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Water Considerations Related to Clean Hydrogen in Arizona

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As electric utilities, transportation and other industries strive to reduce carbon emissions, hydrogen has emerged as a potential critical component of the clean energy transition.[1] While clean hydrogen is often defined narrowly as hydrogen produced through electrolysis powered by low-carbon electricity[2], we recognize the diversity of pathways that can also be considered clean or low-carbon. In this paper, we focus on examining the water implications of one such pathway, without disregarding the importance and validity of other clean hydrogen production methods.

Because water is a relatively scarce resource in Arizona, there is understandable concern about the impacts new industrial uses of water may have on the state's long-term supplies. In this paper, we offer guidance related to the use of Arizona's water resources for clean hydrogen production. In Part I, we present an overview of the current state of Arizona water resources and policy. In Part II, we quantify the amount of water required to produce enough hydrogen to fuel 5% of electricity generation and 100% of trucking freight in the state by 2050. Finally, we make the reasonable assumption that individuals and organizations working on producing clean hydrogen in Arizona will also be concerned with ensuring that its production is sustainable in terms of Arizona's overall water resilience. Accordingly, in Part

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[1] Wakim Ghassan and Magnolia Tovar, *Hydrogen for Decarbonization: A Realistic Assessment* (November 2023), https://www.catf.us/resource/hydrogen-for-decarbonization-a-realistic-assessment/.
[2] Wakim Ghassan, *Hydrogen Production via Electrolysis: The Limits of Potential Cost Declines* (November 2023), https://www.catf.us/resource/hydrogen-production-via-electrolysis/; *see also* Electric Power Research Institute, P178 Quick Insights: Resource Planning for Electric Power Systems https://esca.epri.com/pdf/Back-Pocket-Insights/Hydrogen-in-Energy-System-Resource-Planning.pdf (August 2023).

III, we provide recommendations for achieving sustainable water use for clean hydrogen production.

Part I: Arizona Water Basics

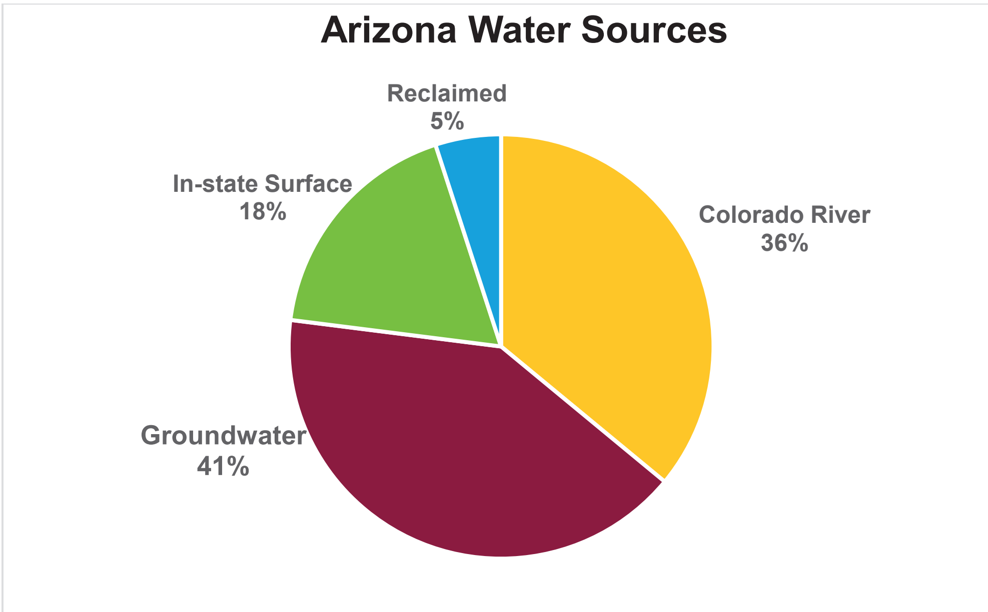

Figure 1: Arizona Water Sources

Supply

Arizonans use approximately seven million acre-feet (AF) of water annually.[3] Although the water supply used by any given community uses varies throughout the state, Arizona has four main sources: groundwater, Colorado River water, water from in-state rivers and reclaimed water.

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[3] An acre-foot (AF) of water equals 325,851 gallons, enough to supply 3.5 single family households for one year. See Arizona Department of Water Resources, "How many homes in Arizona, on average, share an acre-foot of water each year?" (April 19, 2021) https://www.azwater.gov/news/articles/2021-19-04.

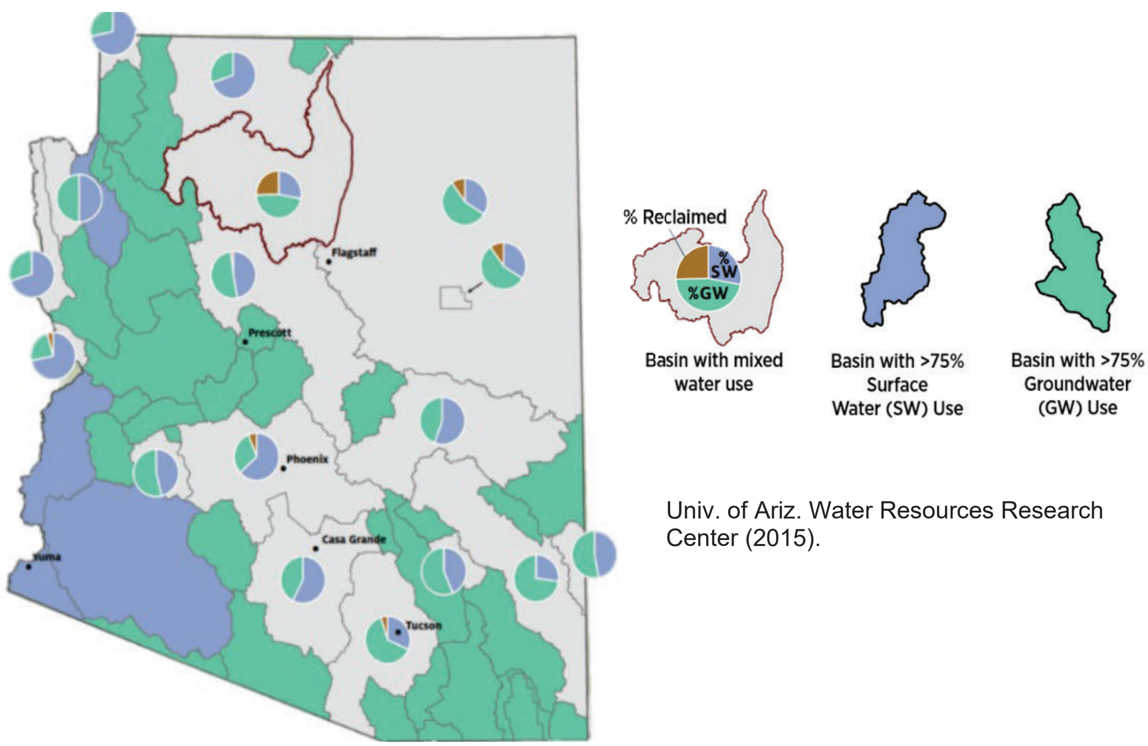
- *Colorado River water:* Arizona shares Colorado River water with six other states, thirty Native American tribes and Mexico. Within Arizona, Colorado River water is available to users along the mainstem, which defines most of Arizona's western border, and to users who receive Colorado River water deliveries from the Central Arizona Project (CAP) canal, which serves cities, tribes, farms and industries in Maricopa, Pinal and Pima counties.

Figure 2: The Central Arizona Project

- *In-state surface water:* Rivers and streams within Arizona supply water to users in several parts of the state. The Salt-Verde system, managed by the Salt River Project (SRP), is the largest in-state surface water system, providing about 30% of the Phoenix-area municipal supply. In northeastern Arizona, the Little Colorado system provides a water supply for the Navajo Nation and Hopi Tribe as well as to numerous non-tribal water users.

- *Reclaimed water:* In Central Arizona, over 90% of the water that enters the wastewater treatment system is treated and reused. Reclaimed water comprises about 15% of the water supply in the Phoenix and Tucson areas.
- *Groundwater:* Groundwater (water that fills the spaces between soil particles and fractured rock beneath Earth's surface) supplies around 40% of the state's water demand. In Arizona and other arid and semi-arid regions, groundwater is considered non-renewing because precipitation is insufficient to naturally replenish aquifers at the rate of typical groundwater withdrawals using modern pumping technology. Achieving sustainable groundwater use involves implementing policies that limit its use alongside managed aquifer recharge, where water is directed into aquifers through injection or infiltration.

Source of Water Supply by Groundwater Basin



Univ. of Ariz. Water Resources Research Center (2015).

Figure 3: Sources of Water Supply by Groundwater Basin

Demand

Agriculture accounts for an estimated 72% of the state's water demand, domestic uses amount to 16% of demand and commercial uses comprise 4% of statewide demand. Thermoelectric power production and golf each account for around 3% of total water demand.[4]

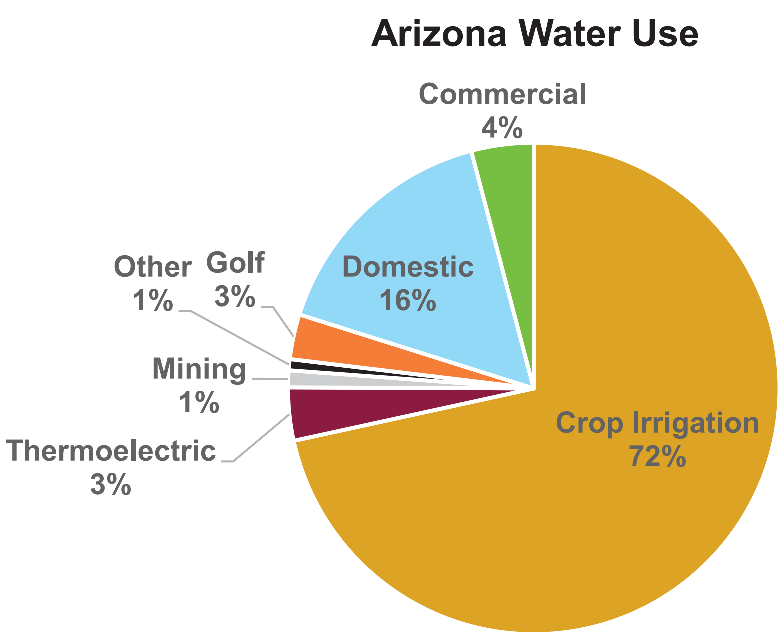


Figure 4: Arizona Water Use

The total amount of water withdrawn for a particular use is only part of the story, as some uses contribute to aquifer recharge. For instance, up to 30% of water used for crop irrigation makes its way below ground and recharges the aquifer. Similarly, certain industrial

[4] United States Geological Survey, Water Use Data for Arizona (2015, refreshed 2018) https://waterdata.usgs.gov/az/nwis/water_use?.

processes can reclaim and re-use water.[5] In contrast, water applied to golf courses or other turf facilities generally does not contribute meaningfully to aquifer recharge.

Since the mid-20th Century, Arizona has taken pro-active steps to manage water resources sustainably in the most populous areas, requiring renewable water supplies to serve urban growth, maximizing re-use and improving water efficiency across all sectors. As a result of increasing efficiency and a gradual transition to lower water-intensity uses of land, population and economic growth have become significantly decoupled from water demand: Between 2000 and 2019, population in Maricopa, Pinal and Pima Counties increased 45% while municipal water demand increased only 14%.

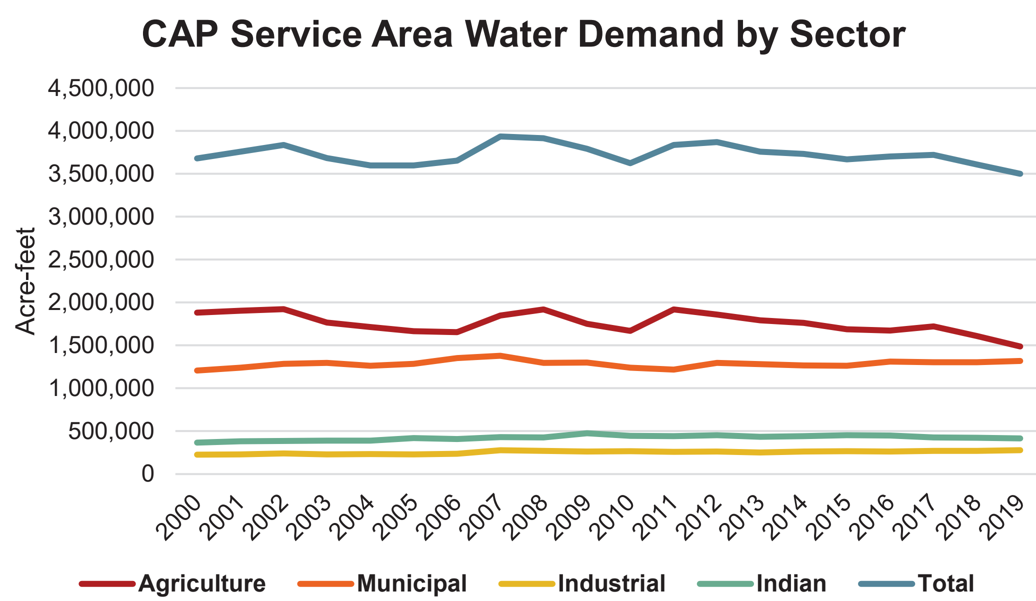


Figure 5: CAP Service Area Water Demand by Sector

[5] *See* Joanna Allhands, "How much water will TSMC Arizona use? Probably a lot less than you think," *The Arizona Republic* (June 12, 2024) https://www.azcentral.com/story/opinion/op-ed/joannaallhands/2024/06/12/tsmc-arizona-water-use-recycling/74059522007/.

Challenges

Arizona's biggest water supply challenges are a diminishing Colorado River, over-reliance on non-renewing groundwater and unresolved water rights claims. The Colorado River is over-allocated and experiencing declines in flows.[6] As a result, the region must find ways to reduce its dependence on Colorado River supplies. Because Central Arizona users have junior priority, meaning that they are first to have their water cut in a time of shortage, the Central Arizona cities and industries that rely on Colorado River water are actively looking for ways to stretch available supplies through conservation and efficiency. For example, the City of Phoenix has announced plans to implement advanced water purification, a multi-stage treatment process that produces high-quality, safe drinking water from treated effluent, enabling Phoenix to reduce its reliance on Colorado River water by up to 50%.[7] The City of Scottsdale has prohibited the use of grass in front yard landscaping of new homes and is offering financial incentives to existing homeowners to convert grass to low water-use landscaping.[8] Cities and industries are also working to develop new supplies to replace shorted Colorado River supplies.[9]

Groundwater presents a different set of challenges. Arizona has three levels of groundwater regulation. In Active Management Areas (AMAs), which include over 80% of the state's population, groundwater is highly regulated, and new non-domestic uses of groundwater are

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[6] United States Bureau of Reclamation, Supplement to the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead: Record of Decision (May 2024) at 3.
[7] Taylor Seely, "Phoenix to build multibillion dollar purification plant to make wastewater drinkable by 2030, The Arizona Republic (April 12, 2023) https://www.azcentral.com/story/news/local/phoenix/2023/04/12/exclusive-phoenix-to-make-wastewater-drinkable-on-mass-scale-by-2030/70101091007/.
[8] City of Scottsdale, Ariz., Ordinance 4606 (adopted July 10, 2023).
[9] *See* Natalie Kilker, Arizona Water Blueprint: Augmentation Concepts (Kyl Center for Water Policy, ASU Morrison Inst.) https://asu.maps.arcgis.com/apps/Shortlist/index.html?appid=ac3c8db6aeef4b8fb8612734675e8192.

allowed only pursuant to a permit issued by the Arizona Department of Water Resources.[10] In Irrigation Non-expansion Areas (INAs), the use of groundwater for agriculture is limited to lands that were irrigated in the five years prior to the INA's establishment.[11] Outside of AMAs and INAs, the state does not require the measuring and reporting of groundwater withdrawals. With limited exceptions, the transportation of groundwater out of a sub-basin is prohibited.[12]

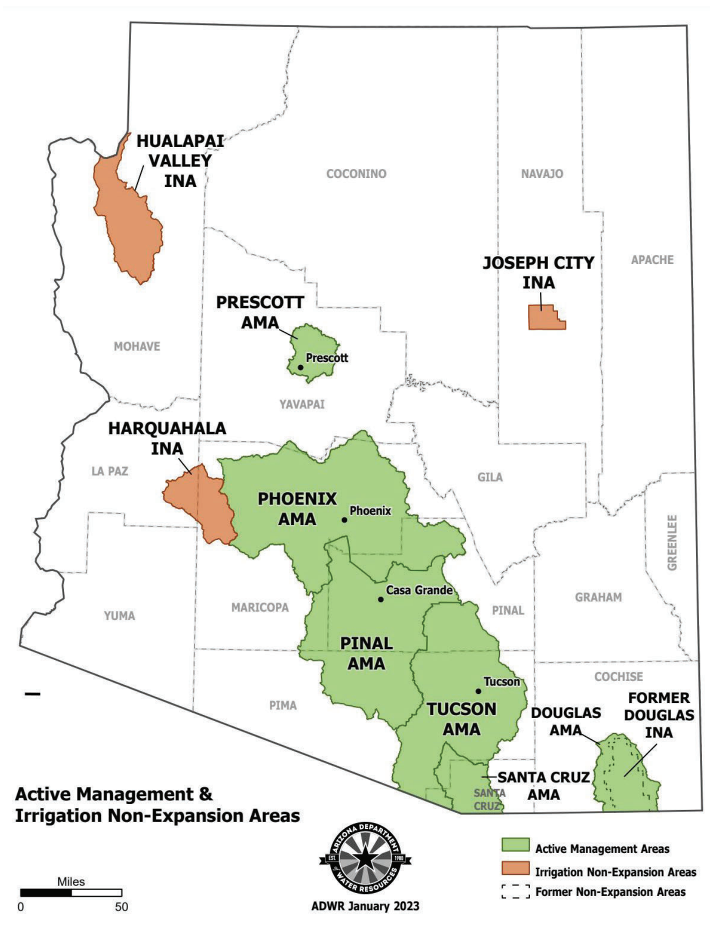

Figure 6: Arizona AMAs and INAs

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[10] Ariz. Rev. Stat. § 45-512 & 45-515.
[11] *Id.* § 45-437(B).
[12] *Id.* § 45-544(A)(2).

Recent hundred-year demand modeling in the Phoenix and Pinal AMAs triggered new limits on groundwater use.[13] The Arizona Department of Water Resources has indicated that similar modeling results can be expected for all Arizona AMAs.[14]

Outside of AMAs and INAs, some groundwater basins are experiencing rapid depletion by agricultural water users.[15] In 31 of the state's 46 non-AMA basins, groundwater supplies at least 75% of the total water. The Arizona Department of Water Resources estimates that 36 of the state's non-AMA basins will be in a water supply deficit by 2110.

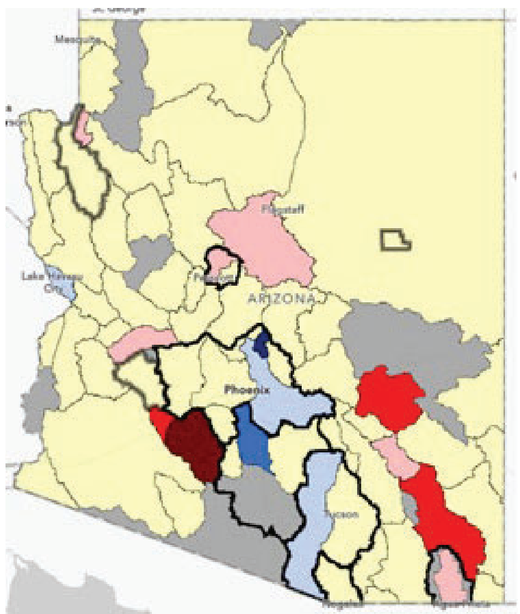

Figure 7: Groundwater basins in shades of pink and red are experiencing a 20-year average overdraft of over 3 feet/year. Groundwater levels are increasing in basins shaded blue.

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[13] See Kyl Center for Water Policy, *New Phoenix AMA Model Shows Limits of Groundwater as an Assured Water Supply,* ASU Morrison Inst. for Public Policy (June 2023) https://morrisoninstitute.asu.edu/sites/default/files/kyl_center_phoenix_ama_groundwater_model_explainer_062023.pdf.
[14] Tony Davis, "Pima County among areas that could face water messes like Buckeye's," *Arizona Daily Star* (January 10, 2023) https://tucson.com/news/local/subscriber/pima-county-among-areas-that-could-face-water-messes-like-buckeyes/article_67ea20e6-90a4-11ed-9193-d3dc2db28bcc.html.
[15] For an interactive map showing the status of groundwater supplies throughout the state, see Kyl Center for Water Policy, Groundwater Level Changes, *Arizona Water Blueprint* https://asu.maps.arcgis.com/apps/webappviewer/index.html?id=40ab99d10a224d6c83818fb0e1c153e0.

Water Rights Uncertainty

Arizona applies the doctrine of prior appropriation to surface water rights, meaning that a person who first diverts river or stream water for a beneficial use acquires a right that is senior to later appropriators of water from that system. Under this priority system more junior users take cuts when streamflows are insufficient to meet demand. In two complex legal proceedings known as "general stream adjudications," the Arizona courts are working to determine the priority, quantity and other attributes of thousands of surface water rights claims in two large in-state river systems, the Gila River and the Little Colorado River watersheds. Parties include eight Native American tribes, federal and state agencies, mining companies, electric power producers, farmers, ranchers and cities, as well as individual claimants. The general stream adjudications will also determine the rights of well owners to pump water that would otherwise form the sub-surface flows of rivers and streams.[16] Until the adjudications are completed, uncertainty will persist regarding the rights to use surface and some underground water in these two watersheds.

[16] For more information about Arizona's general stream adjudications, see Ferris et al., *The Price of Uncertainty*, ASU Morrison Inst. for Public Policy (2017).

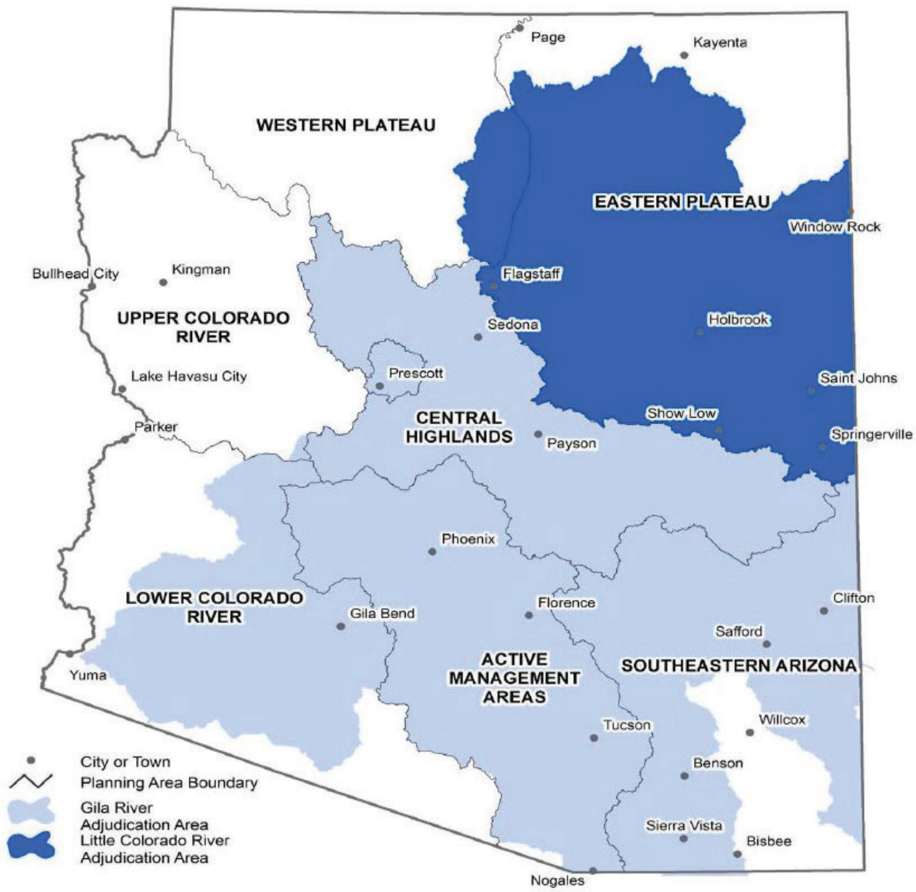

Figure 8: General stream adjudication areas.

Part II: How Much Water Does Clean Hydrogen Production in Arizona Need?

In Arizona, water is from time-to-time re-allocated from one use to another. The legal feasibility of reallocating any particular water supply depends on the source (*e.g.*, Colorado River, in-state river, groundwater or effluent) and the facility's location, since surface water rights are generally associated with the land where the water has historically been used and groundwater regulation is a function of location. The feasibility of securing a sustainable water supply for clean hydrogen production also depends on the quantities of water required.

The key questions are:
How much locally produced hydrogen would AZ need to satisfy local demand?
What water supplies might be available to produce clean hydrogen?

Quantifying Hydrogen Demand

Hydrogen offers significant potential to decarbonize multiple sectors, including transportation, power generation and heavy industry. Globally, hydrogen is gaining traction in "difficult-to-abate" sectors where reducing emissions proves challenging. However, its suitability depends on regional contexts, infrastructure and the availability of competitive alternatives. Clean hydrogen can theoretically replace fossil fuels in any application. However, alternative solutions, such as direct electrification and biofuels, often outperform hydrogen in terms of efficiency and cost for many sectors. Hydrogen stands out in cases where alternatives face significant barriers—such as long-haul freight trucking and seasonal energy storage for grid reliability. In Arizona, freight trucking and electric power generation stand out as the largest opportunities for clean hydrogen adoption. We selected freight trucking and electric power generation because they offer a realistic scale of demand and present unique challenges where clean hydrogen provides distinct advantages.

Freight Trucking: Heavy-duty, long-haul trucking demands high energy density, fast refueling and extended range—areas where hydrogen fuel cells could excel over battery-electric alternatives. Although debate continues about whether clean hydrogen is the best long-haul freight solution, Arizona's freight sector represents a large emissions source and a key decarbonization target. Clean hydrogen offers a scalable pathway to replace diesel for freight operations while addressing emissions and air pollution in this critical transportation sector.

Electric Power Generation: Arizona's electric utilities plan to achieve net-zero carbon emissions by 2050. Renewable energy sources such as solar and wind will dominate the future grid, but their variability raises concerns about reliability and resiliency. Clean hydrogen-fueled gas turbines can provide on-demand, carbon-free power during peak demand or when renewable generation is insufficient. For this report, we estimate that clean hydrogen might contribute 5% of Arizona's electricity generation by 2050. This targeted use reflects hydrogen's higher cost relative to other energy resources while leveraging its value for grid stability during critical periods.

Why not other applications? Globally, hydrogen plays an emerging role in industrial processes such as steel, cement and ammonia production. However, these applications contribute relatively little to Arizona's emissions profile: Cement accounts for approximately 2% of statewide emissions, ammonia production and petroleum refining are minimal in Arizona compared to other regions.

Why not import hydrogen? Importing hydrogen from less water scarce regions is a valid consideration, particularly as global clean hydrogen trade develops. However, relying on imported hydrogen introduces economic, logistical and infrastructure challenges that increase overall costs and complexity. Transporting hydrogen over long distances requires significant investment in infrastructure, such as pipelines, shipping terminals or specialized carriers, which are not yet widely available. These additional costs could undermine clean hydrogen's competitiveness, and they should be considered in the context of the trade-offs entailed in re-allocating a sustainable water supply from a current use to hydrogen production or importing water supplies into Arizona for hydrogen production.

By focusing on freight trucking and the last 5% of electric power generation, this report prioritizes the two largest potential sources of clean hydrogen demand in Arizona. These sectors represent realistic and impactful opportunities for clean hydrogen adoption while aligning with emissions reduction goals. This analysis quantifies the water requirements for producing clean hydrogen to meet those demands, recognizing that broader applications may emerge as technologies and policies continue to evolve.

Quantifying Water Demand

The theoretical minimum amount of water required to produce one kilogram of hydrogen through water splitting, such as electrolysis, is approximately nine liters (about 2.5 gallons).[17] Additional water is necessary for purification and typically for cooling, bringing the total water withdrawal to 26-32 liters (about 6.9-8.5 gallons) per kilogram of hydrogen.[18] For hydrogen produced via steam methane reforming with carbon-capture and sequestration, known as "blue" hydrogen, the water requirement would be comparable.[19] [20]

Most of the water needed for clean hydrogen production would be unavailable for reclamation. However, certain applications could reclaim some water, such as byproduct water from purification processes or evaporation from cooling towers. For the purposes of this report, we conservatively assume that producing one kilogram of hydrogen via electrolysis will consume between four and nine gallons (about 15-34 liters). Four gallons of water reflects potential efficiency gains expected in the industry by 2050, while nine gallons

[17] Frano Barbir, "PEM electrolysis for production of hydrogen from renewable energy sources," *Solar energy.* (2005) 78 (5), 661–669 https://www.sciencedirect.com/science/article/abs/pii/S0038092X04002464.
[18] IRENA and Bluerisk (2023), *Water for hydrogen production,* International Renewable Energy Agency, Bluerisk, Abu Dhabi, United Arab Emirates.
[19] https://rmi.org/hydrogen-reality-check-distilling-green-hydrogens-water-consumption/
[20] These estimates do not account for upstream water consumption, such as that required to produce solar panels, wind turbines or natural gas, as these products are typically imported to Arizona.

represents the upper estimate for clean hydrogen production in 2024. This assumption results in a wide range for estimated annual water requirements attributable to potential efficiencies that may be gained in the industry as these technologies develop (e.g., proton exchange membrane[21] electrolysis), whether some portion of water can be re-used or returned to beneficial use and the degree to which stock water would require treatment to reach the purity needed for the electrolysis process.

Hydrogen for Power Production

According to the US Energy Information Administration, Arizona produced 109,305,057 megawatt hours (MWh) in 2020.[22] By 2050, major electric utilities anticipate projected generation will increase dramatically as electrification continues. For the purposes of this report, we assume that generation will increase by 50%, to an approximate total of 163,000,000 MWh of electricity generated in Arizona in 2050. Arizona's largest utility companies, APS, SRP and TEP, have all committed to reaching net-zero carbon emissions by 2050.[23] [24] [25] Accordingly, generation of energy in the future will use non-emitting resources, such as wind, solar, nuclear, hydroelectric and geothermal power.

However, meeting reliability, affordability and resiliency criteria[26] may require generating some electricity with thermoelectric technologies, such as gas turbines, which have historically produced carbon emissions. Arizona utilities could meet their CO_2 reduction goals by replacing some natural gas with clean hydrogen as a fuel in gas turbines. As an

[21] https://www.energy.gov/eere/fuelcells/technical-targets-proton-exchange-membrane-electrolysis
[22] https://www.eia.gov/electricity/state/archive/2020/arizona/state_tables.php (Table 1)
[23] https://www.aps.com/en/About/Our-Company/Clean-Energy
[24] https://media.srpnet.com/srp-board-of-directors-approves-more-ambitious-sustainability-goals/
[25] https://www.tep.com/news/tep-targets-net-zero-carbon-emissions-faster-clean-energy-expansion-in-new-resource-plan/
[26] https://www.gevernova.com/gas-power/applications/grid-firming

example, the majority of SRP's fleet of natural gas turbines could be capable of cofiring natural gas with hydrogen at a composition of 40% (by volume) hydrogen today.[27]

By 2050, technological developments may enable gas turbines to operate entirely on hydrogen. Because the costs of hydrogen generation, storage, distribution and firing as fuel for gas turbines will likely mean hydrogen remains a relatively expensive yet reliable resource, this paper assumes that hydrogen will be used to generate only 5% of the state's electricity in 2050. If by 2050, Arizona's 100% hydrogen capable gas turbines fleet are used only on an as-needed basis during times of peak demand (5% capacity factor) and could reliably fire with 100% hydrogen, approximately 600,000 metric tons of hydrogen would be required to generate approximately 8,200,000 MWh[28]. Common peaking units such as the GE LM6000 are already 100% hydrogen capable[29] and are actively being tested to understand the operational impacts of hydrogen use.[30] Using previously stated assumptions, we estimate that 7,500 to 17,000 AF per year of water would be necessary to produce enough hydrogen to meet 5% of Arizona's projected generation demands in 2050. It is reasonable to expect that as hydrogen production via electrolysis powered by zero-carbon electricity becomes more water efficient, the water demand per kilogram of hydrogen will decrease.

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[27] For this to occur, infrastructure improvements external to the generation asset would be necessary to deliver the required hydrogen. This external infrastructure would theoretically be in place for this "2050 Arizona" scenario.
[28] Assumes a thermal efficiency of 34% and an HHV of 25.39 kg/MWh for hydrogen.
[29] https://www.gevernova.com/gas-power/products/gas-turbines/lm6000
[30] https://restservice.epri.com/publicdownload/000000003002025166/0/Product

Hydrogen Fuel for Freight Trucking

The US Department of Transportation estimates that by 2050 freight trucking will carry 78,627 million ton-miles per year in Arizona.[31] Assuming an average freight load of 20 tons per truck and fuel efficiency of six miles per kilogram of hydrogen, the total projected hydrogen fuel required to support freight trucking[32] in the state would be 655,225 metric tons per year. The amount of water annually needed to produce this quantity of clean hydrogen would be between 8,000 and 17,250 AF.

Estimated Annual Water Requirements for Clean H_2 by 2050	
5% of Electric Power Generation	**7,500 – 17,000 AF**
100% of Freight Trucking	**8,000 – 17,250 AF**

Every day, Arizonans make water use decisions that result in consumptive utilization of the resource. While many companies and industries are working to improve their water-use efficiency and reduce their water footprint, some water consumption is inevitably necessary to support economic activities, public health and quality of life. Water demand for a new industry can be managed sustainably and result in a positive outcome for the Arizonans impacted. The two hydrogen-demand scenarios chosen for this exercise (5% of electricity generation and 100% of freight trucking) would require a small percentage of the state's current demand to shift towards hydrogen production and could have positive impacts if shifted in a way that improves overall sustainability and resiliency for the state.

[31] https://ops.fhwa.dot.gov/freight/freight_analysis/faf/. This estimate includes intra- and interstate freight trucking.
[32] Class 8 freight trucking

Part III: Considerations for Ensuring a Sustainable Water Supply for Clean Hydrogen.

Determining the sustainability, feasibility and availability of any particular water supply for clean hydrogen production will require additional analysis that is outside of the scope of this report. However, some general considerations apply.

(1) *Withdrawing groundwater for any use results in aquifer depletion unless the withdrawal is offset by recharge (or within AMAs the purchase of long-term storage credits).* Outside of Arizona's AMAs, there are almost no limitations on groundwater withdrawals for industrial use. Even within AMAs, where the use of groundwater is highly regulated, an industrial user can, under certain conditions, obtain a permit for unreplenished groundwater withdrawals. Within AMAs, industrial users account for over 165,000 AF per year of unreplenished groundwater pumping – enough water to serve 575,000 single family homes for a year.[33] Without recharge, additional groundwater withdrawals for clean hydrogen production will increase the region's unreplenished pumping.

(2) *The sustainability of reallocating water from agricultural uses to clean hydrogen production depends primarily on the source of supply.* As discussed above, throughout most of Arizona, groundwater is considered a non-renewable resource, and its use permanently depletes the aquifer unless it is managed through a combination of limitations on use and aquifer recharge. Without recharge, reallocation from higher to lower water use per acre may slow the rate of depletion but it will not stop depletion.[34] In contrast, re-

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[33] Ariz. Dept. of Water Resources, AMA Data, https://www.azwater.gov/ama/ama-data; see also Ariz. Dept. of Water Resources, Issue Brief: Unreplenished Groundwater Withdrawals (June 15, 2020).
[34] These principles apply equally to re-allocation of groundwater from an industrial use to another.

allocating surface water supplies to clean hydrogen production will not result in aquifer depletion but such supplies are uncertain and difficult to secure.

(3) *Reclaimed water is in high demand.* Under Arizona law, the entity that treats a wastewater supply is free to contract for its disposition, which makes effluent highly useful and marketable.[35] Within Active Management Areas, water providers use effluent to recharge aquifers to accrue credits for stored groundwater and to water turf grass.[36] The cities of Mesa and Chandler exchange effluent with their neighbor the Gila River Indian Community in exchange for a lesser quantity of Colorado River water. As mentioned above, the City of Phoenix is investing in an advanced water purification facility that will recycle treated effluent into the tap water delivery system. Arizona Public Service buys effluent from Phoenix-area cities to cool the Palo Verde Nuclear Generating Station, the only nuclear power plant not located adjacent to a body of water. In recent years, the rising cost of reclaimed water has prompted APS to seek ways to reduce its reliance on it.[37] Outside of Active Management Areas, there may be an opportunity to improve effluent treatment for clean hydrogen source water, but incidental recharge and other environmental impacts must be accounted for to ensure its sustainability.

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[35] *Arizona Public Service Co. v. Long*, 160 Ariz. 429 (1989).
[36] Ariz. Rev. Stat. § 45-852.01. For more information and an interactive dashboard showing accounts by credit holders, *see* Kyl Center for Water Policy, Long Term Storage Credits in Central Arizona (ASU Morrison Institute), https://storymaps.arcgis.com/stories/61c95c2245e549fbb51fb94e7e0070bb.
[37] Beginning in 2025, APS will pay $300 / AF, with the price increasing 3% / year after 2029. https://www.abqjournal.com/news/arizona-nuclear-plant-seeking-alternative-source-of-water/article_eaa22cc5-2c54-56c8-8640-79c75dbc6be1.html.

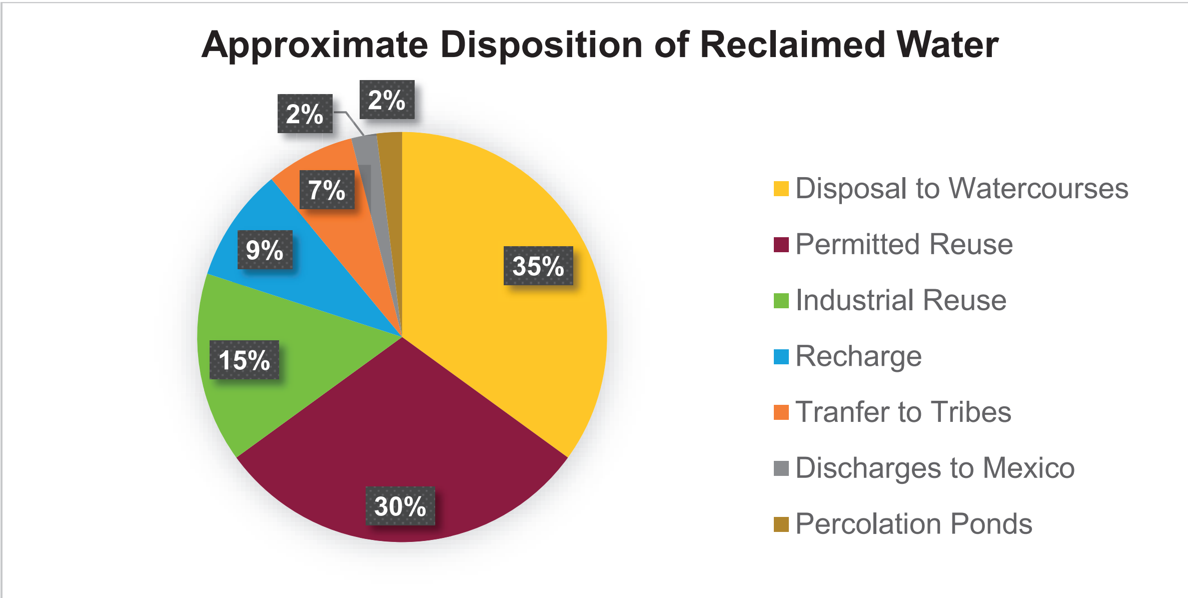

Figure 9: Approximate Disposition of Reclaimed Water[38]

(4) *Even with relatively expensive sustainable water supplies, producing clean hydrogen may still be economically feasible.* For example, water costing $3,000 per AF (roughly the current price for desalinated ocean water from the Claude "Bud" Lewis Carlsbad Desalination Plant) would constitute an input cost of $0.04 to $0.08 per kilogram of clean hydrogen, which is less than 1% of the current cost of clean hydrogen production at $6.2/kg and 3.5% of future cost projections at $1.7/kg.[39]

(5) *Arizona has natural and built infrastructure that may be helpful.* The proximity of any given water supply or water conveyance infrastructure to naturally occurring salt deposits suitable for hydrogen storage will likely be another determinant of the feasibility of clean

[38] Chuck Graf, "Status, Opportunities and Challenges for Wastewater Reuse in Arizona," Presentation to the Governor's Water Augmentation Council page 30 (October 28, 2016) http://infoshare.azwater.gov/docushare/dsweb/Get/Document-9520/10.28.16_GWAC_Master.pdf
[39] See Figure 4 in this document, https://cdn.catf.us/wp-content/uploads/2023/11/21103902/hydrogen-production-electrolysis.pdf.

hydrogen.[40] Because it runs through areas of the state where salt bodies occur, the 336-mile CAP canal can potentially be useful for conveying stock water to clean hydrogen production facilities.

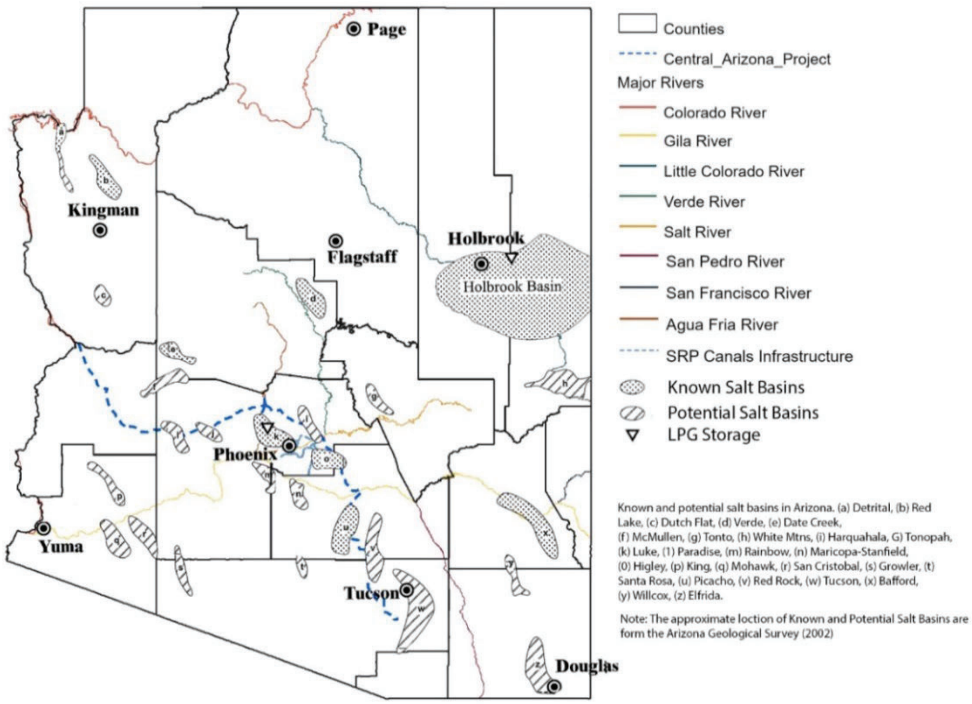

Figure 10: Pertinent AZ Natural and Built Infrastructure

Conclusion

The total projected water volume required to supply future hydrogen-powered freight trucking and to fuel 5% of Arizona's electric power represents about 0.5% of the state's current total annual water consumption. In comparison to other industries, the water demand for hydrogen production, as envisioned in this paper, is relatively modest. If hydrogen

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[40] *See* US Dept. of Transportation, [https://www.phmsa.dot.gov/technical-resources/pipeline/underground-natural-gas-storage/fact-sheet-underground-natural-gas.](https://www.phmsa.dot.gov/technical-resources/pipeline/underground-natural-gas-storage/fact-sheet-underground-natural-gas)

emerges as a critical component of the clean energy transition, this demand may be met through voluntary reallocations of sustainable water supplies which could contribute to Arizona's progress towards greater water sustainability while supporting the development the clean energy transition.