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Water and Energy in the Intermountain West

Considerations and Opportunities While Transitioning to Carbon Neutrality

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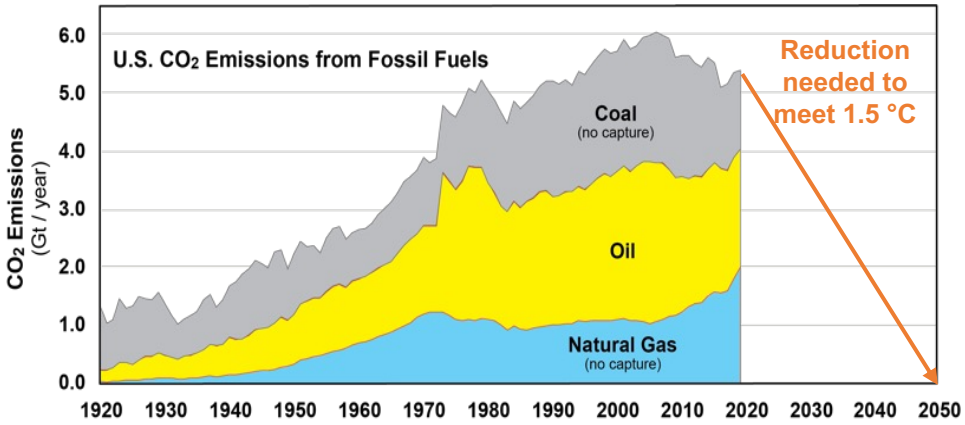
The global approach to energy is shifting, with a target of eliminating the net emissions of carbon dioxide within decades.



Rapid Transition Will Be Challenging

- Energy systems evolved gradually over a century
  → ***Change may occur over decades***
- Communities established their workforce and revenues as energy systems evolved
  → ***How can we avoid disruption to communities?***

Energy (Transition) & Water Are Linked

- Water is needed in energy production
  → ***e.g., cooling water for many processes; feedstock for green hydrogen production; etc.***
- Energy is needed in water processing
  → ***e.g., purification technologies for nontraditional water sources***

How can we transition our approach to energy rapidly AND equitably within regions across the country?

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The I–WEST initiative is looking at equitable transition strategies for getting to carbon neutral

Visit iwest.org for more detail and archived material from workshops or email iwest@lanl.gov

Objectives

- Develop a stakeholder-based roadmap to achieve carbon neutrality
- Build regional coalitions to deploy the roadmap

Place-based Approach

- Prioritize regional attributes and societal readiness first, and technologies second
- Explicitly consider non-technological aspects of region—policy landscape, revenue and jobs, workforce, equity, energy & environmental justice

Multiple Technologies and Multiple (Symbiotic) Economies

- Carbon capture, utilization, and storage; clean hydrogen; bioenergy; and low-carbon electricity

Phase I Team

Los Alamos · U.S. Department of Energy · San Juan College · New Mexico Tech · National Energy Technology Laboratory · Resources for the Future · ASU · University of Wyoming · The University of Utah · Montana State University · New Mexico State University · Colorado School of Mines

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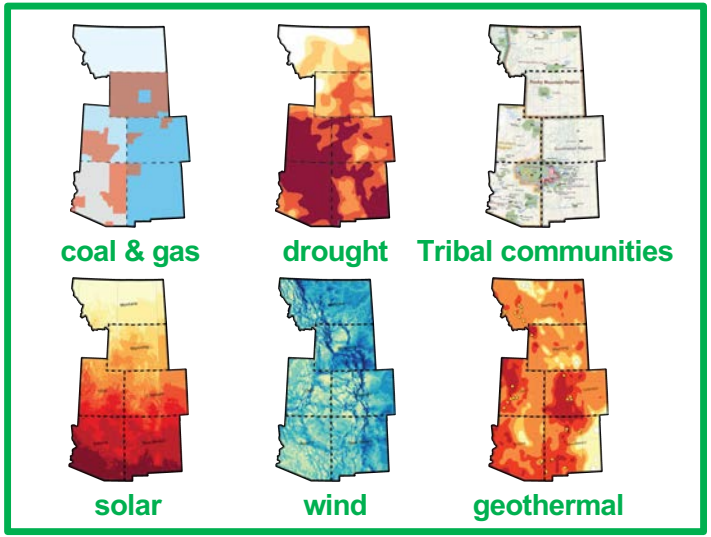
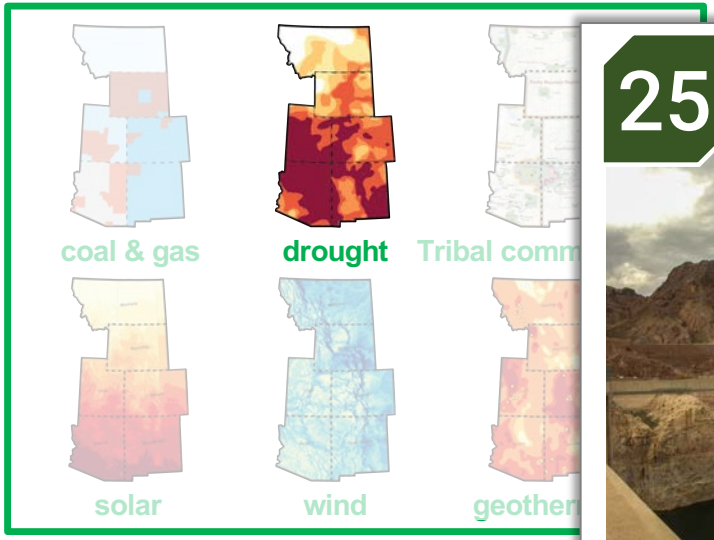


Why these six states?

- Existing fossil economy
- Shared characteristics
  - Water challenged
  - Evolving climate & impacts
  - Sovereign Nations and other rural communities
  - High solar, wind, geothermal
  - Energy export—electricity, natural gas



Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II

25 Southwest

Low water levels in Lake Mead

Key Message 1

Water Resources

Water for people and nature in the Southwest has declined during droughts, due in part to human-caused climate change. Intensifying droughts and occasional large floods, combined with critical water demands from a growing population, deteriorating infrastructure, and groundwater depletion, suggest the need for flexible water management techniques that address changing risks over time, balancing declining supplies with greater demands.

from: https://nca2018.globalchange.gov/

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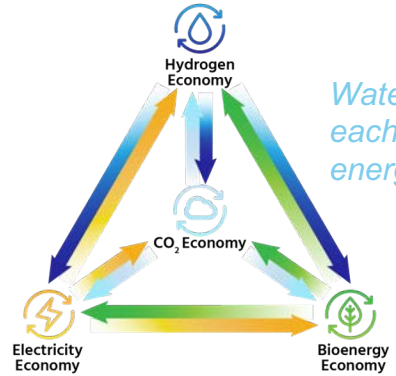

Water is central to each of these new energy economies

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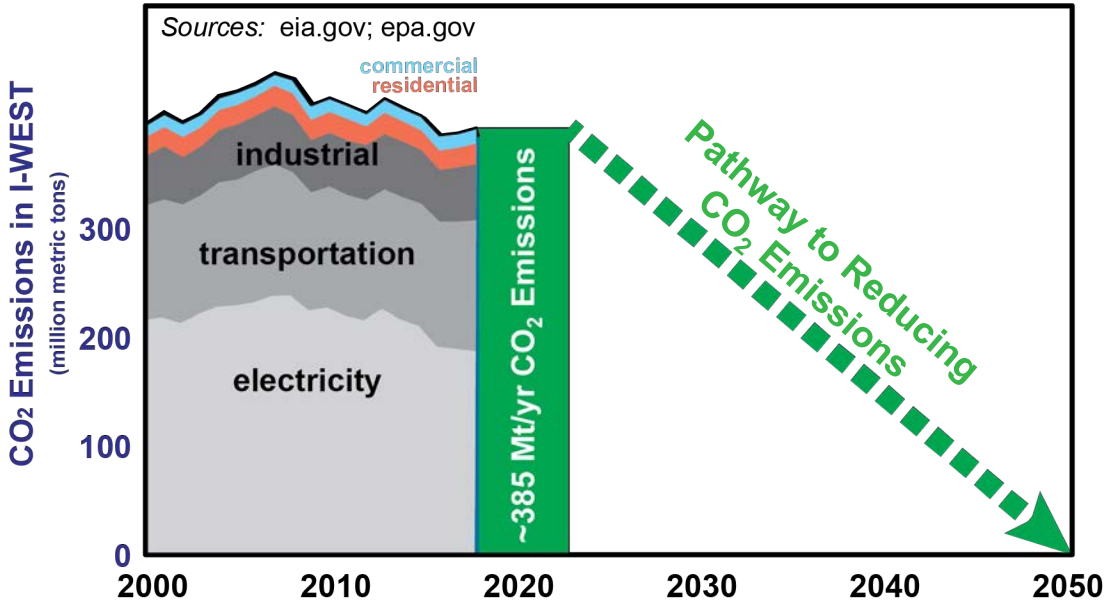
Why emphasize symbiotic economies?

- The future of regional economies is a common concern across the region—despite variation in perspectives on climate
- Multiple solutions (economies) will be needed and they must deploy simultaneously
- Symbiotic economies can accelerate deployment

Achieving carbon neutrality in the I-WEST region means reducing emissions by ~385 million metric tons per year



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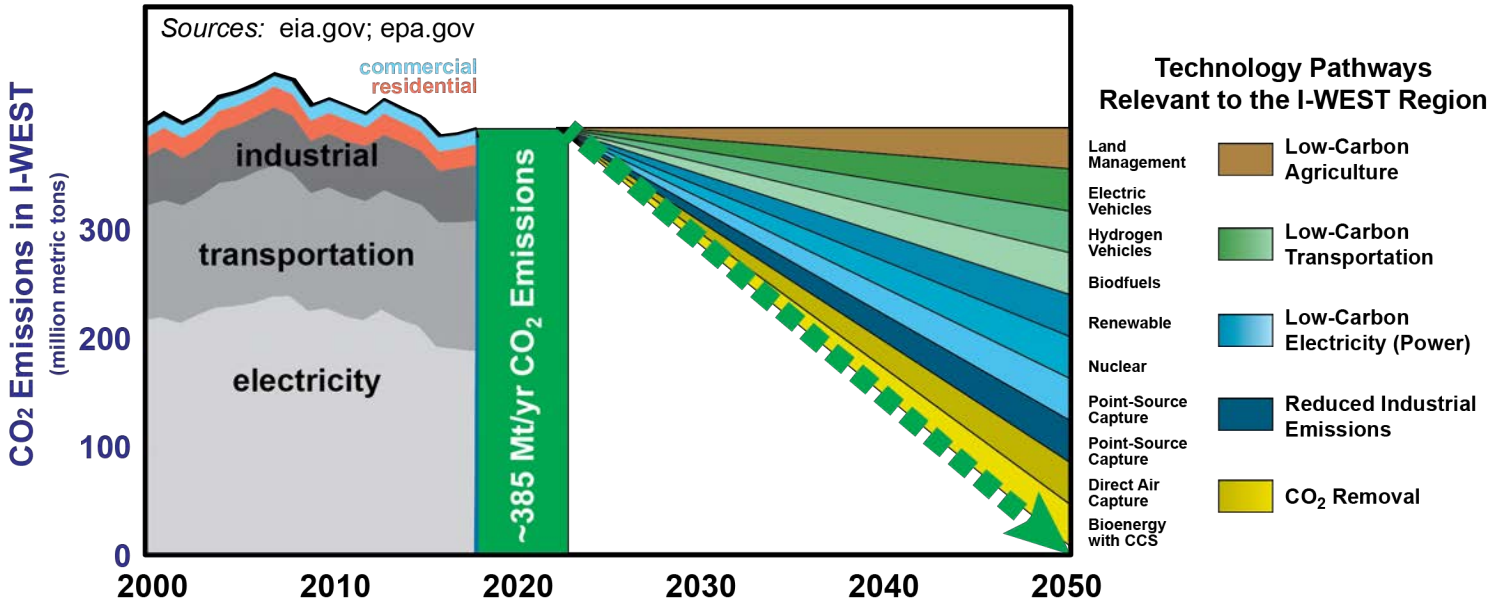
Multiple options will be needed to reduce emissions in the region, and each of these "wedges" has implications tied to water



I-WEST is assessing each of these pathways (wedges):
How big could the wedge be? What are the impacts of each (including water use)?

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Water Usage in the Intermountain West

(based on data from waterdata.usgs.gov)
(electricity data from eia.doe.gov)

Water use is dominated by agriculture

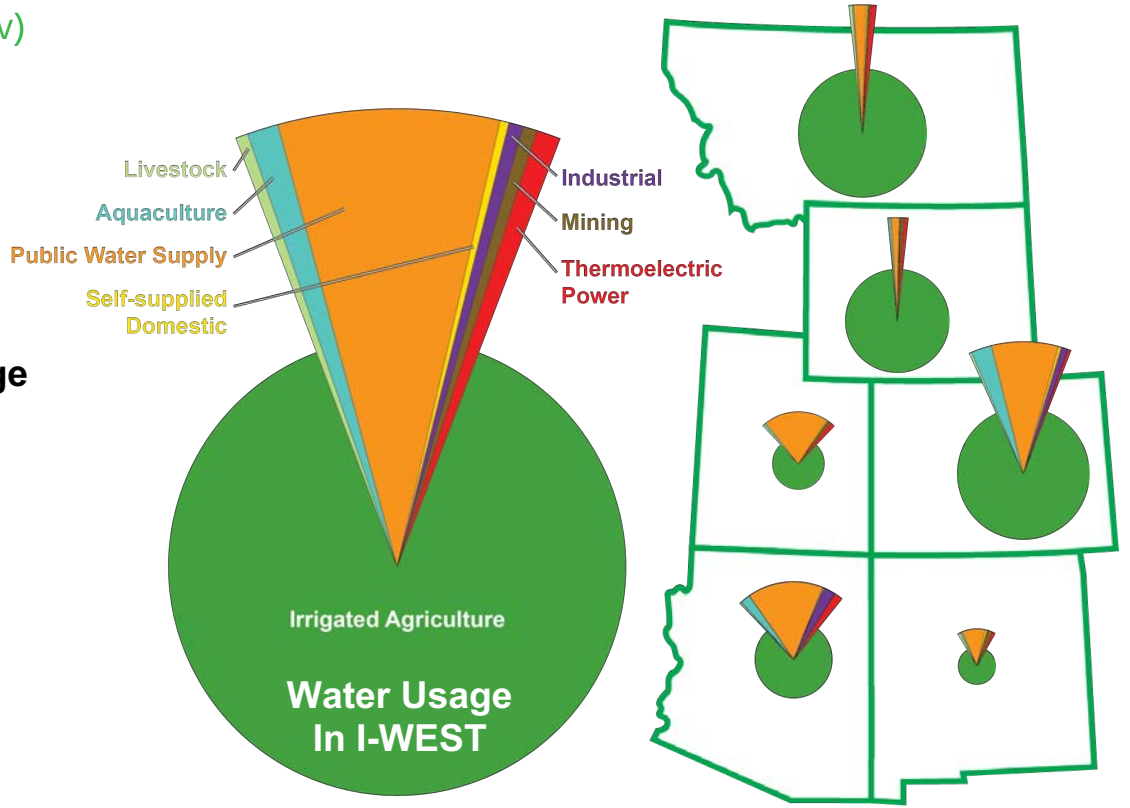
- 45M acre-feet per year total
- 80% from surface water

Public water supply is 2nd highest usage

- 3.6M acre-feet per year
- 57% from surface water

Thermoelectric power generation currently uses a small fraction

- 0.4M acre-feet per year (~400k AF/yr)
- 72% from surface water
- Accounts for ~87% of the 300 GW-hrs produced in region; region exports ~24%



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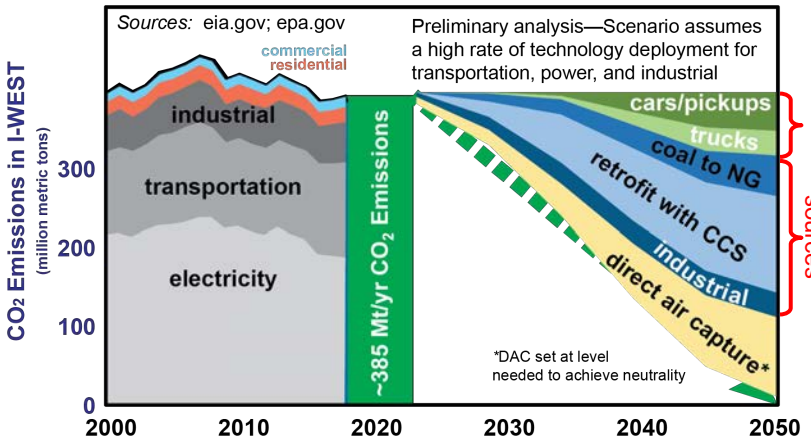
Water Usage and Energy Transition in the Intermountain West

Example Scenario of Energy Transition to Carbon Neutrality in the I-WEST Region



‡ Calculated as the sum of net water required by SMR, natural gas extraction and carbon capture process.

† Calculated as the sum of net water needed as feedstock and minimal amount needed for solar

§ Veil (2020) reported 411k acre-feet of produced water from oil/gas operations in the I-WEST region

fi Point source data from eia.gov. Water needs for capture based on analysis by Grol et al. (2018) NETL-PUB-22446.

Converting all vehicles to hydrogen

- Producing enough hydrogen via steam-methane reforming to fuel all cars/pickups/trucks in region would require ~300k acre-feet/yr ‡
- Producing enough hydrogen via electrolysis† to fuel all cars/pickups/trucks in region would require ~45k acre-feet/yr

Capturing all point sources of CO_2

- Capturing all large point sources of CO_2 in region would require ~200k acre-feet/yr based on water-cooled amine technology[fi]
- Using air cooling could reduce required water by ~90%[fi] (e.g., to ~20k acre-feet/yr)

Storing all captured point-source CO_2 in reservoirs

- Co-producing brine while injecting CO_2 (to manage pressure) could be a nontraditional water source; e.g., storing 200Mt CO_2/yr could result in ~185k acre-feet/yr water§

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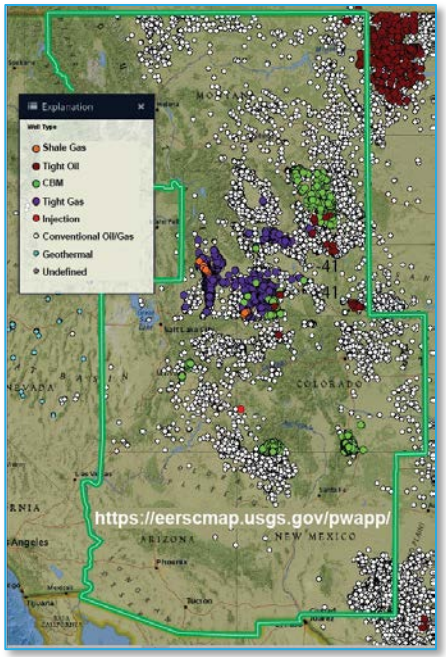
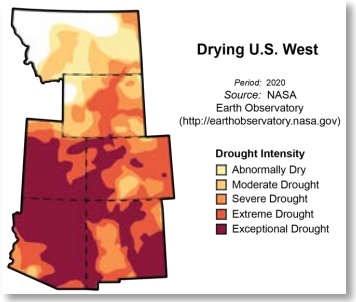
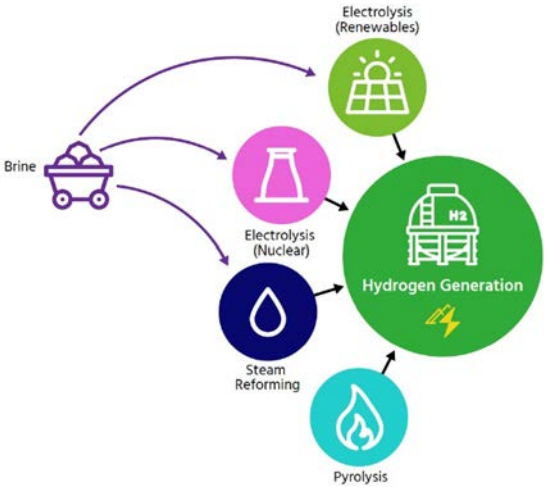
Water is an issue throughout the region, but there are opportunities to utilize "produced" water—oil/gas & CO_2.

Locations of Wells Generating Produced Water







Different water needs for each generation pathway

- *Electrolysis*—all of the hydrogen (H_2) comes from water
- *Steam methane reforming*—half the hydrogen from water, half from methane; but SMR is a thermal process and requires water for cooling

Could brine be used for some/all of the water in hydrogen production—e.g., after desalination

- Produced water from regional oil/gas operations (~411k acre-feet/yr in region)
- Brine co-produced during CO_2 injection (potential for ~200k acre-feet/yr in region)

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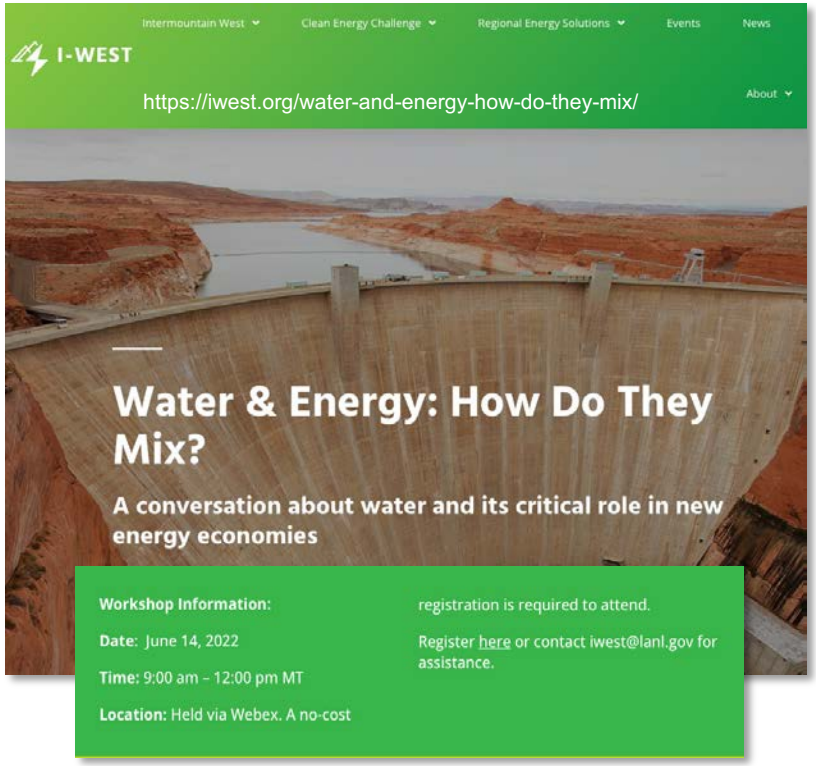
I-WEST is interested in dialog on energy transition and water in order to inform the roadmap



Upcoming Workshop

- Presentations to frame the topic followed by roundtable Q&A with participants and panelists

Recent Seminar

- Mike Hightower—"Emerging Energy Trends and Water Use Innovation in the West". Video recording can be accessed on Events tab at iwest.org

Listening/Learning Session

- I-WEST team is interested in hearing regional perspectives—schedule a session at iwest.org

General Inquiries & Comments

- Email team at iwest@lanl.gov