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INDIAN CHEMICAL NEWS

HYDROGEN INDUSTRY OUTLOOK 2026

Transforming Energy for a Sustainable Future

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TRANSFORMING ENERGY FOR A SUSTAINABLE FUTURE

As the nodal agency, SRM University–AP facilitates collaboration among stakeholders, supports translational research, and anchors workforce development initiatives

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India's pursuit of green hydrogen marks a decisive shift in how the country thinks about energy, industry, and development. India's clean energy transition has entered a decisive phase, with the Union Cabinet's approval of National Green Hydrogen Mission (NGHM). The national aspiration to achieve 5 million tonnes per annum of green hydrogen production by 2030, under NGHM, is not simply a quantitative target; it is a qualitative reimagining of India's energy future. Green hydrogen sits at the convergence of climate responsibility, energy security, and industrial competitiveness, offering India a pathway to decarbonise hard-to-abate sectors while simultaneously building indigenous technological and manufacturing capabilities.

NGHM aims to attract investments of over Rs. 8 lakh crore, create more than 6 lakh jobs and cut fossil fuel imports by at least Rs. 1 lakh crore. These numbers indicate that hydrogen is central to India's economic vision.

Green Hydrogen has emerged as one of the promising energy sources to decarbonise core industries, enhancing energy security and open new global markets.

Technology and policy alone will not be able to deliver this transition. At its core, the green hydrogen economy is a human enterprise. Its success depends on whether India can develop a workforce that is scientifically competent, technologically agile, safety-conscious, and industry-ready, innovative applications of hydrogen

> **The pace and complexity of the hydrogen transition demand a rethinking of traditional industry–academia relationships**

in energy intensive sectors, such as railways, aviation, data centers etc. As India transforms its energy systems, it must also transform its education, training, R&D, and institutional frameworks to ensure that skills evolve in step with ambition.

Green Hydrogen as a Systemic Energy Transition

Green hydrogen is produced by splitting water using renewable electricity, resulting in a clean energy carrier that emits no carbon from end to end. While the concept is well understood, its deployment at scale introduces significant complexity. Hydrogen production requires high-performance electrolysers, stable and quality renewable power supply, reliable water management, and robust balance-of-plant systems. Storage and transportation add further layers of challenge due to hydrogen's low volumetric energy density, necessitating solutions such as high-pressure compression, liquefaction, or advanced material-based storage.

What distinguishes green hydrogen from earlier energy transitions is its systemic nature. It does not replace a single fuel in a single sector. Instead, it connects renewable electrical energy with industry, transport, chemicals, and power generation. This interconnectedness means that the workforce supporting green hydrogen must be interdisciplinary—combining knowledge of electrochemistry, materials science, electrical engineering, mechanical systems, digital control, and environmental assessment.

Applications Driving Demand for Skills

Hydrogen's versatility explains why it has emerged as a cornerstone of long-term decarbonisation strategies. In transportation, fuel cell electric vehicles are gaining attention for applications where batteries struggle, particularly heavy-duty trucks, buses, and long-distance mobility. In industrial processes, hydrogen offers a route to deep decarbonisation in steelmaking, refining, and high-temperature manufacturing, where fossil fuels have traditionally been indispensable.

The fertiliser and chemical sectors stand to benefit through the production of green ammonia, reducing dependence on imported feedstocks and lowering lifecycle emissions. Hydrogen also enables long-duration energy storage, complementing solar and wind power by addressing intermittency. Emerging applications—such as backup and prime power for telecom infrastructure, data centres, and even aviation—highlight hydrogen's potential to penetrate new domains as technologies mature.

Ministry of Railways has developed a hydrogen powered fuel cell base passenger

train and will be demonstrated soon. The Indian Railways is undertaking a transformation with a few global parallels.

Each application introduces distinct technical and operational requirements. A hydrogen-based steel plant demands metallurgical expertise and process integration skills, while hydrogen-powered buses require competencies in fuel cells, power electronics, and refuelling infrastructure. Data centres, increasingly energy-intensive due to digitalisation and artificial intelligence, require professionals who understand both hydrogen systems and mission-critical power reliability. The breadth of applications therefore translates directly into a wide spectrum of workforce needs.

National Vision and the Role of Human Capital

The National Green Hydrogen Mission, announced by the Prime Minister, Narendra Modi, positions India as a future global supplier of green hydrogen and its derivatives. The Mission's emphasis on domestic manufacturing, cost reduction, research and development, and employment creation reflects a strategic understanding: leadership in green hydrogen will be determined not only by natural resources or capital investment, but by capabilities embedded in people and institutions.

India's demographic advantage amplifies this opportunity. A young workforce, if appropriately trained, can become a competitive asset in a global hydrogen market that will increasingly value skills in system design, safety management, and large-scale operations. Conversely, without targeted skilling initiatives, the same demographic advantage could become a bottleneck, slowing deployment and increasing reliance on imported expertise.

Andhra Pradesh and the Green Hydrogen Valley Vision

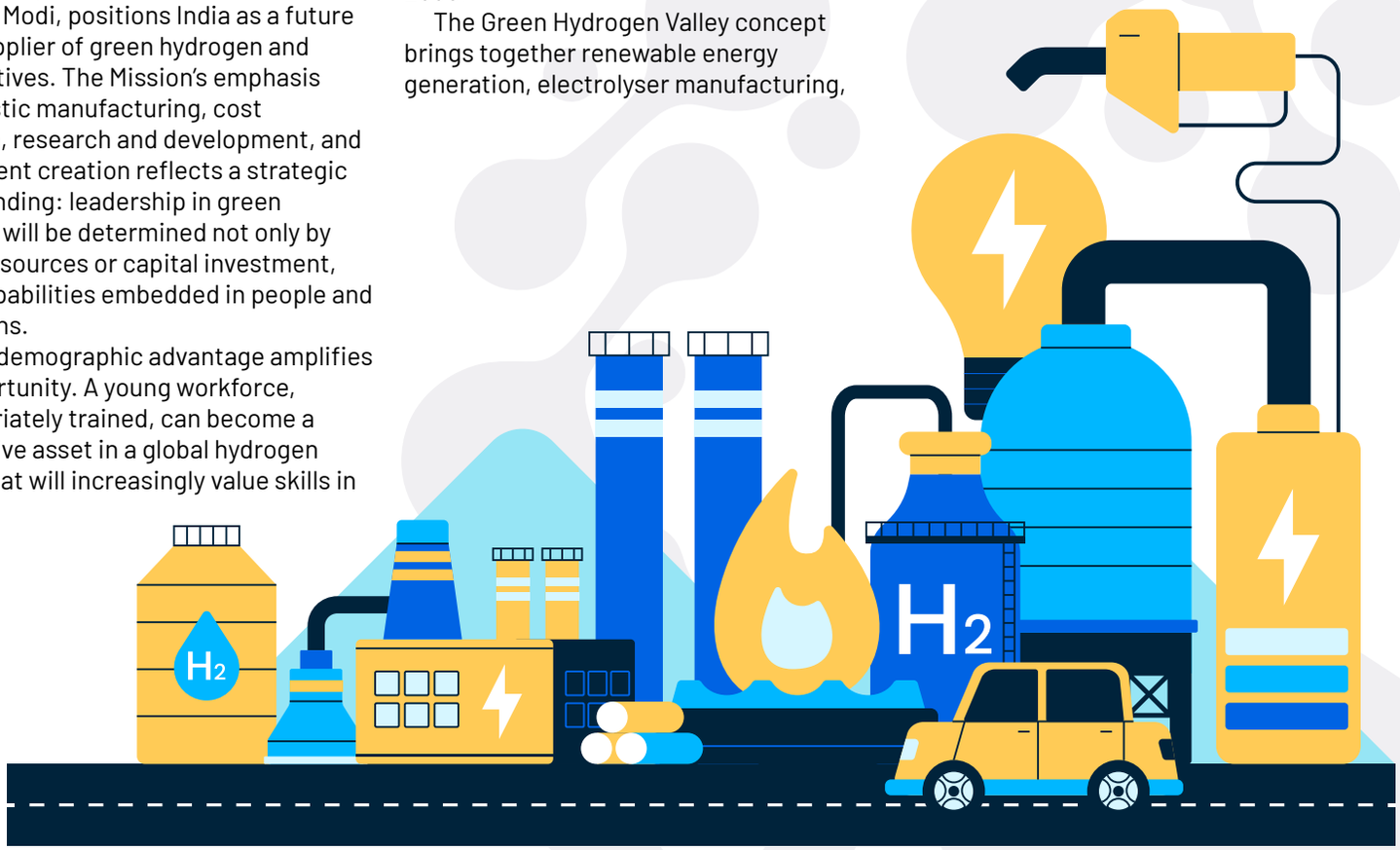
Within this national context, Andhra Pradesh has articulated a particularly ambitious and integrated approach. The declaration of the Green Hydrogen Valley – Andhra Pradesh signals the state's intention and commitment to move beyond isolated pilot projects and towards an ecosystem-based model of development. The vision is to establish Andhra Pradesh as India's largest green hydrogen hub and a global reference point for clean energy transformation by 2030.

The Green Hydrogen Valley concept brings together renewable energy generation, electrolyser manufacturing, hydrogen production, end-use applications, and skill development within a single strategic framework. Targets such as large-scale hydrogen production capacity, local manufacturing of electrolysers and storage systems, and the creation of dedicated green energy corridors reflect a commitment to scale and integration. Equally important is the focus on demand creation through hydrogen-powered transport, industrial clusters, and decentralised energy solutions.

What sets this approach apart is the recognition that infrastructure and incentives must be matched by institutional leadership and workforce preparedness.

SRM University–AP as the Nodal Institution

Recognizing the need for coordinated institutional leadership, SRM



University–AP has been designated as the State Nodal Agency for the Green Hydrogen Valley. This role places the university at the intersection of policy, industry, research, and skill development.

As the nodal agency, SRM University–AP facilitates collaboration among stakeholders, supports translational research, and anchors workforce development initiatives. Its mandate extends beyond academic instruction to include technology validation, start-up incubation, and continuous dialogue between government and industry. By situating the hydrogen ecosystem within an academic institution, the state ensures that learning, innovation, and deployment progress together rather than in isolation.

A particularly significant aspect of this role is the emphasis on creating an integrated green hydrogen skilling ecosystem. Such an ecosystem recognises that hydrogen-related jobs will span multiple qualification levels—from researchers and design engineers to technicians, safety officers, and plant operators. Training programs must therefore be modular, interdisciplinary, and closely aligned with industry needs.

Industry–Academia Partnership as a Cornerstone

The pace and complexity of the hydrogen transition demand a rethinking of traditional industry–academia relationships. Static curricula and isolated research efforts are insufficient in a domain where technologies, standards, and economics are evolving rapidly. Instead, continuous engagement is required, with industry shaping research questions and academia responding with solutions that are not only innovative but also scalable and commercially relevant.

Such partnerships are particularly critical for workforce development. Students trained in hydrogen technologies must be familiar with real-world operating conditions, safety protocols, and industrial constraints. Similarly, professionals already in the workforce require opportunities for reskilling and upskilling as hydrogen systems are integrated into existing industries.

A Centre of Excellence in Hydrogen focusing on production, storage, and utilisation keeping the industry standards on place. The centre is being established at SRM University – AP, in association with industry and the objectives are

- Indigenous development of electrolysers for hydrogen production at industrial scale
- Large scale and novel solid-state storage of Hydrogen using NaBH4
- Direct sea water electrolysis to produce Hydrogen using a low-cost electrocatalyst: A combination of precious metals and mixed metal oxides (Synergized Precious Group Metal Catalysts)

Workforce Development across the Value Chain

A future-ready hydrogen workforce must be developed across the entire value chain. At the upstream end, researchers and engineers are needed to improve electrolyser performance, reduce reliance on critical materials, and develop safer and more compact storage solutions. In manufacturing, skills in precision fabrication, quality assurance, and systems integration are essential to localise production and reduce costs.

At the deployment and operations stage, technicians trained in installation, maintenance, and safety management become critical. Hydrogen's unique properties require rigorous adherence to codes and standards, making specialised training indispensable. Beyond technical roles, the hydrogen economy also demands professionals in project management, policy analysis, environmental assessment, and finance—underscoring the need for multidisciplinary education.

Platforms for Knowledge Exchange and Collaboration

Sustaining momentum in workforce development requires regular platforms for knowledge exchange. Events such as the Green Hydrogen Summit – 2025 are designed to bring together industry leaders, researchers, policymakers, start-ups, and students to share insights and align priorities. Such forums play a vital role in translating policy goals into actionable strategies, while exposing the next generation of professionals to emerging challenges and opportunities.

More importantly, these platforms help build a shared narrative around green hydrogen—as a long-term national mission rather than a short-term technological trend. This narrative is essential for attracting talent, investment, and sustained public support.

Conclusion: People at the Centre of the Hydrogen Transition

India's green hydrogen ambition is bold, timely, and necessary. Yet its realisation will depend on the country's ability to place people and skills at the centre of the transition. Technologies can be imported and infrastructure can be financed, but the capacity to innovate, adapt, and operate at scale must be cultivated domestically.

The Green Hydrogen Valley initiative in Andhra Pradesh, supported by strong industry–academia partnerships and institutional leadership from SRM University–AP, offers a compelling blueprint. By aligning national ambition with regional execution and workforce development, it demonstrates how India can transform energy systems while simultaneously building human capital. In doing so, green hydrogen becomes not only a pathway to decarbonisation, but also a vehicle for inclusive, sustainable, and future-ready growth

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