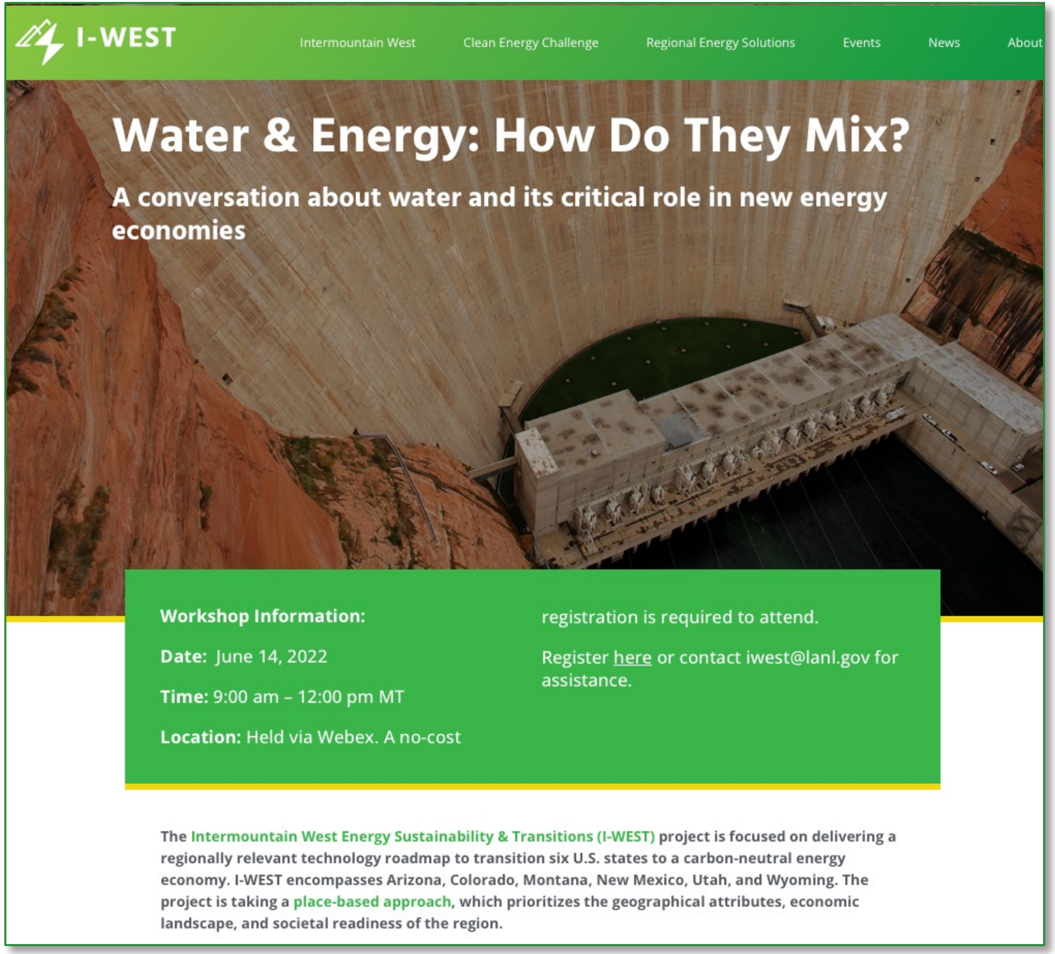
Background Material for the I-WEST Workshop on Water and Energy Transition

Registration for the workshop can be found at:

iwest.org/water-and-energy-how-do-they-mix

Question about I-WEST and/or the workshop: *iwest@lanl.gov*

Recordings of prior workshops can be found at: *iwest.org/events*



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

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

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

Multiple Technologies and Multiple (Symbiotic) Economies

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

Phase I Team

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Water Terminology for Reference

Common Units of Water Volumes

- Gallons
  - Equivalent to a standard gallon of milk
- Acre-feet
  - 1 acre-foot is equivalent to ~326,000 gallons
  - 1 acre-foot is equivalent to ~326k gallons, where "k" signifies 1,000
  - 1 acre-foot is equivalent to ~0.3M gallons, where "M" signifies 1,000,000
- Barrel
  - 1 standard barrel of oil will hold 42 gallons of water

Common Terms Associated with Water

- *Freshwater*—"pure" water (H_2O), i.e., water that lacks high concentrations of dissolved salts.
- *Brine*—water containing high concentrations of dissolved salts. Seawater typically contains ~3.6% dissolved salts (36,000 ppm or parts per million). Some deep reservoirs contain dissolved salt concentrations of >100,000 ppm.
- *Brackish*—water that is saltier than freshwater but less salty than seawater.
- *Desalination*—the process of removing dissolved salts from brine.
- *Surface water*—a water source derived from rivers, lakes, etc. It is typically a freshwater.
- *Groundwater*—a water source derived from pore space in rocks underground. Typically groundwater is fresh near the surface and becomes saltier with depth.
- *Produced water*—a water (typically brine) that is co-produced during the production of oil and gas. Brines can also be co-produced when carbon dioxide is injected for storage.
- *Reclaimed water*—a water that is recovered from another source of wastewater.
- *Non-traditional water*—a water source other than conventional surface water or groundwater, for example produced water.

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

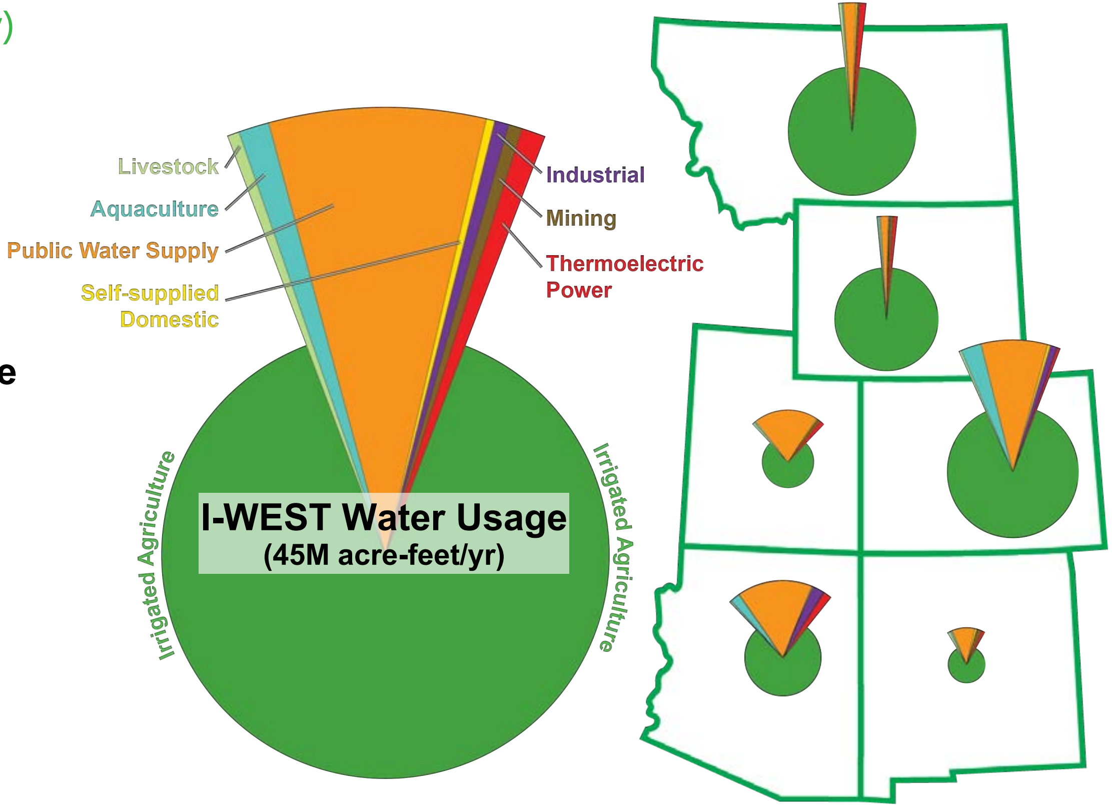
- 40M acre-feet per year total
- 85% from surface water

Public water supply is 2nd highest usage

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

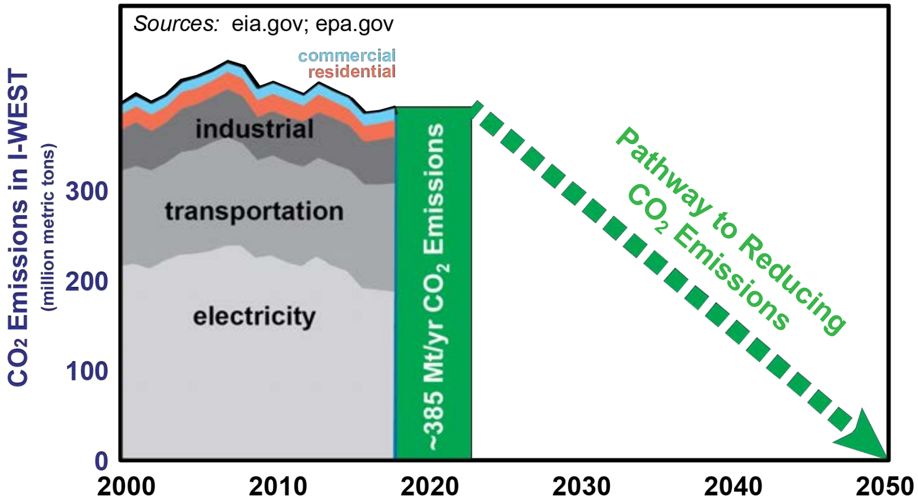
Thermoelectric power generation currently uses a small fraction

- 0.4M acre-feet per year (~400k acre-feet/yr)
- 72% from surface water
- Accounts for ~87% of the 300 GW-hrs produced in region, of which ~24% is exported to other regions



(Sizes of pie charts are scaled to volume of water used. The slices for usages other than irrigated agriculture have been expanded by a factor of two to facilitate viewing.)

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



Multiple options will be needed to reduce emissions in the region, each of which has implications tied to water.

Possible solutions for emissions from transportation:

- Producing sufficient hydrogen for fuel-cell vehicles
- Producing biofuels for vehicles
- Producing sufficient low-carbon electricity for vehicles

Possible solutions for emissions from electricity generation:

- Capturing CO_2 from point sources
- Shifting to low-carbon thermoelectric sources
- Shifting to a periodic renewable source (e.g., solar or wind)
- Shifting to a sustained renewable source (e.g., hydroelectric or geothermal)

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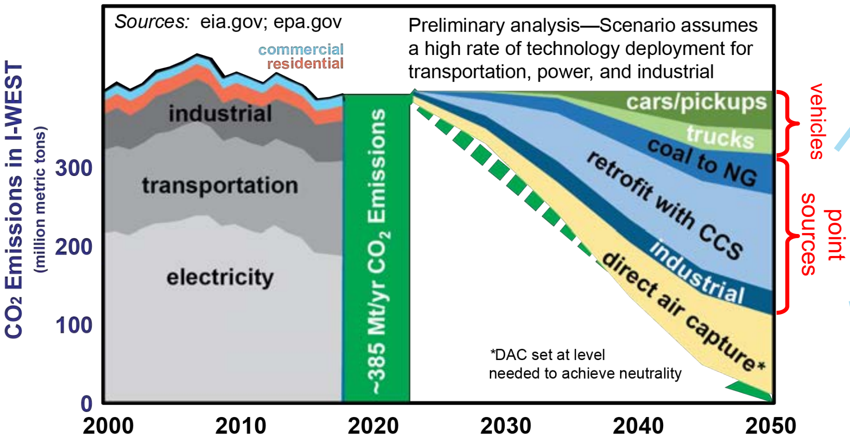
Water Usage and Energy Transition in the Intermountain West

Example Scenario of Possible Technology Pathways 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

§ Water co-produced during CO_2 storage assumes an equivalent volume of brine is removed for pressure management and the brine is desalinated to produce water; for comparison, 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 ~40–80k 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
- Storing 200Mt CO_2/yr could result in ~200k acre-feet/yr water§

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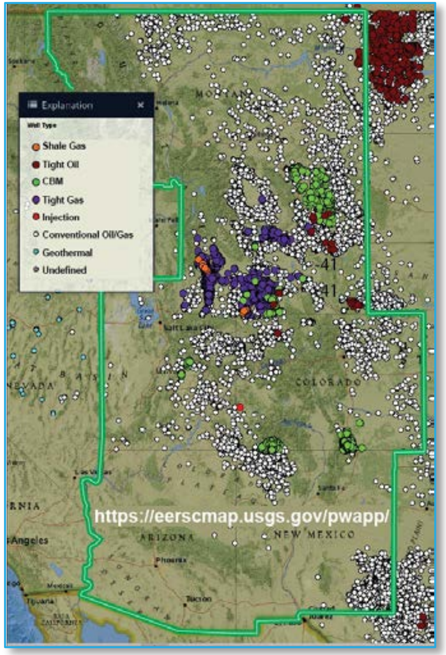
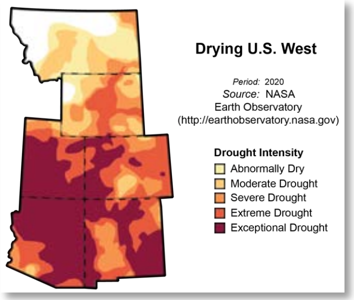
Water is an issue throughout the region, but there are opportunities to utilize "produced" water—oil/gas & CO_2.

Locations of Wells Generating Produced Water





Salty water (brine) is often co-produced with oil and gas, and it may also be co-produced with CO_2 storage.

This non-traditional water could be an opportunity for some of the water in needs in energy transition.

- 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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