



Blue Hydrogen's Impact on Water Supplies

Clean hydrogen has received a lot of interest for its potential use as a tool for decarbonization but has also prompted a lot of concerns. Hydrogen production and use can have serious consequences on water supplies, particularly in areas already facing water scarcity. The production of blue hydrogen, as well as certain end uses, can be very water intensive.

Blue Hydrogen Production Uses Massive Amounts of Water, Most of which Cannot Be Recycled

- There are two types of water use: water withdrawals, in which water is taken from a body of water, with some of the water recycled back, and water consumption, in which water is withdrawn and altered in such a way that it cannot be returned to the original body of water. Hydrogen production requires both types of water use ([source](#)).
- Blue hydrogen refers to hydrogen produced from natural gas via a process called steam methane reforming (SMR), with carbon capture and storage (CCS) technology deployed during the process to capture emissions. This process relies on water consumption, because the water molecules involved are broken down in such a way that no water remains once the chemical process is complete.
- In SMR, steam and methane molecules are converted into hydrogen and carbon monoxide. **The steam required by SMR consumes 1.2 gallons of purified water per kilogram (kg) of hydrogen produced.** This is the minimum amount of water required to produce the hydrogen, although additional water will be used for cooling during the process. Once the SMR process is complete, the water used for steam has been transformed into hydrogen, and **cannot be recycled back into the original water source** ([source](#)).
- Because the water required by SMR must be purified, the process requires significantly more “raw” water, or water taken directly from a body of water such as an aquifer, lake, or well. Minerals, chemicals, or other compounds must be filtered out of the water before it can be used.

Depending on the water source, most standard purification processes require roughly double the amount of input water to produce the amount of purified water needed ([source](#)). The reject water from the purification process contains a highly concentrated mix of impurities, making it difficult to reuse.

- Blue hydrogen production requires water as an input and for cooling. Blue hydrogen utilizes CCS, which is an energy- and water-intensive process. **92 percent of the total water needed to produce blue hydrogen is used for cooling** ([source](#)).
- This is especially concerning because 55 percent of green and blue hydrogen production capacity (in operation and planned) in the US is in **medium-to-highly water-stressed regions** ([source](#)). Groundwater tables overall are declining more rapidly than in previous decades ([source](#)).

Hydrogen Combustion Can Significantly Increase Water Demand

- While blue hydrogen production can be extremely water intensive, its water impacts can be compounded depending on how the hydrogen is used.
- The energy sector is the largest water user of all industrial sectors, due in part to cooling requirements at most power plants. In the US, thermal power plants requiring water for cooling accounted for more than **40 percent of all water withdrawals in 2015** ([source](#)).

— continue on page 3 —

Concerns about Hydrogen in the Power Sector

Despite the increasing hype surrounding hydrogen in the power sector, there are many reasons to be concerned about its use, including harmful emissions, poor efficiency, storage and transport issues, high water usage, and the potential for explosions.



NO_x EMISSIONS

Burning hydrogen in a power plant can lead to nitrogen oxide (NO_x) emissions at six times the rate of methane. Effective pollution controls for high hydrogen blends and pure H₂ in gas turbines do not yet exist.



DIVERSION OF RENEWABLE ENERGY

When green hydrogen is burned in a power plant, 70% of the initial renewable energy is wasted due to inefficiencies. This diversion of renewables reduces the amount of fossil fuels that could be directly replaced, along with corresponding reductions in CO₂ emissions.



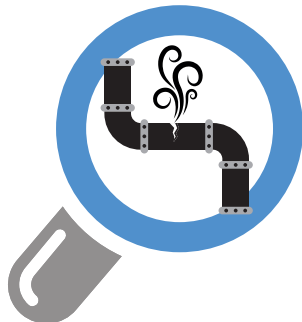
PUBLIC HEALTH

Burning H₂ would create new sources of local NO_x emissions, harming the health of families in frontline communities for decades to come.



HIGH WATER USAGE

Blue hydrogen and green hydrogen production are extremely water intensive. Blue and green hydrogen plants can use over 3 million gallons of water per day, most of which can't be recycled.



STORAGE AND TRANSPORT

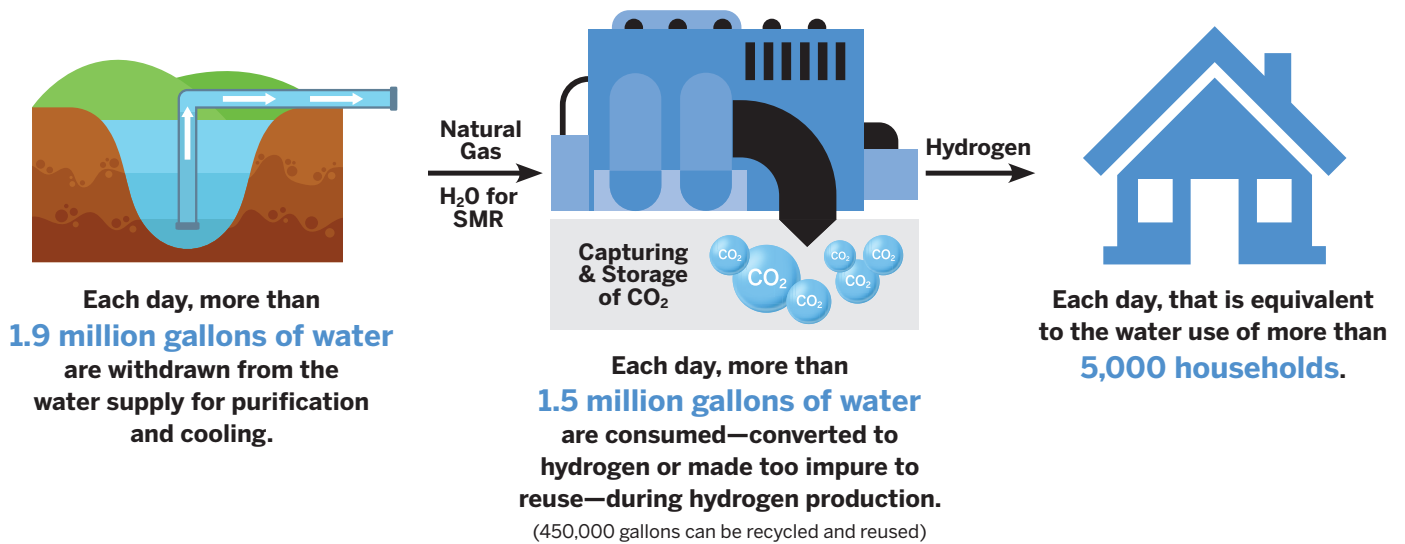
When steel pipelines are exposed to H₂ at high temperatures or high pressure, it can crack the pipes, which could lead to leakage or explosions.



DANGERS OF EXPLOSION

Using H₂ in homes for heating and cooking would lead to four times as many domestic explosions, resulting in increased injuries and loss.

How Much Water Does a **Blue Hydrogen Plant** Use in a Day?



To make blue hydrogen, a plant will withdraw water from a nearby water supply such as a municipal water facility or wastewater treatment plant. If needed, the water will then undergo purification and then be converted into steam via steam methane reforming at the hydrogen plant. The water that is converted into steam, and any rejected water from the purification process, is not able to be recycled back into the water supply and is considered consumed. An average blue hydrogen plant producing over 500 thousand pounds of hydrogen in a day will withdraw over 1.9 million gallons of water and consume over 1.5 million gallons of that water.

Source: <https://www.osti.gov/biblio/1862910>

■ If hydrogen is **combusted in a power plant**, the cooling requirements of the power plant **will increase**. During one pilot in which a blend of hydrogen and natural gas was cofired in a gas power plant, the plant had to increase water injection rates by **20 percent at low levels of hydrogen blending** to maintain air pollutant emissions within regulatory limits. At higher levels of blending, water injections **increased at a linear rate to the amount of hydrogen** (source).

So, Should Clean Hydrogen Be Part of the Clean Energy Transition?

Any role hydrogen fuel plays in the clean energy transition must factor in hydrogen's potential to impact local water

supplies, particularly in regions that are experiencing or will experience water stress due to over-extraction and climate change.

This fact sheet only examines concerns related to blue hydrogen and water. More information about green hydrogen's water impacts can be found in this companion [fact sheet](#).

All types of clean hydrogen production and usage can cause additional harm to nearby communities. While some specific decarbonization use cases may benefit from zero-carbon green hydrogen, these are narrow in scope and should be weighed against the many potential harms associated with hydrogen production and use.



To learn more about other harms associated with hydrogen's production and use, visit www.cleangroup.org/initiatives/hydrogen.