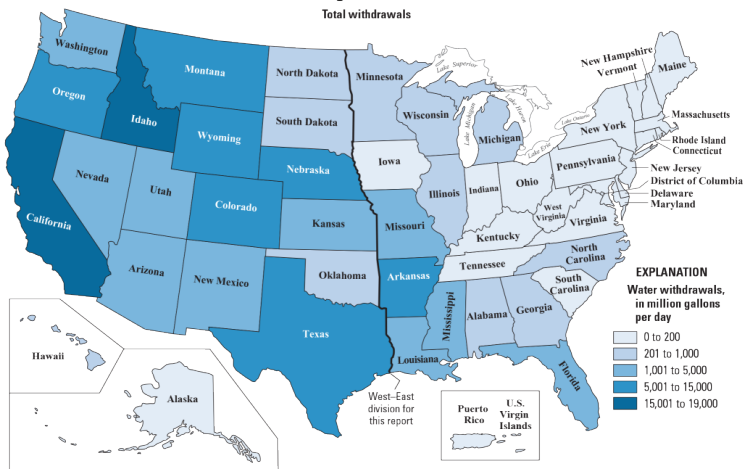
2015
Total withdrawals



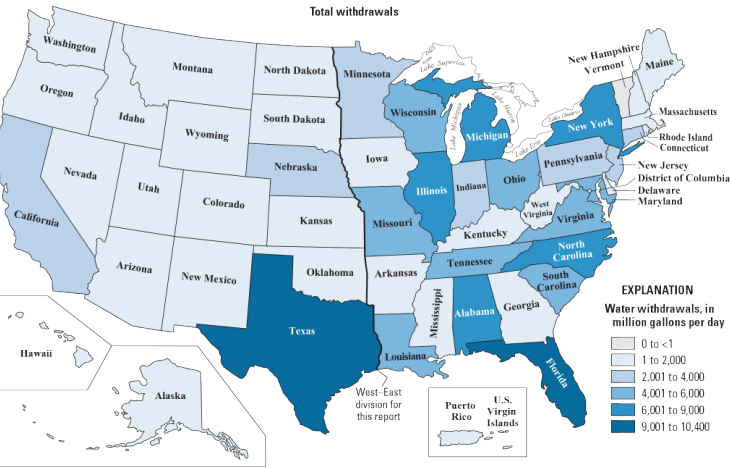
Public Supply 2015
Total withdrawals



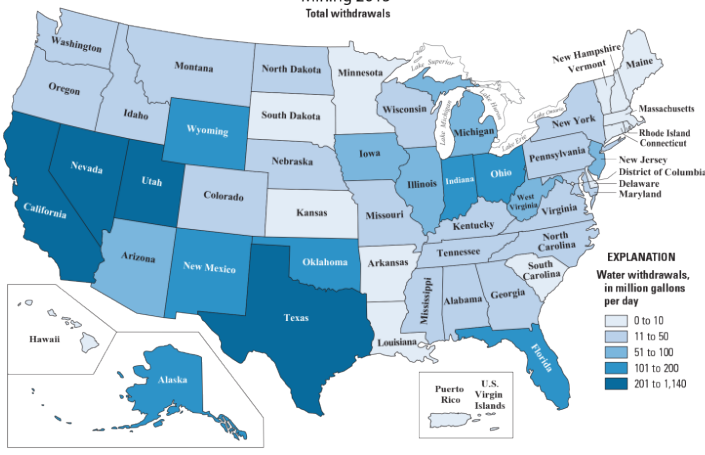
Irrigation 2015
Total withdrawals



Thermoelectric Power 2015
Total withdrawals



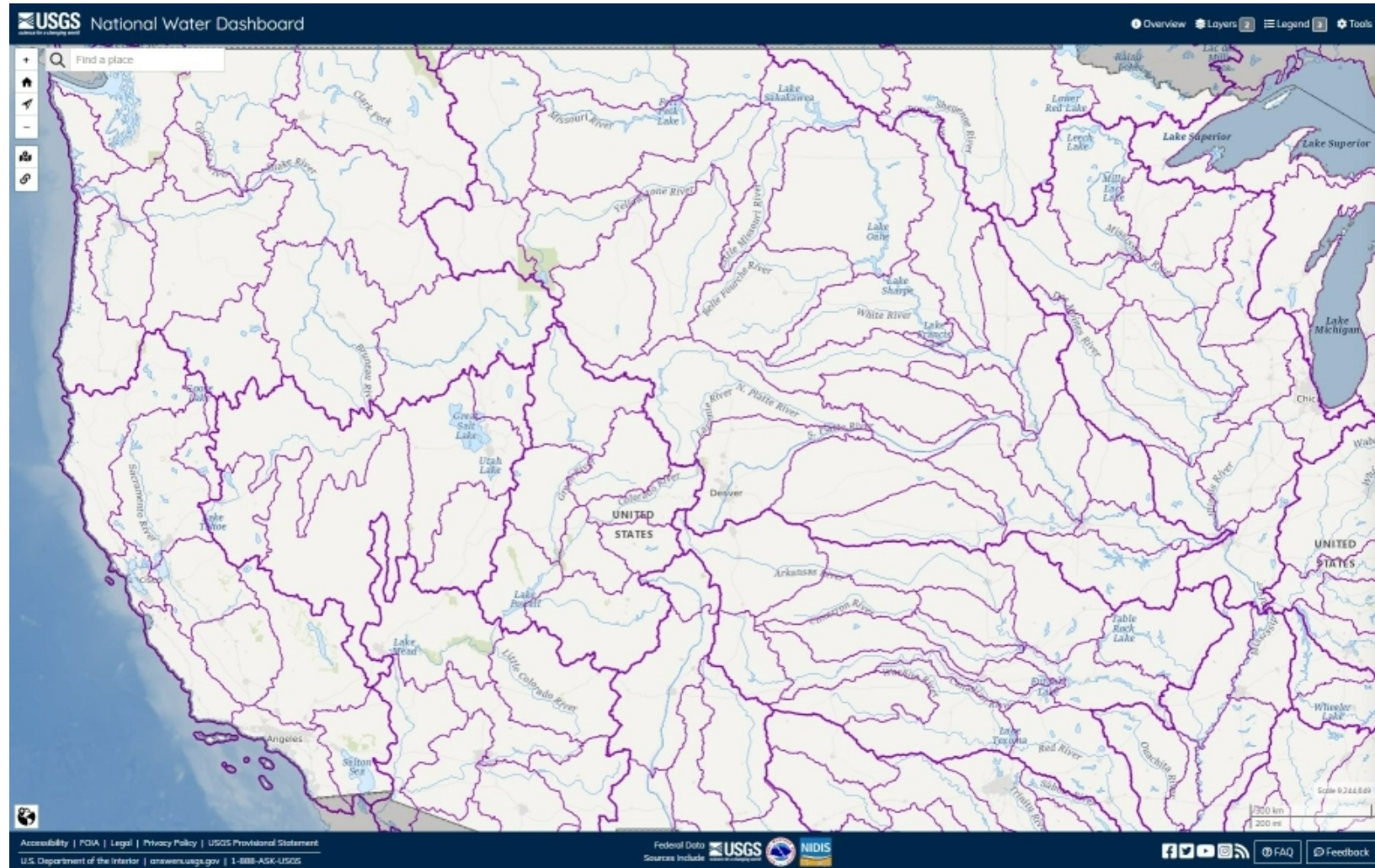
Mining 2015
Total withdrawals



Source: USGS

Water is Place-Based

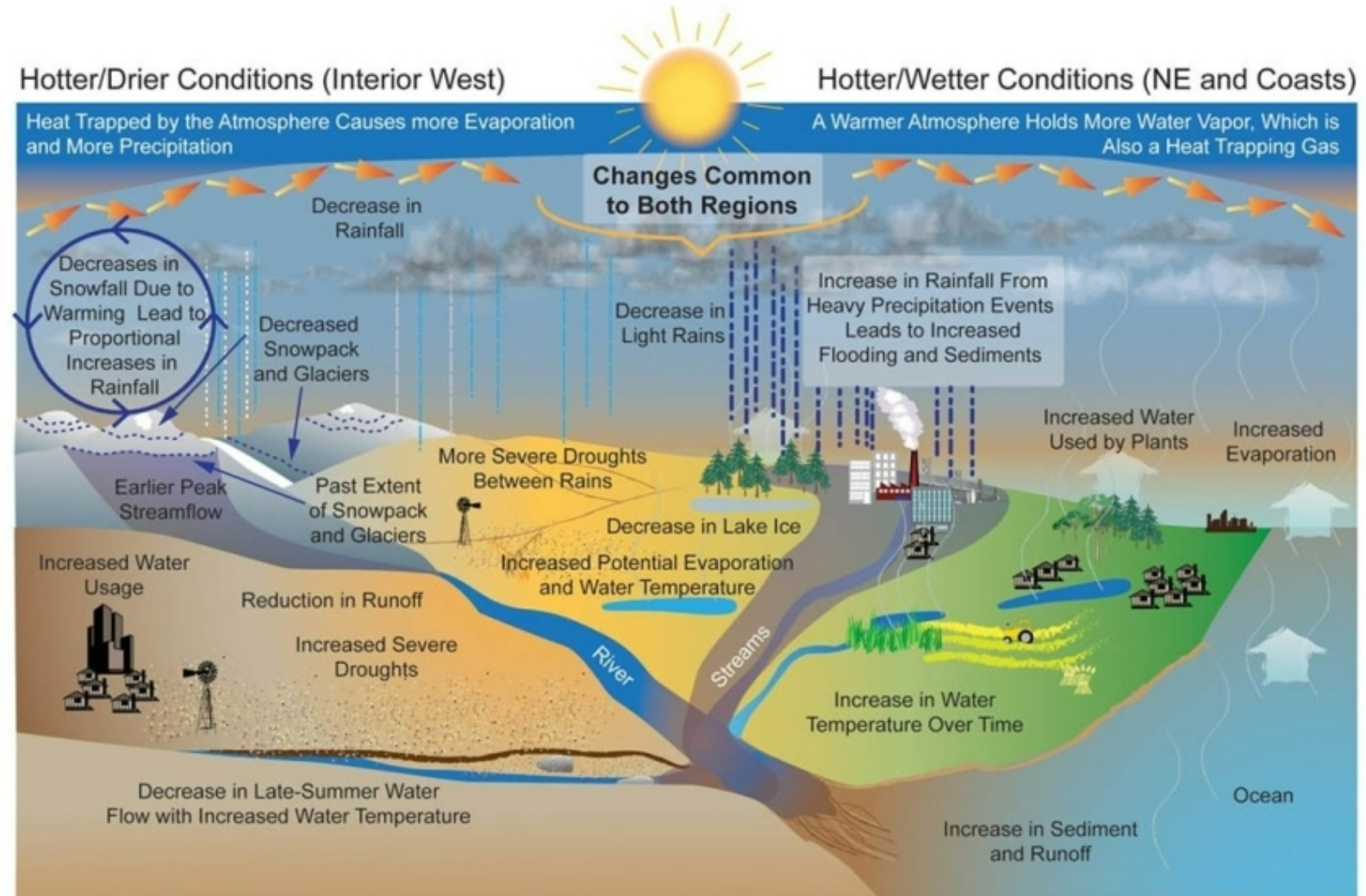
- Watersheds don't follow political boundaries
- Water management is hierarchical with day-to-day management done at the local scale (esp. groundwater)
- Water flows downhill ☺
 - My sewage is your supply
 - Competing interests



Energy-Water-Carbon

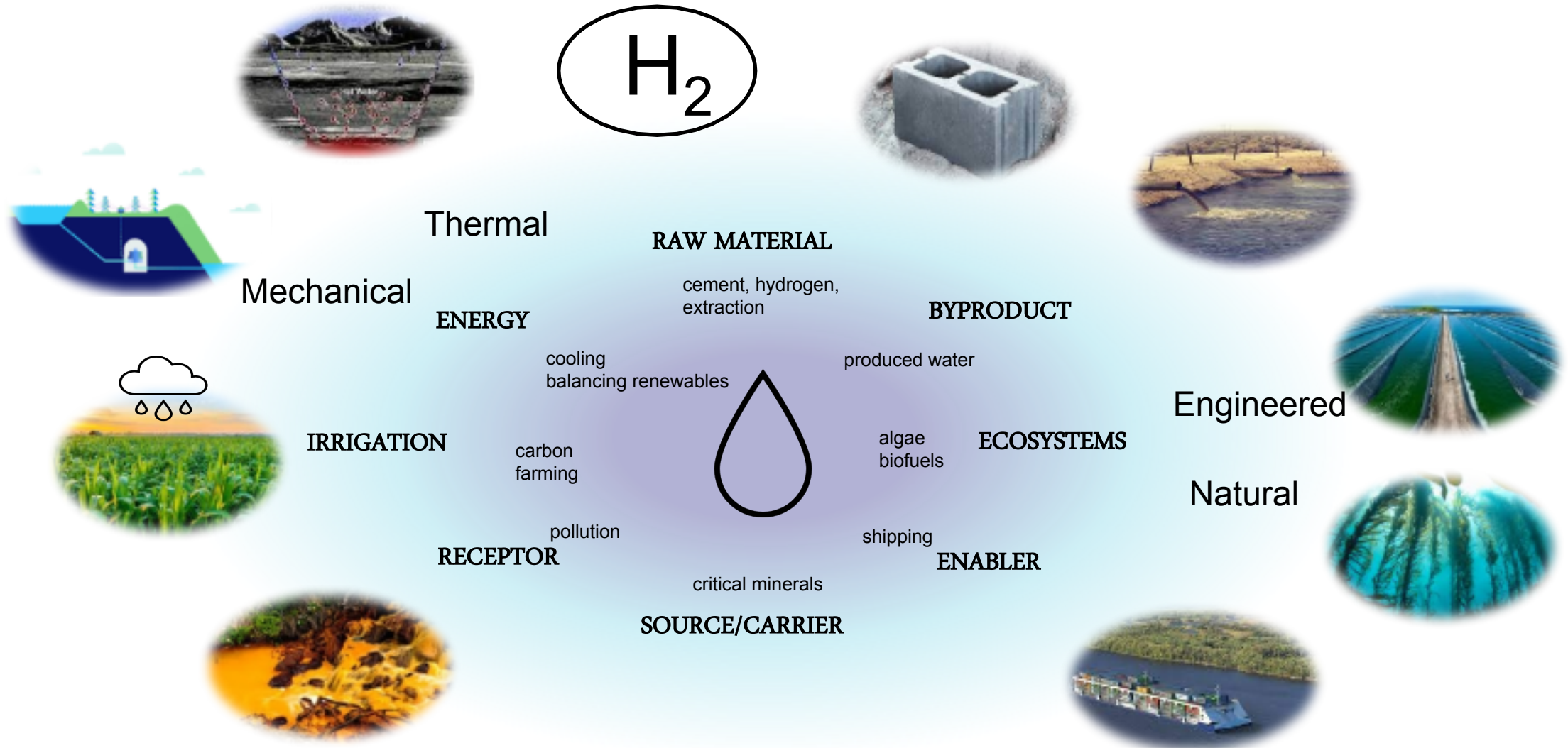
- Climate change manifests through changes in the hydrologic cycle – both supply and demand
- Water resources are expected to be at the forefront of climate impacts, with demand-supply gap expected to be up to 40% by 2030
- Emerging carbon-neutral technologies can further impact/influence these changing water resources

What is Water's Role in a Carbon Neutral Future?

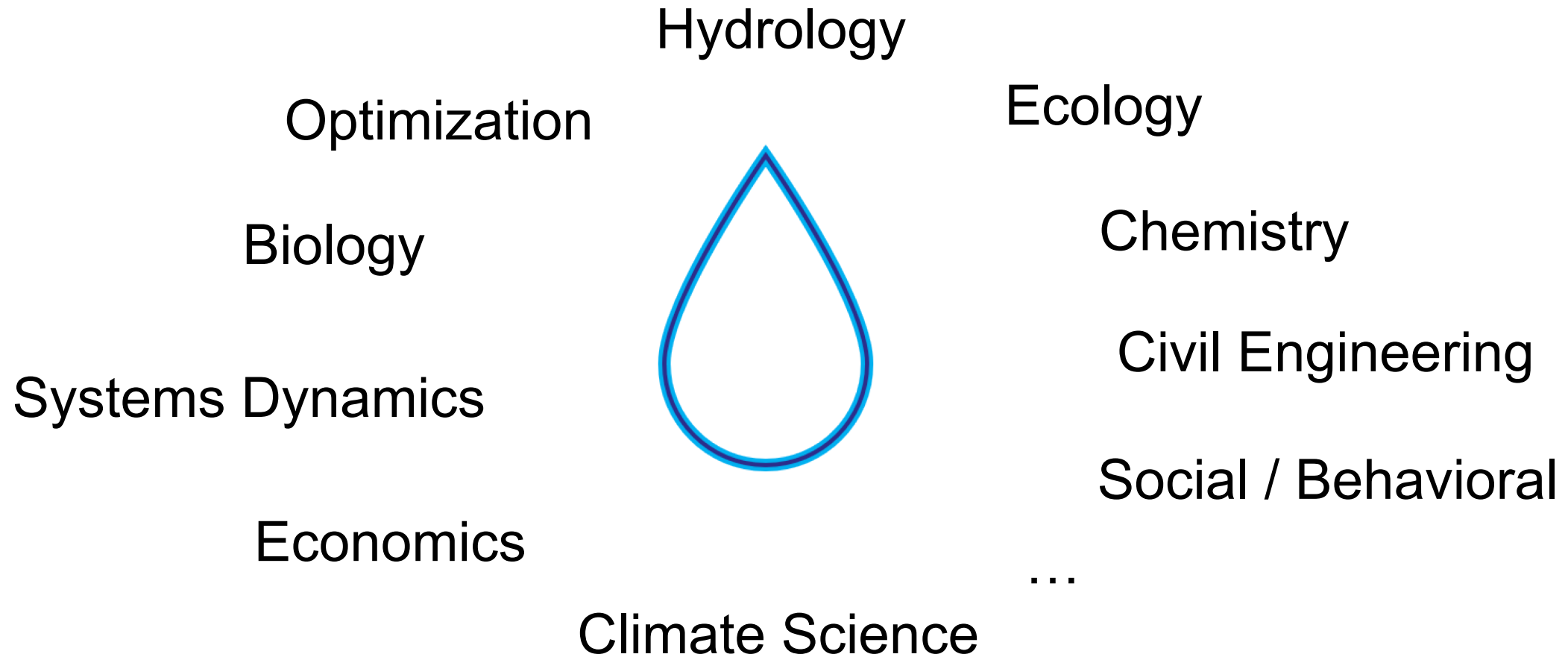


Source: [USGCRP 2009](#)

Water's Diverse Roles



The E-W-C Nexus is Interdisciplinary



Parting Questions

Energy: Are there issues with the **transfer or reallocation** of water that was previously used by natural gas/coal power plants to hydrogen production? Particularly in drought prone regions?

Energy, Industrial Decarb: What type of **infrastructure** is needed to support integration of desalination with hydrogen production?

Energy, Carbon Management: How can we **best manage produced brine/saline water treatment** to support disposal and beneficial use in support of carbon neutral activities?

Energy, Carbon Management: How is **uncertainty** (price, availability) of assumptions captured in water calculations? Are these non-stationary?

Cross-cutting: How do **assumptions in costs and prices** impact market feasibility analyses of these technologies?

Cross-cutting: How would water-energy-carbon nexus priorities and challenges (both technical and economic, such as financing) **vary by location**?

Thank You