Hydrogen Energy Research Center

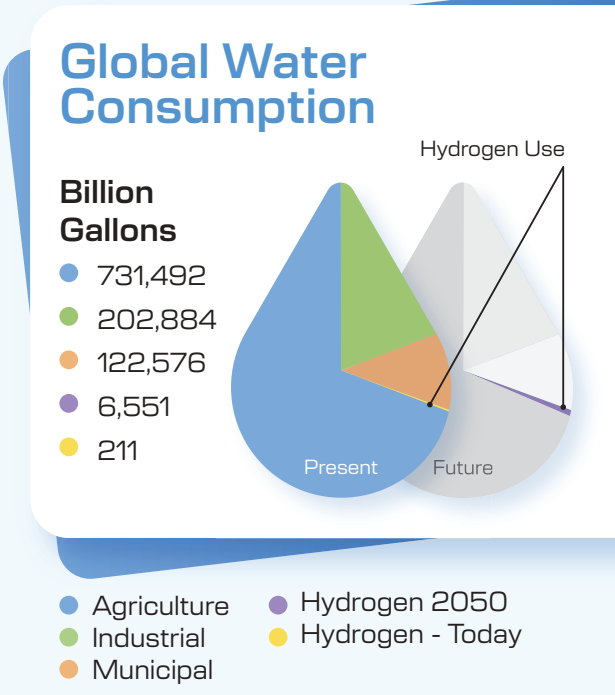
WATER USE FOR HYDROGEN PRODUCTION IN WYOMING

Did You Know?

All modes of hydrogen production require various amounts of water. Water scarcity is a critical issue throughout the Western United States, particularly in Wyoming, the fifth driest state in the nation[1]. As a result, freshwater access can be a limiting factor in the hydrogen production process as the rising population and regional droughts create uncertainty over freshwater availability.

Despite hydrogen production's relatively low water demands - requiring less than 1% of the water used in Wyoming's agriculture by 2050 (**Figure 1**) - the introduction of any new water-consuming energy production faces public scrutiny. The resistance largely stems from concerns over water scarcity and the competition with existing water uses under the state's strict prior appropriation water rights system. Additionally, the lack of public awareness about the water requirements for each hydrogen production method further exacerbates negative attitudes. To ameliorate the issues of scarcity and public opposition, H_2ERC proposes the reuse of treated produced water (PW) - i.e., water in underground formations extracted as a byproduct in oil and gas production - in hydrogen production.

Figure 1 Total Water Consumption by Application in Billion Gallons.[2]



Fun Fact

The amount of desalination production today equals the projected hydrogen production in 2050.

What It Means For You?

Wyoming is the second-largest net energy supplier in the United states.[3] Energy production comprises a significant share of the state's gross domestic product, supporting more than 58,000 jobs and contributing nearly $11.9 billion towards the state's economy in 2021.[4] As the world favors low-carbon energy solutions, Wyoming is well-positioned to spearhead this transition through low-carbon hydrogen production. All hydrogen production methods require water as an input; electrolysis, carbon -free mode, requires about 2-3 gallons of H2O for every 1 kg of hydrogen (**Figure 2**).

Given the physical and regulatory constraints associated with freshwater consumption, utilizing produced water is a natural alternative. Currently PW is treated as a waste-product of mineral extraction activities and is injected into deep underground disposal wells or released in surface evaporation ponds. Disposal of PW through underground injection is not only costly but is also subject to capacity limitations and creates environmental risks, like contamination of groundwater and seismicity.

Wyoming is a stellar candidate for utilizing the untapped PW resource as the state's oil and gas activities result in over 1.4 billion gallons of PW a year.[5] Wyoming is in the top eight of the highest volumes of PW and accounts for 6% of the total national volume. Furthermore, PW in Wyoming is in the top-quality category based on the percentage concentration of total dissolved solids (**Figure 3**). Electrolysis requires ultra-pure water quality as a feedstock - less saline water needs lower amounts of treatment, and as a result is a more cost-effective input.

[1] https://www.wrds.uwyo.edu/drought/drought.html
[2] https://energypost.eu/hydrogen-production-in-2050-how-much-water-will-74ej-need/
[3] https://www.eia.gov/state/analysis.php?sid=WY
[4] https://pawyo.org/paw-api-report-2023/

Figure 2: Total Water Consumption Across Various Hydrogen Production Methods.

Total Water Consumption

for Various Hydrogen Production Methods.

Method	H_2O Consumed (gallons)	H_2O Used in Supporting Devices (gallons)
	(Per kg of H_2 Produced)	
Electrolysis	2.4	0.3 - 0.79
Steam Methane Reforming	1.2	1.59 - 3.43
Autothermal Reforming	1.0	1.59 - 3.43
Coal Gasification	≤ 2.4	~ 4.76
Biomass Gasification	≤ 2.4	~ 2.38

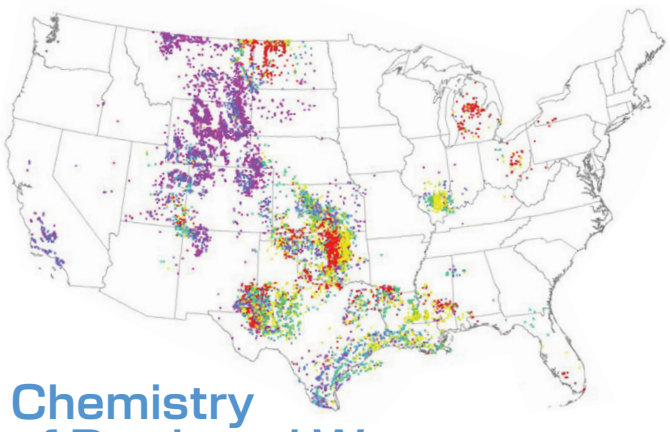
Produced water market itself is a potential source of revenue for the state of Wyoming- currently, the United States oilfield water management market is valued at $37.5 billion.[6] The Permian Basin is an example of an area which began to capitalize on its produced water resources. Although the Permian PW salinity is 8 to 10 times the salinity in Wyoming, the PW hauling market there has grown by 12% a year since 2018.[7] Treatment costs remain the biggest barrier in the beneficial reuse of produced water. As the freshwater resources become scarcer and the market for PW grows, incentives are strengthened to further the R&D of economical water treatment technologies.

Next Steps

H_2ERC is committed to protecting Wyoming's water resources, reducing the costs for disposal of produced water, and demonstrating new ways to make Hydrogen to diversify Wyoming's economy. To achieve these goals, H_2ERC has partnered with Los Alamos National Laboratory, the Wyoming Energy Authority, U.S. Department of Energy, and two commercial companies to demonstrate a technology to desalinate produced water with heat and pressure, and then to maintain that heat to perform steam methane reforming with minimal energy input. This clever integration of water treatment and hydrogen generation will output 1 ton of hydrogen per day and be modular. The project will carry out a pilot-scale field demonstration of hydrogen production using produced water at a cost of 15% below existing methods ($1.30-$2.10/kg of H2), with the goal of reaching the DOE's target of $1 per kg by 2030.

To learn more about how Wyoming can become a leader in Hydrogen while also guarding our water resources please contact us Insert Contact Info for SER.

Figure 3: Total Dissolved Solids (TDS) of Produced Water from Oil and Gas Operations in the United States. For Reference Seawater Salinity (TDS) is about 33,000 ppm.[8]



Chemistry of Produced Waters

in the United States.

Salinity (%) 0-1 1-5 5-10 10-20 20-46

UW School of Energy Resources Hydrogen Energy Research Center

Learn More: *bit.ly/H2ERC*

[5] https://www.gwpc.org/

[6] https://dot-ready.com/water-hauling-market-in-the-permian-basin/

[7] https://dot-ready.com/water-hauling-market-in-the-permian-basin/

[8] Otton, J.K,, 2006, Environmental aspects of produced-water salt releases in onshore and estuarine petroleum-producing areas of the United States- a bibliography: U.S. Geological Survey Open-File report 2006-1154, 223p.