LCRI LOW-CARBON RESOURCES INITIATIVE

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EXECUTIVE SUMMARY

THE ROLE OF WATER IN HYDROGEN PRODUCTION

As the world aims to reduce carbon emissions, low-carbon hydrogen is expected to play a key role in decarbonizing difficult-to-electrify applications in multiple industries. Hydrogen is a versatile low-carbon fuel, with production pathways capable of generating hydrogen with both low production-related emissions (scope 1) and utilization-related emissions (scope 2). Hence, hydrogen is likely to be a major element of future energy systems.

Stability of an evolving water-energy nexus is an essential component of ensuring a just and equitable transition into a low-carbon future. With water scarcity observed globally and water-intensive low-carbon hydrogen introduced into the energy sector, the energy industry needs to research the impacts of low-carbon hydrogen on water.

Key insights from the full report include:

- Low-carbon hydrogen is expected to be produced from several different production pathways, including electrolysis, steam methane reforming (SMR) with carbon capture and sequestration (CCS), coal gasification with CCS, and methane pyrolysis. Currently, electrolysis and SMR with CCS are expected to be the most prevalent of these four in a low-carbon economy.
- Both alkaline and proton exchange membrane (PEM) electrolysis require highly purified feedwater to ensure optimal operations. This water quality is typically ASTM Type I or II, which requires substantial treatment in a manner similar to boiler feedwater in steam-electric power plants. Additionally, these systems typically require cooling, which can increase the water footprint if wet cooling is employed.
- Like electrolysis, SMR requires high-purity water as a reactant for both the steam-methane reforming reaction and the water-gas shift reaction. While alkaline and PEM electrolysis use liquid-phase water to meet feedstock demand, SMR (as well as solid oxide electrolysis and coal gasification) uses reactant water in the form of steam. System cooling also adds an additional water burden to these systems when wet cooling is utilized. This burden is compounded when water-intensive carbon capture systems—such as industry-standard solvent-based carbon capture—are implemented.
- Water may not have the greatest economic impact on these low-carbon hydrogen production systems. However, water availability and other water-related considerations (e.g., brine management) could greatly impact project feasibility via permitting and facility siting.

This report outlines the water impacts associated with the production of low-carbon hydrogen from four major production pathways, as well as necessary considerations from a water treatment and water availability perspective.

The Low-Carbon Resources Initiative

This report was published under the Low-Carbon Resources Initiative (LCRI), a joint effort of the EPRI and GTI Energy addressing the need to accelerate development and deployment of low- and zero-carbon energy technologies. The LCRI is targeting advances in the production, distribution, and application of low-carbon energy carriers and the cross-cutting technologies that enable their integration at scale. These energy carriers, which include hydrogen, ammonia, synthetic fuels, and biofuels, are needed to enable affordable pathways to economy-wide decarbonization by mid-century. For more information, visit www.LowCarbonLCRI.com.

Technical Contact

Trent Rogers, Engineer/Scientist IV,
980-829-2867, trogers@epri.com

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EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com