

Water for Energy: Complex Data Requirements across Stakeholders

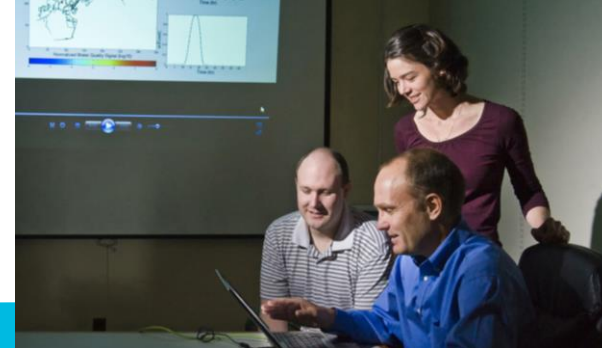
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 Sandia National Laboratories



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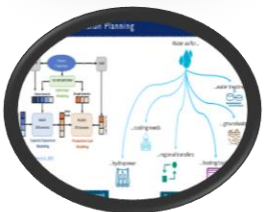




Background

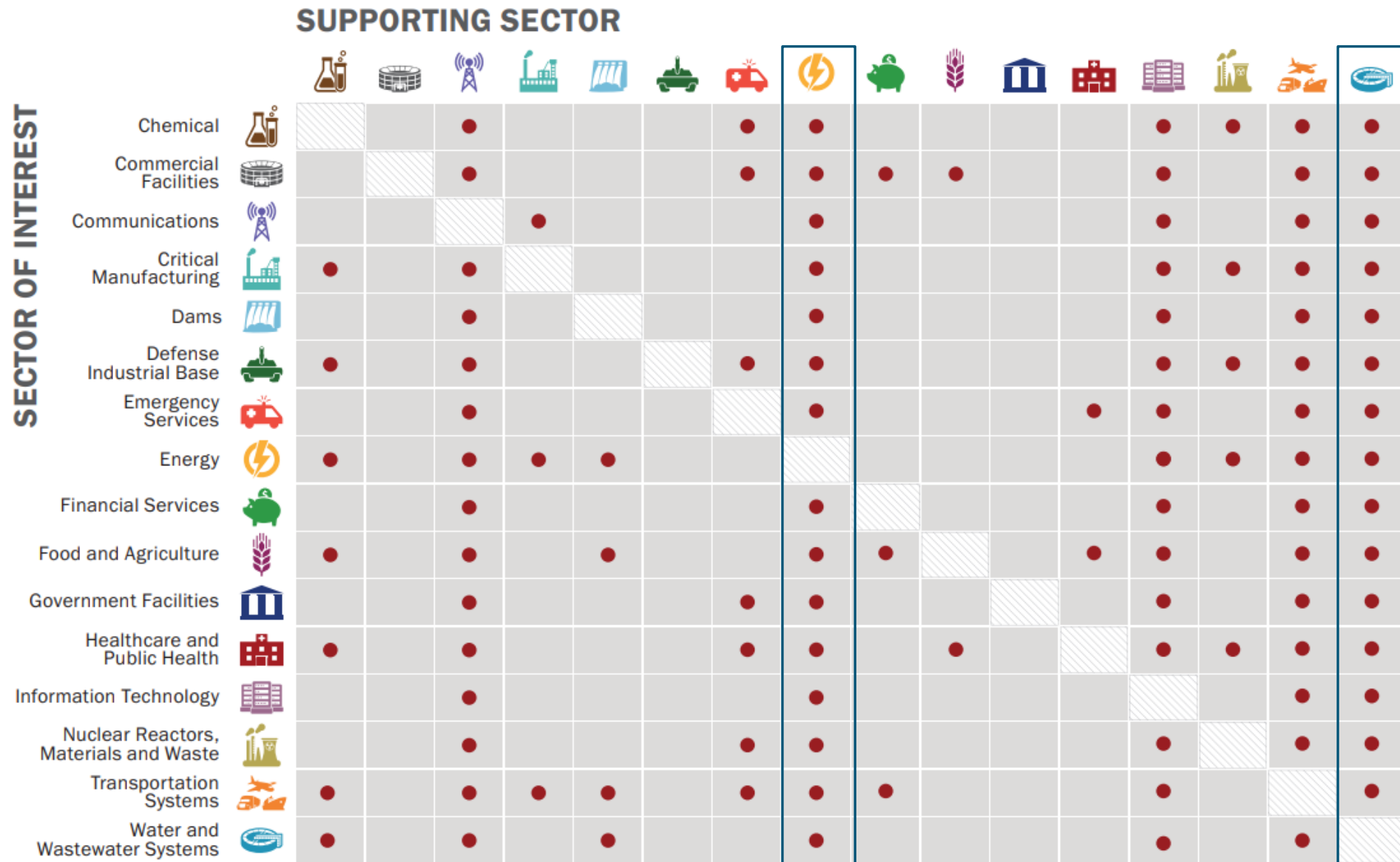


Water-Energy

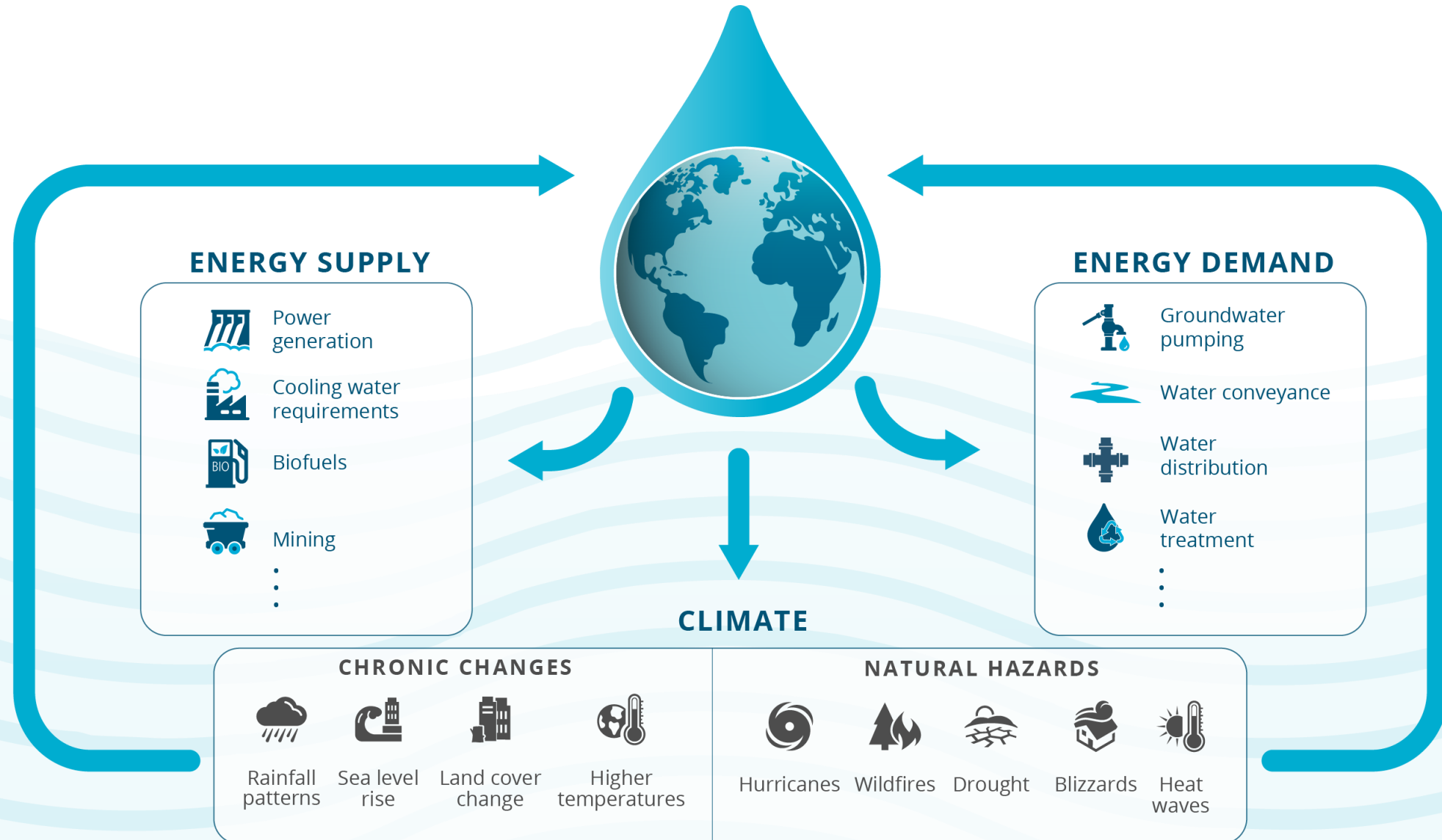


Ongoing Work

Central Role of Water for Critical Infrastructures



Source: [DHS CISA](#)

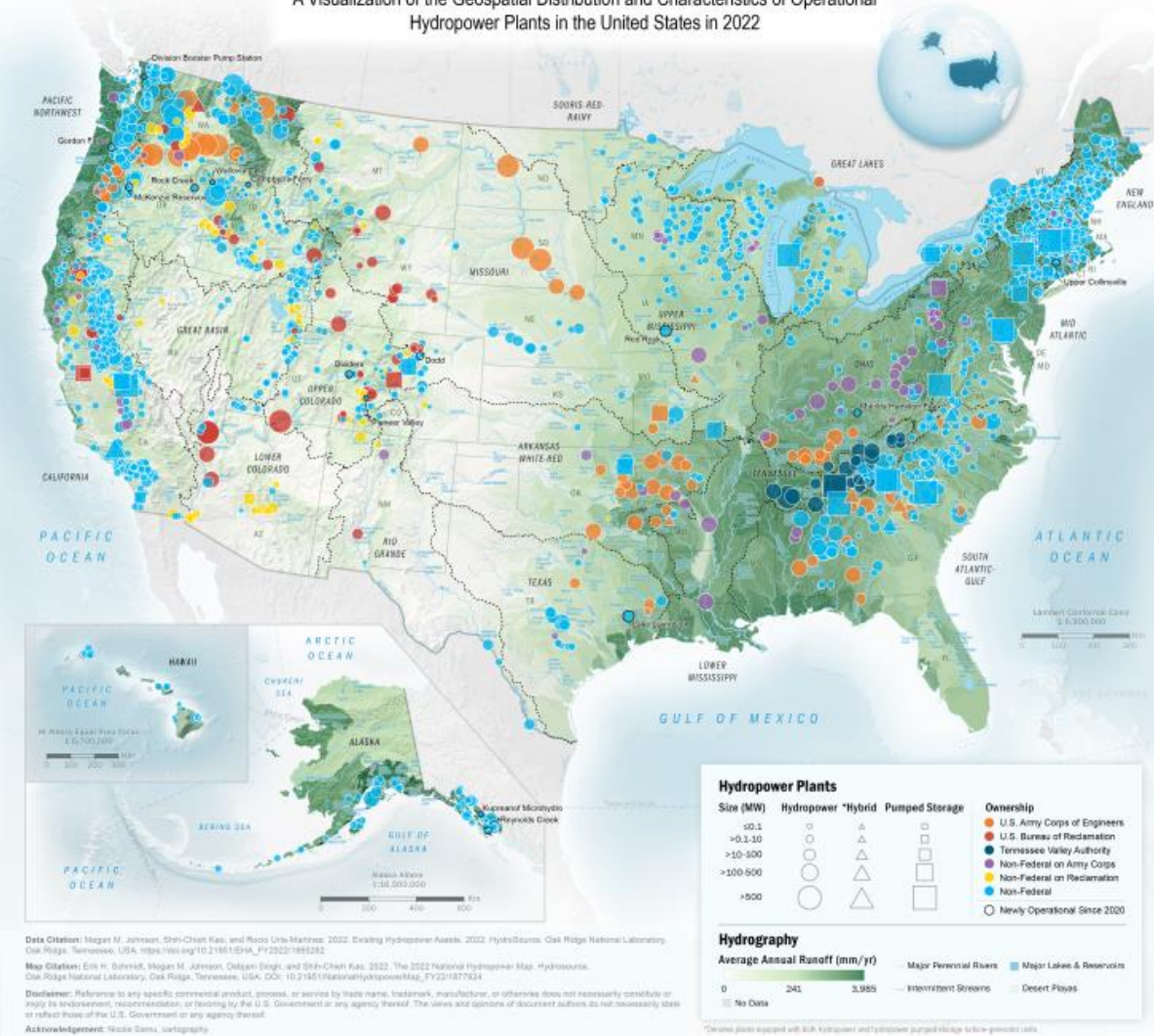


- Multiple dimensions of water influence energy activities in non-linear ways
- How much water is available at a given time and location?
 - (ER) Precipitation patterns
 - (RD) River management
- How do the energy-water connections influence the reliability of each systems?
 - (IR) Cooling system or feedstock needs for operations
 - (RD) Influences energy demand
- How does water influence reliability of energy?
 - (ER) Extreme events
 - (IR) Design priorities
- What type of data is of interest across the energy system?



The 2022 National Hydropower Map

A Visualization of the Geospatial Distribution and Characteristics of Operational Hydropower Plants in the United States in 2022

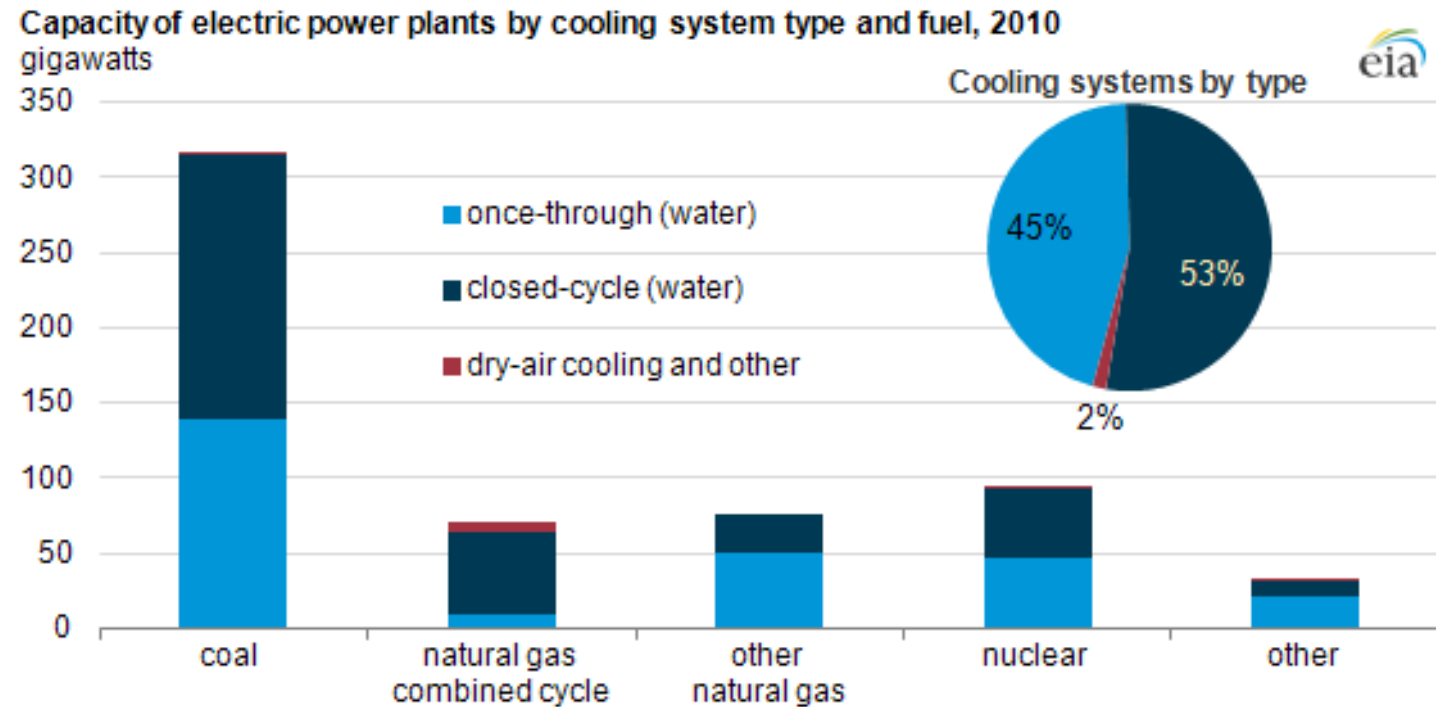


- Hydropower accounts for 28% of US renewable electricity generation (6% of total US electricity generation) ([EERE](#))
- Generation is strongly influenced by natural, built, and social factors:
 - Precipitation patterns
 - Streamflow volumes
 - Reservoir levels
 - Reservoir operations (e.g., flood control, environmental flows, irrigation releases)
- Some of these datasets are readily available while others are being actively developed
 - Hydropower plant database ([Johnson et al., 2024](#))
 - RectifHyd ([Turner et al., 2022](#))
 - Environmental flow requirements ([Cameron and Pracheil, 2022](#))

Thermo-Electric Cooling



- 70%+ of electricity in the US is from thermoelectric sources (e.g., coal, natural gas, and nuclear) ([EIA](#))
- Water withdrawals are primarily used to support cooling operations
- Water use is driven by:
 - Water availability and access
 - Cooling technology
 - Temperature of water
 - Species management
- Data nuances
 - Water withdrawal and consumption rates for cooling are collected annually ([EIA](#))
 - Owner-operator discussions reveal site-specific challenges and adaptations ([Tidwell et al., 2021](#))



The Mississippi River has dropped to a historic low for the second consecutive year



By Ritu Prasad, Eric Zerkel and Derek Van Dam, CNN

4 minute read · Updated 3:42 PM EDT, Wed October 11, 2023



Source: [Prasad et al., 2023](#)

Scientists develop technology to produce green hydrogen from seawater

IIT-Madras researchers have developed components for an alkaline water electrolyser that can use seawater directly to make green hydrogen. This is proposed as an alternative to the use of freshwater that is currently the key input for green hydrogen production.



Source: [Sinha, 2023](#)

BUSINESS | GERMANY

Tesla in Germany: Locals vote against factory expansion plan

02/20/2024

Residents of Grünheide near Berlin have voted against expansion plans for the large Tesla facility there. But the vote is not binding and local authorities can still decide. Turnout was high, though, indicating interest.



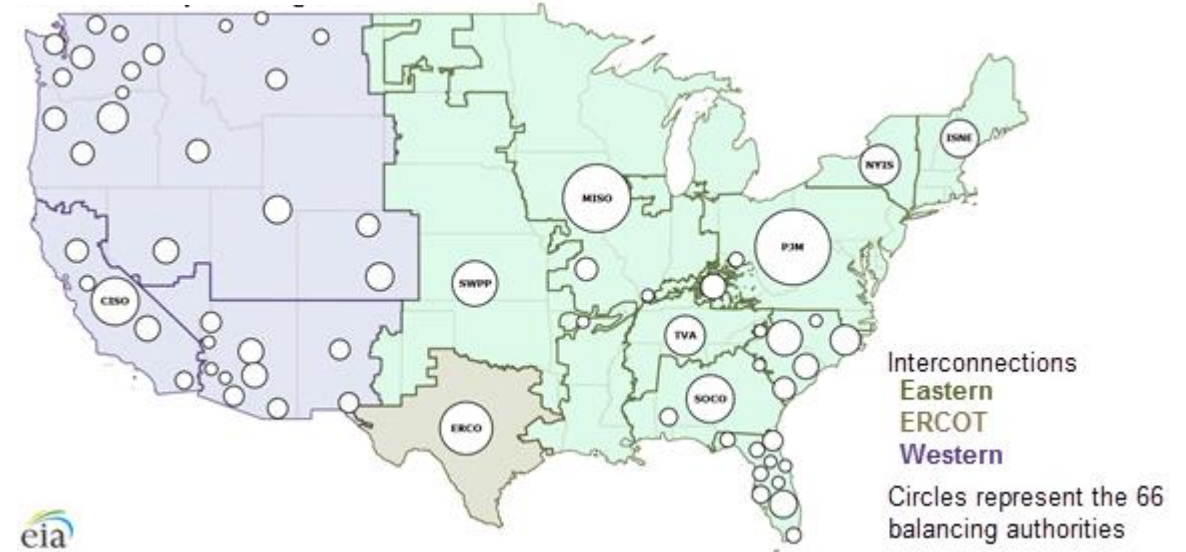
Source: [DW, 2024](#)

Grid and Transmission Planning

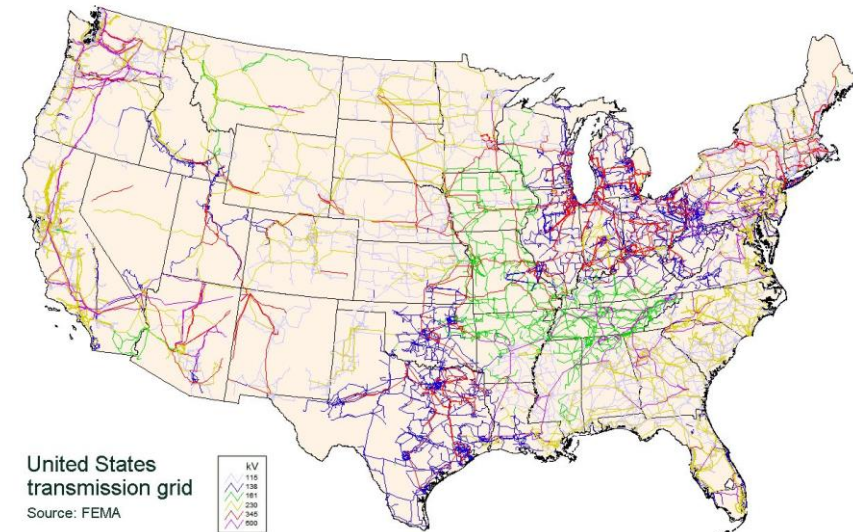


- How do you effectively support transmission planning?
 - Maintain reliability of current system
 - Facilitate transition for energy systems
- Datasets of interest
 - Distribution of technologies (current and future)
 - Water requirements for technologies (fixed, seasonal)
 - Local availability of water resources (to support build outs, etc.)
 - Regional connections
- Decisions influenced by stakeholders across scales:
 - Federal priorities
 - Interconnections
 - Balancing authorities
 - Utility-level (e.g., integrated resources planning)

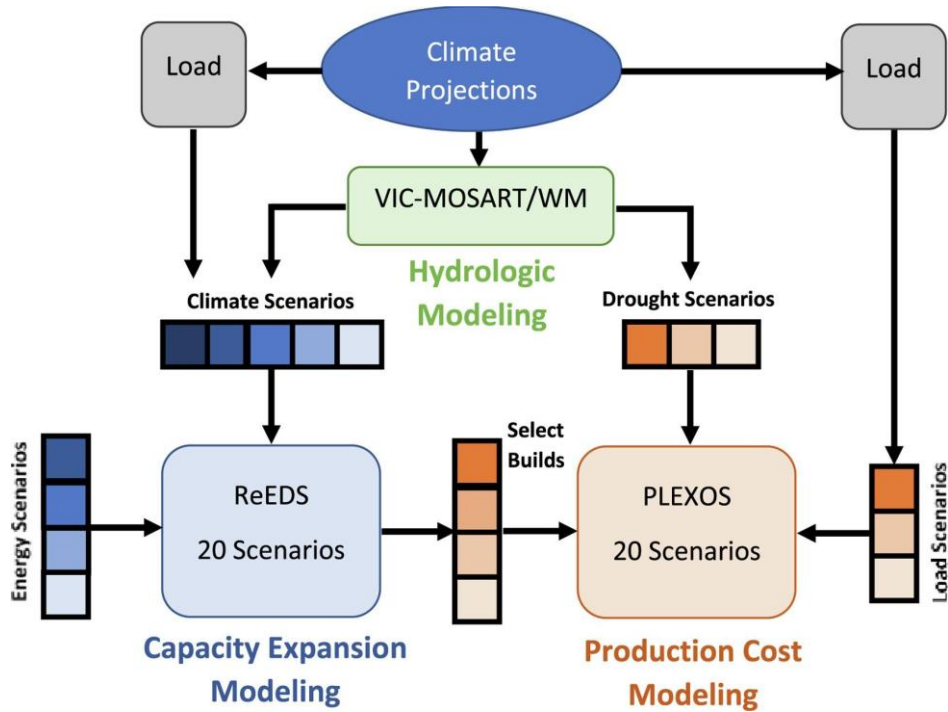
U.S. Electric Power Regions



Source: [EIA](#)

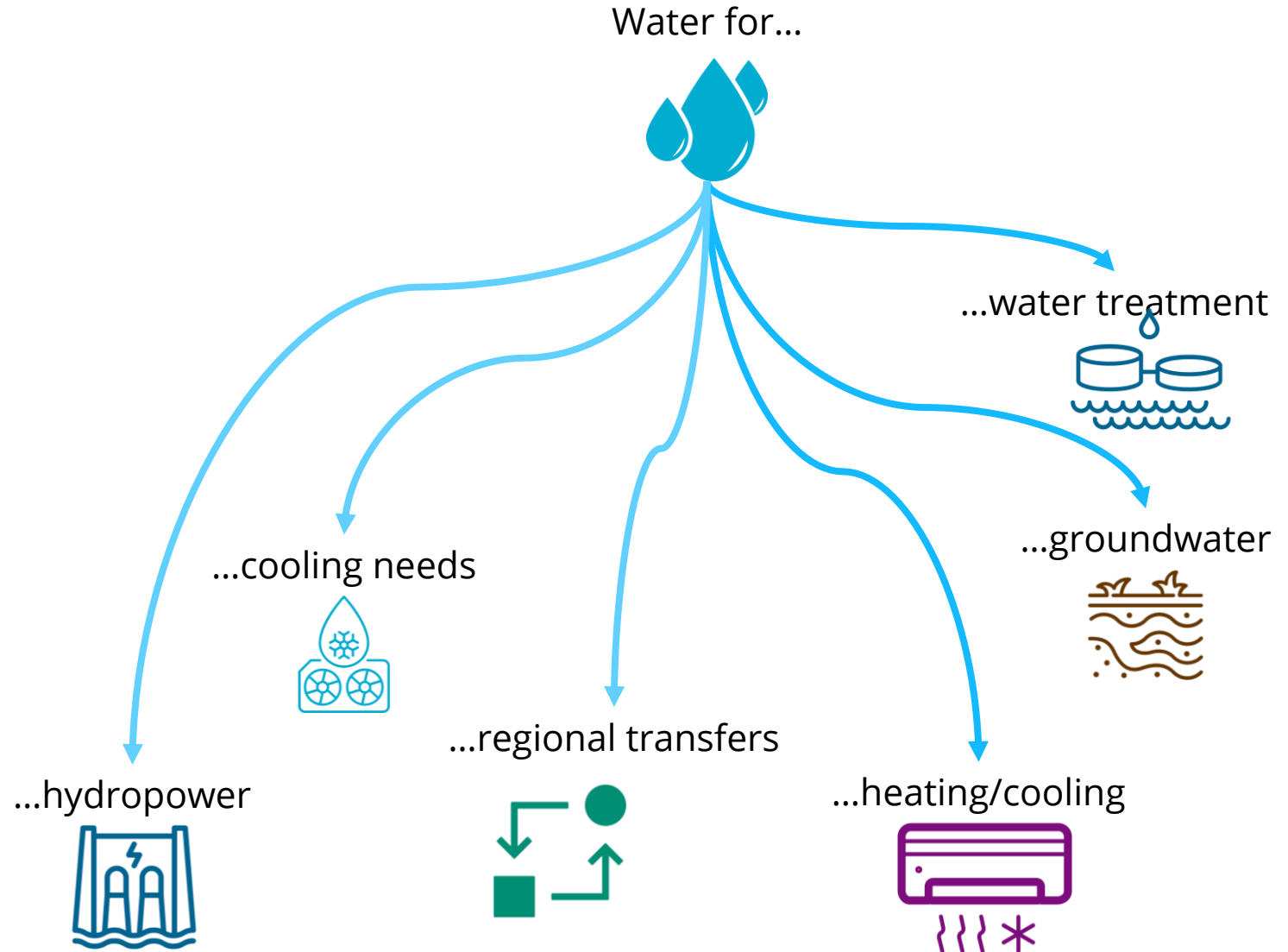


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Source: [Wikimedia](#)



Source: [Cohen et al., 2022](#)

Integrated modeling framework

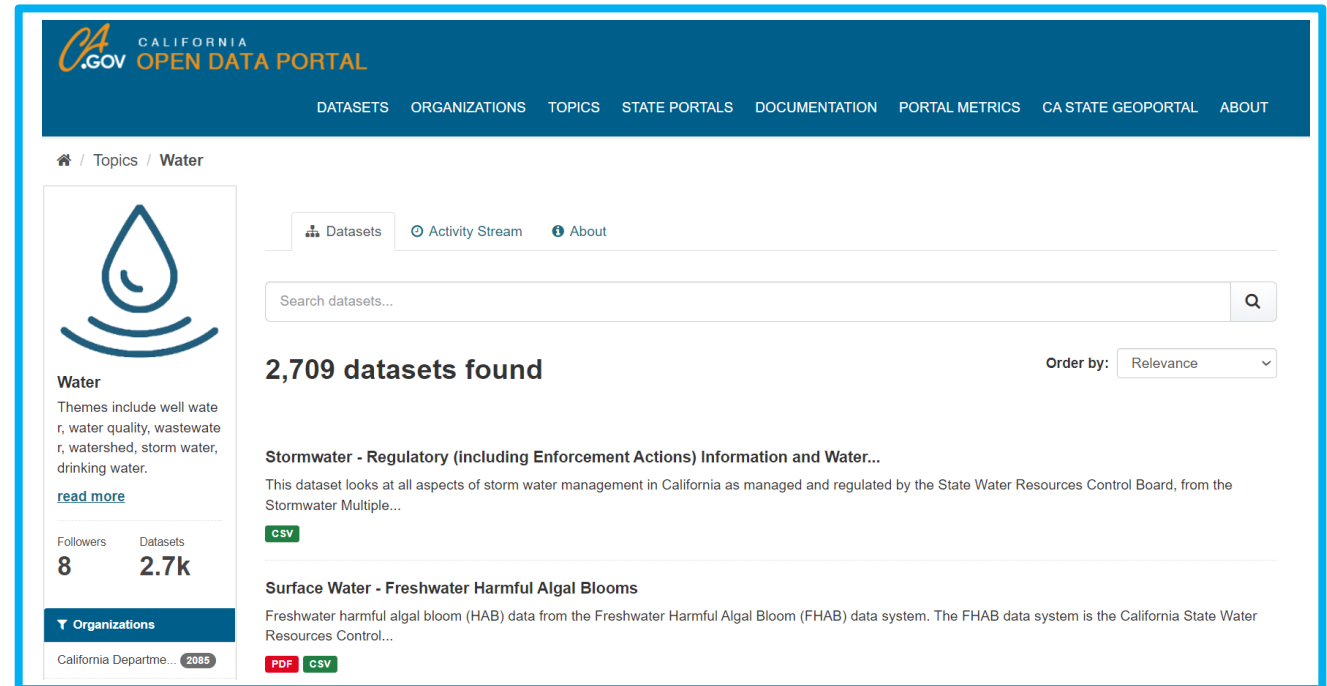


Dataset development

State-Level Water Data Initiatives



Source: [New Mexico Water Data](#)



Source: [California Open Water Data Portal](#)

- Various initiatives aim to collate relevant state water data, including sectoral uses
- Current datasets often only capture certain dimensions of energy-water dynamics (e.g., volumes or quality of produced water)
- Significant potential exists to integrate and increase the inter-operability of existing energy-water data nuances into these state-level databases

Acknowledgements



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Happy to answer any questions!

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