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How green hydrogen is transforming India's steel sector



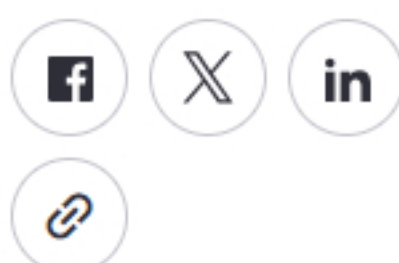
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India's steel sector aims to decarbonize through green hydrogen steel adoption, requiring substantial investment and policy support by 2070.

In brief

- Alkaline electrolysis and biomass gasification with carbon capture are key technologies for green hydrogen production in India.
- Green hydrogen in steelmaking can significantly reduce CO₂ emissions, particularly through the hydrogen-based DRI-EAF route.
- Government incentives and strategic investments are crucial for making low-carbon steel adoption economically feasible by reducing hydrogen costs.

India's steel sector is at a pivotal point in its sustainability journey , aiming to decarbonize through the adoption of green hydrogen steel. This transition requires substantial investment and policy support, with a target set for 2070. Integrating green hydrogen into steel production presents a transformative opportunity to significantly reduce CO₂ emissions, particularly through the hydrogen-based direct reduced iron (DRI) and electric arc furnace (EAF) route.

Green hydrogen production technologies

India is advancing its green hydrogen production infrastructure, transitioning from carbon-intensive methods to renewable-powered electrolysis. The National Hydrogen Mission, launched in 2021, aims to establish India as a global leader in green hydrogen production, targeting five million metric tons annually by 2030. Key technologies driving this hydrogen transition include:

- **Alkaline electrolysis:** A mature technology offering reliability for large-scale production.
- **Biomass gasification with carbon capture:** Providing a near-carbon-neutral pathway.
- **Solid oxide electrolysis:** An emerging high-temperature method with improved efficiency.

Application in steelmaking

Hydrogen steelmaking can be integrated into multiple stages of steel production, revolutionizing traditional carbon-intensive processes. The most promising applications of industrial hydrogen in India include:

- **Agglomeration processes:** Partially replacing conventional fuels.
- **Blast furnace operations:** Reducing coke consumption through hydrogen injection.
- **Direct reduced iron (DRI) processes:** Substituting natural gas with green hydrogen.

The hydrogen-based DRI electric arc furnace (EAF) route is expected to play a crucial role in achieving India's net-zero steel targets by 2070. Industry trials across India are already demonstrating the technical feasibility of H₂-DRI integration in steelmaking.

Economic and policy support framework

The transition to green hydrogen requires substantial investments, estimated at US\$297 billion to US\$304 billion by 2070. To make this transition to low-carbon steel economically viable, the report, 'Role of green hydrogen in Indian steel sector' emphasizes the need for:

- **Production-linked incentive schemes:** To encourage the adoption of green hydrogen technologies.
- **Tax benefits and subsidies:** To reduce the financial burden on steel producers.
- **Public-private partnerships:** To share the investment and expertise required for infrastructure development.
- **A comprehensive green steel policy:** To provide a clear regulatory framework and support for green hydrogen adoption.

While current production costs of green hydrogen exceed those of conventional hydrogen, significant hydrogen cost reduction is projected. By 2030, hydrogen costs are expected to reduce by 40% to 60% through advancement in steel decarbonization technologies and increased renewable energy penetration.

Challenges and strategies

Despite the promising potential of green hydrogen, several challenges must be addressed to ensure its successful integration into the steel sector:

- **High initial investment costs:** Government incentives and strategic investments are crucial to making low-carbon steel adoption economically feasible.
- **Lack of mature infrastructure:** Developing centralized hydrogen hubs and dedicated pipeline networks can improve efficiency and reduce costs.
- **Supply chain logistics and standardization:** Establishing industry-wide standards and optimizing logistics are essential for a cohesive hydrogen ecosystem.
- **Technical challenges and skill development:** Investing in research and development (R&D) and workforce training is critical for improving hydrogen technology efficiency and creating a skilled workforce.