

THE ROLE OF LOW-CARBON HYDROGEN

Hydrogen H₂

zero emission

Low-carbon hydrogen can play a key role in a lower emissions future given its ability to reduce emissions in hard-to-electrify sectors like aviation, shipping, cement, and steel manufacturing. Achieving meaningful emissions reductions will require a combination of all types of low-carbon hydrogen production.

WHAT IS HYDROGEN?

Hydrogen is a molecule (H₂) that emits no carbon dioxide (CO₂), the most common greenhouse gas (GHG), when combusted. **Low-carbon hydrogen can be produced through a variety of processes but the most promising are:**

1 Steam methane reformation (SMR) or Auto-thermal reforming (ATR) using natural gas with carbon capture and storage (CCS)

2 Electrolysis using electricity from low-carbon sources like renewables or nuclear

WHAT IS HYDROGEN CARBON INTENSITY?

The 'carbon intensity' of hydrogen refers to how many kilograms of carbon dioxide equivalent (CO₂e) are released to produce one kilogram of hydrogen. CO₂ equivalencies are used to standardize the emissions impact of other greenhouse gases that may be produced along the production process.

When hydrogen is produced using natural gas paired with CCS it is known as **blue hydrogen**, when electrolysis is powered by renewable electricity it is known as **green hydrogen**, when electrolysis is powered by nuclear energy it is known as **pink hydrogen**.

While these color definitions are widely used, they are not the most helpful for understanding the real impacts of carbon intensity and emissions reductions. Though hydrogen doesn't create CO₂ emissions when combusted, the production process can generate emissions. In the Inflation Reduction Act of 2022 (IRA) Section 45V, Congress defined clean hydrogen as that which is "produced through a process that results in a lifecycle greenhouse gas emissions rate of not greater than 4 kilograms of CO₂e per kilogram of hydrogen."

Carbon intensity, or the CO₂ emissions reduction potential, is the most important metric in quantifying hydrogen's emissions benefit.

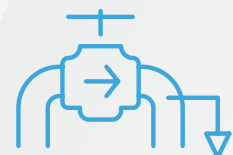
BENEFITS OF HYDROGEN:



Hydrogen can play a key role in reducing CO₂ emissions in high-heat, hard-to-decarbonize sectors, including: **STEEL & CEMENT, REFINING, CHEMICALS, AMMONIA**



It can be blended into existing gas-fired power plants to reduce CO₂ emissions and retain key flexibility and grid reliability benefits as well as balance the variability of wind and solar resources.



Existing natural gas pipelines could be adapted to transport hydrogen, which could mitigate the need for additional pipelines. Hydrogen pipelines have an excellent safety record, operating under federal regulation for decades.

WHAT IS THE OPPORTUNITY OF THE HYDROGEN ECONOMY?

With the funding from the Infrastructure Investment and Jobs Act of 2021 (IIJA) and IRA's 45V hydrogen production tax credit, the U.S. is well positioned to expand global energy leadership in low-carbon hydrogen and drive additional economic growth.

As of January 2023, there were over 130 announced clean hydrogen projects in the U.S. Almost half of the projects announced intend to use natural gas with CCS. While announced projects grew 60 percent in the past year – likely in response to legislative support for hydrogen – the current proposed production capacity of 6.5 MMT by 2030 still lags behind the U.S. Department of Energy's (DOE) goal of 10 MMT of hydrogen by the end of the decade.

A U.S. industry estimate shows that by 2030, the U.S. hydrogen economy could generate



JOBS
700K



ECONOMIC BENEFIT
\$140B

CHALLENGES

To achieve DOE's hydrogen goals and accelerate emissions reductions across diverse sectors, several challenges to the development of a low-carbon hydrogen economy need to be addressed.

- **Permitting and siting H₂ infrastructure.** Hydrogen infrastructure includes production facilities, carbon capture equipment, carbon pipelines, carbon sequestration sites, transmission lines, and hydrogen pipelines. Regardless of production type, pipelines will be required to transport hydrogen from where it is produced to where it will be used. No federal agency has clear siting authority over hydrogen infrastructure. Without regulatory certainty and a clear, consistent, and timely permitting process, the buildout of necessary hydrogen infrastructure will be difficult.
- **Uneven treatment of hydrogen production methods.** Scaled incentives for producing hydrogen from natural gas with CCS, electricity and other energy sources are the best way to fully harness the potential emissions benefits of hydrogen. Currently, the 45V tiers are uneven and provide far greater value to green hydrogen, ignoring the near-term, low-cost GHG advantages of hydrogen produced from natural gas with CCS. Uneven incentive structures and preferential treatment could lead to a smaller hydrogen economy.
- **Uncertainty surrounding the future hydrogen economy.** Without regulatory certainty and clear, consistent guidance on the functioning of a hydrogen economy in the long-term, potential producers and buyers of low-carbon hydrogen will be reluctant to make the significant investments required. Only 10% of projects in the U.S. have reached final investment decision (FID), signaling that those interested in purchasing hydrogen need additional assurances about the long-term feasibility of hydrogen.

HOW TO ACCELERATE A HYDROGEN ECONOMY:

- Policies should provide regulatory clarity and accelerate much needed permitting reform that can facilitate the **expansion of infrastructure along the full value chain**, recognizing physical and regulatory barriers to buildout. Consistent support for hydrogen transport, storage, and end use will be essential to bolster a nascent hydrogen economy.
- Policies to promote low-carbon hydrogen should be **technology neutral with focus on carbon intensity, not color**, with corresponding credit values based on incremental carbon emissions reductions. Policy approaches should include life cycle analysis of CO₂e to ensure accurate emissions accounting, and leverage existing standards, such as EPA's Greenhouse Gas Reporting Program (GHGRP).
- Policies to support **demand and end-use of low-carbon hydrogen** should be designed to reach diverse sectors. Policies should also provide certainty for the level of financial investment needed to attract private sector investment.