



Pathway to Commercial Liftoff

In the next 5 years, clean hydrogen is best positioned to replace carbon-intensive hydrogen in industrial applications, e.g., ammonia production. In the longer term, the transportation sector may drive significant demand, primarily in heavy-duty vehicles and production of liquid fuels for offroad sectors, such as aviation.

The U.S. is on track to reach its national production capacity goal of 10 million metric tons per annum (MMTpa) by 2030. Publicly announced capacity reflects over 14 MMTpa possible by 2030, not including 3 MMTpa announced as part of the DOE's Hydrogen Hubs Program. The current investment gap in the hydrogen value chain is estimated at \$30-150 billion (B), significantly lower than the \$85-215B gap quoted in March 2023, thanks to the H2Hubs, which represent \$8B in public funding and ~\$40B of private sector crowd-in. DOE has also issued conditional commitments for several hydrogen projects, including Plug Power (\$1.7B) and Monolith (\$1.04B), with other hydrogen projects in the pipeline. The ACES Delta project, which represents a \$504 million (M) loan guarantee, has already reached financial close.

Reaching the target capacity could create up to 100,000 net new direct and indirect jobs related to new capital projects and infrastructure and an additional 120,000 jobs related to operations and maintenance by 2030. New electrolyzer and fuel cell manufacturing facilities announced since 2020 represent up to \$2.9B of investment and up to 5,500 potential new jobs.

The biggest challenge to reaching Liftoff is clean hydrogen's cost relative to its unabated fossil-based alternative, currently priced at less than \$1.50/kg. To address this challenge, DOE is investing in reducing the costs of promising clean hydrogen production technologies, such as electrolysis, and has announced an ambitious Hydrogen Shot Target to enable clean hydrogen production at \$1/kg by 2031. While the cost of electrolysis is currently between 5-7x higher than this target, cost reductions are expected via continued research, development, demonstration, and deployment (RDD&D), falling interest rates, and the 45V production tax credit.

Market Status

Metric	Value	2030 Target
Clean Hydrogen Production Capacity Source: BNEF 2024 Q1	0.08 MMTpa ¹	10 MMTpa ²
Levelized Cost of Hydrogen (LCOH) Source: DOE 2024	\$5-7/kg for electrolysis; \$1.8-2.2/kg for low-carbon reformation	\$1/kg (by 2031) ³
Miles of Pipeline Source: Clean Hydrogen Liftoff 2023	~1,600 miles of dedicated H ₂ pipelines	Low thousands of additional H ₂ pipeline miles ⁴
Total Contracted Offtake Announced ⁵ Source: BNEF 2024 Q2	0.336 MMTpa	10 MMTpa

1. Value as of yearend 2023 2. U.S. National Clean Hydrogen Strategy and Roadmap 3. DOE Hydrogen Shot target 4. Estimates based on potential H2Hub and other deployments 5. Binding agreements only, excludes MOUs

Possible Near-term Actions

1. Project developers could target markets with higher willingness to pay and/or markets with stackable incentives. Initiatives like the DOE's Demand-Side Support Mechanism, announced in January 2024 and currently in its design phase, could help bridge the gap between willingness to pay and delivered costs to accelerate adoption.
2. Project developers could design their projects to optimize costs (e.g., leverage existing infrastructure or co-locate with end markets, site in regions with abundant, low-cost renewable energy, and state and/or international incentives).
3. Investors could take a long-term view on additional and potentially low-cost production pathways, like geologic hydrogen and methane pyrolysis.
4. Equipment manufacturers could focus on deployment at scale while continuing to invest in R&D for electrolyzers and other technical innovations.