GREEN HYDROGEN Technology Innovation Digest

Government of Maharashtra

CENTER of EXCELLENCE
for Green Hydrogen Ecosystem Development @ CSIR-NCL

Inside:

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MEDA महाऊर्जा

Maharashtra Energy Development Agency (MEDA)

Maharashtra set foot into a new era of industrialization

A landmark Memorandum of Understanding (MoU) was welcomed by Haffner Energy, which was signed on 16 April 2026, between the Government of Maharashtra, India, JW Global Group and The Seed Consortium Partners. An investment of around €15 billion is planned across four large-scale infrastructure and clean technology projects. The two such projects require the technologies of Haffner Energy, a green-hydrogen technology partner of the Seed Consortium Partners. The strategic importance of Haffner Energy's exclusive solutions in significant industrial decarbonization initiatives is highlighted by these flagship projects:

(i) A 1.4 GW AI-focused campus and data center
(ii) A green-hydrogen production plant

Read more…

Announcement on Trade of Green Hydrogen Derivatives: Green Ammonia & Green Urea

The Government of India, for the significant growth of the National Green Hydrogen Mission (NGHM), announced the Green Ammonia and Green Methanol Standards for India on 27 February 2026. The Ministry of New and Renewable Energy's (MNRE) regulations specify the eligibility requirements and emission criteria that must be satisfied in order for ammonia and methanol produced to be categorized as "Green," that is, created using Green Hydrogen derived from renewable sources.

The notification further states that carbon dioxide for the generation of green methanol can be sourced from existing industrial and biogenic sources, or Direct Air Capture (DAC). Further updates will be provided by the Ministry in future on the list of acceptable sources of carbon dioxide.

Read more...

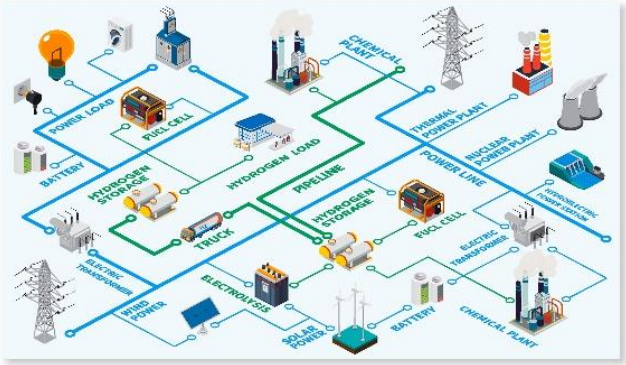
Drivers of Green Hydrogen: Tech Revolution, Economic Viability, and Global Impacts

This review article suggests that the transformation to a green hydrogen economy is driven by a combination of strategic policy alignment and technological advancements. Recent trends indicate that green hydrogen production cost could decrease by up to 50% by 2030 due to improved electrolyzer efficiencies (>80%) and lower renewable energy cost. The expandability of green hydrogen technology depends on multiple factors, including technological innovation, socio-political harmonization, and strategic partnerships. Ultimately, the economic viability of hydrogen for challenging sectors has improved, contributing to global decarbonization efforts and aiding in the long-term maintenance of a sustainable climate. Read More…

Source: Renewable and Sustainable Energy Reviews

Aerial view of 20 kTPA photovoltaic Green Hydrogen Pilot Project—Sinopec's Kuqa facility, Xinjiang, China

Image: Sinopec



Advancing the Future by Coupling Green Hydrogen with Renewables

In this review article, the primary focus is on the Integrated Electricity and Hydrogen System (IEHS). Various algorithmic tools, such as stochastic and robust optimizations, are being employed to enhance academic research for physical modelling and operational management strategies within centralized, decentralized, and hierarchical frameworks. Overall, this review portrays modelling, planning, scheduling, control, and market trading of IEHSs as the reasons behind a developed global hydrogen economy. Read More…

Source: Renewable and Sustainable Energy Reviews

Can Subsidy Policies Boost Green Hydrogen Adoption in India?

States with Green Hydrogen Policy in India (till April 2026)
Data Source: MNRE

This review article focuses on integrating discrete choice technology adoption, sector-specific demand estimation, and cost learning to drive the green hydrogen revolution. The research emphasizes implementing a logit-based market share model and "learning-by-doing" feedback loops.

This approach could lower the Levelized Cost of Hydrogen (LCOH) to $1.84/kg by 2035, may yield cumulative savings of $18 billion by 2050, and potentially boost hydrogen energy demand by 20-80%. The review also advocates for a "coherent policy architecture". Read More…

Source: Energy Policy

Power of AI for Escalating Green Hydrogen in Transport Sectors

This review focuses on the crucial connection between Artificial Intelligence (AI), Green Hydrogen Adoption (GHA), and Network Capability (NC). Together, these elements have been portrayed as vital drivers for advancing sustainable transportation (ST) and the hydrogen economy. The Resource-Based View (RBV) framework presented in this study positions AI as a key technological enabler that boosts hydrogen adoption, while NC plays a significant role in coordinating infrastructure needs. Ultimately, the integration of digital intelligence with networked ecosystems is seen as the future of the hydrogen economy, highlighting the necessity for policymakers to combine AI-based analytics with inter-organizational collaboration. Read More…

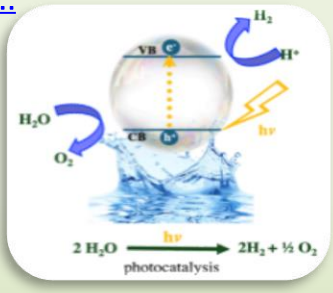
Source: International Journal of Hydrogen Energy

RESEARCH ARTICLES

Hydrogels dominated Photocatalysis for self-sustained Green H_2 Production

This article introduces hydrogels as an emerging multifunctional medium for photocatalytic production of green hydrogen. This also resolves problems of conventional water splitting techniques by acting as both a water reservoir and a catalyst host, which leads to the improvement in dispersion and prevents aggregation. Additionally, innovations like dark photo-catalysis allow hydrogen generation without continuous light. So overall, the hydrogel-based system offers a promising pathway towards a self-sustained and efficient way for green hydrogen production.

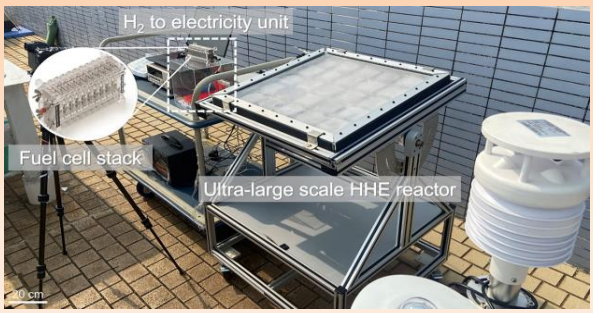
Read more…



Source: ACS Energy Letters

Electricity-free Hydrogen Production from Air

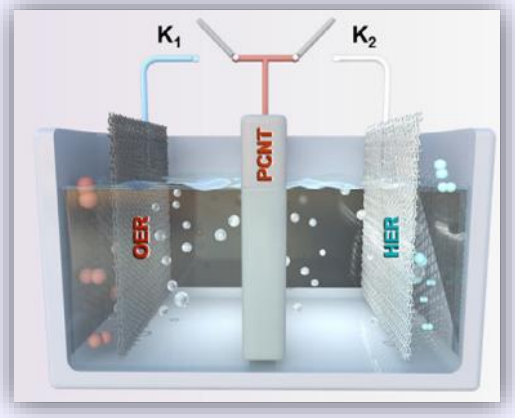
This study explains the electricity-free hydrogen production system, which produces green hydrogen from atmospheric moisture by the process of radiative cooling, photo-catalysis, and photo-thermal conversion. The hygroscopic nanofiber takes water from the air at night, while sunlight-driven processes release vapor and split into hydrogen during the day. This system operates without external electricity, addressing the key limitation of conventional electrolysis. A biphasic gas-solid reaction significantly improves hydrogen production efficiency compared to liquid-phase systems. Read more…



Source: Nature Communications

Conductive Polymer Composites for Decoupled Water Electrolysis

This article introduces a polymer carbon nanotube composite (PCNT) as a solid-state redox mediator for membrane-free decoupled water electrolysis. This material shows an excellent stability over 25000 cycles because of the long-range conductive pathways via π-π interactions that enable high performance. The system operates efficiently under fluctuating renewable energy and can be directly coupled with solar power. This offers a scalable, safe, and cost-effective pathway for high-purity green hydrogen production. Furthermore, this strategy opens new avenues for designing advanced redox-active materials for next-generation energy storage and conversion technologies. Read more...



Source: Advanced Energy Materials

Smart Geospatial Analysis of Green Hydrogen sites in Germany

This study explains the use of a geographic information system (GIS) based multi-criteria analysis to identify the optimal locations for green hydrogen electrolysis in Germany. The principal factors include proximity to renewable energy, electricity grids, hydrogen infrastructure, water availability, and transport networks, while the restricted areas are excluded. The results show that 71.1% of land is unsuitable, with only a small fraction highly suitable, mainly in southern and central regions. The study proposes a framework for data-driven decision support to improve the integration of green hydrogen into future energy systems, optimized site selection, and cost reduction. This also highlights the importance of aligning electrolyzer placements with future hydrogen pipeline expansion plans. Read more…

Source: International Journal of Hydrogen Energy

PATENT SURVEY

Versatile Biomass for Green Hydrogen and Chemicals

Patent Number: WO2025004101A1

CSIR-National Chemical Laboratory has secured a patent for an innovative method of synthesizing palladium nanoparticle-based electrocatalysts. The electrocatalysts convert biomass components into valuable products and the green hydrogen without CO_2 emissions. This breakthrough generates hydrogen at the cathode through electrochemical water splitting at low overpotential value. This technology presents a promising pathway for carbon-free hydrogen generation. Read More…

Femto Green Hydrogen files patent for unveiling Fuel Treatment Technology

Patent Number: PCT/IN2026/050049

Femto Green Hydrogen Limited, a subsidiary of Indo Thai Securities Limited, has patented an invention focused on the decarbonization of ground surface transportation. The innovation employs electromagnetic wave treatment of fuels.

"This development constitutes a strategic advancement towards sustainable transportation solutions designed to reduce carbon emissions in the transport sector." Read More…

Coupled Fuel Cell Hydrogen Storage and Supply System

Patent Number: CN120497368

Xiehe Shanghai New Energy Technology Co., Ltd. has patented an integrated hydrogen fuel cell, hydrogen storage, and delivery system. This invention's technological component includes fixed and movable injection conduction modules, an intake, and other components for monitoring hydrogen's high pressure. This method can also efficiently eliminate water molecules from the injected hydrogen, rather than self-adjusting the injection pressure directed by various hydrogen transmission states. Read More...

From sugars to Green Hydrogen Fuels and Chemicals

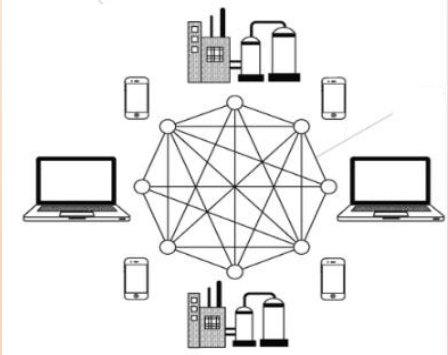
Patent Number: WO2026/058280 A1

An invention incorporating Pd-M based alloy electrocatalysts (M = Cu, Re, Co, Ag) has been patented by the Council of Scientific and Industrial Research-National Chemical Laboratory (CSIR-NCL) in Pune.

"This invention centers around the selective oxidation of disaccharides like lactose, maltose, sucrose, and other C12 molecules into value-added organic compounds in conjunction with the electrocatalytic production of carbon-neutral green hydrogen gas." Read More…

Supply Chain Decarbonization decoded via Digital Carbon Score Tracking

Patent Number: AU2025271453A1



A systematic network approach for reducing carbon footprint production has been disclosed in an invention submitted by Gevo Inc. This technique will monitor a product's carbon intensity (CI) score. An automotive mechanic model will gather input data from each supply chain's stakeholders and offer sophisticated recommendations to manage the goods' CI ratings. Read More…

REPORTS

Green Hydrogen And Future Fuels

Published by Abu Dhabi Sustainability Week (ADSW) Advisory Committee

This report underscores that China has emerged as a dominant force in the global export market, posing a significant challenge for other nations, which must weigh the dilemma of protecting domestic manufacturing against the allure of low-cost imports from China. The report further reveals that around 60% of the value of green hydrogen is tied to end-use technologies, with 25% in production and 15% in mid-stream logistics. This presents an opportunity for countries to not only focus on hydrogen production but also to stimulate domestic demand. The narrative of “Think Big, Start Small” encourages starting with the establishment of 10 MW regional production hubs rather than waiting for extensive 10 GW facilities to be built. Read More…

Source: Abu Dhabi Sustainability Week

Securing India’s Green Hydrogen Future

Published by Chintan Research Foundation March 2026

This report addresses the annual demand for 125 million cubic meters of high-purity water, which is necessary to meet the goal of producing 5 MMT of green hydrogen by 2030. This level of demand parallels that of a mid-sized city, raising concerns about the pressure on India's already strained freshwater resources. The report suggests a strategic pivot towards a Water-Responsible Hydrogen model focusing on seawater desalination (SWRO) and utilizing India’s extensive coastline of 7,500 km as a key resource. Additionally, the report illustrates how RFNBO certifications from the EU and Japan emphasize that hydrogen production must not come at the expense of freshwater resources. Read More…

Source: Chintan Research Foundation

India’s Green Hydrogen Strategy in Action

Published by French Institute of International Relations (IFRI) MEMOS

This report outlines an ambitious plan to reduce hydrogen production costs from €4.80/kg to €1.37/kg by 2030. The long-term goal of India is to establish the world's lowest rates for green energy and expand domestic electrolyzer manufacturing through initiatives like "Hydrogen Hubs" in Tamil Nadu and Andhra Pradesh. India’s targeted hydrogen diplomacy aims to capitalize on the India-Middle East-Europe Economic Corridor (IMEC) to supply 10 million tonnes of hydrogen annually to the EU.

Additionally, India's Green Hydrogen Certification Scheme (GHCI) sets a rigorous standard of 2 kg CO_2/kg of hydrogen, which is more stringent than the EU's threshold of 3.38 kg CO_2, ensuring compliance with the RFNBO requirements for Indian hydrogen. A strategic approach has also identified ports such as Kandla, Paradip, and Tuticorin as integrated hubs to support the co-location of 20 GW-scale renewable energy and green derivative production, thereby lowering overall logistics costs. Read More…

Source: IFRI

TECHNOLOGY DEMO PROJECTS

Oriana Power cracks ₹3,135 Cr Green Ammonia deal with SECI

Solar Energy Corporation of India (SECI) and Oriana Power have come under one roof for a significant advancement in the commercialization of green hydrogen derivatives. The initiative aims to produce 60,000 tonnes of green ammonia each year over a decade in Sagar, Madhya Pradesh.

"A fixed-price revenue model set at ₹52.25 per kg is emerging as a strong competitor for market interest in green hydrogen projects." Read More…

Source: Elite Wealth

NeuEN to supply 10,000 TPA Hydrogen to Numaligarh Refinery

NeuEN Green Energy, a joint venture between BPCL and Sembcorp, has agreed with Numaligarh Refinery (NRL) to effectively implement a green hydrogen production facility with a capacity of 10,000 TPA in Assam. This initiative aims to phase out gray hydrogen in hydrocracking and hydrotreating processes to reduce carbon emissions. The project incorporates macro-scale electrolyzers alongside Battery Energy Storage Systems (BESS). By leveraging Sembcorp's impressive 7.6 GW renewable energy portfolio, the project ensures reliable energy backup and supports BPCL's commitment to achieving net-zero emissions by 2040. The successful commissioning of this project is anticipated by 2028. Read More…

NUMALIGARH REFINERY LIMITED
A GOVERNMENT OF INDIA ENTERPRISE
NRL

Image: Bloomberg

Source: Business Standard

Inauguration of Solar Hydrogen based Microgrid at Chushul

एनटीपीसी
NTPC

A remarkable NTPC initiative, the 3.7 MW solar-hydrogen micro-grid in Chushul, Ladakh, stands as a testament to innovation at high altitudes, which is operating at a challenging 4,500 meters and in temperatures reaching -40°C. This project harnesses hydrogen as a critical medium for ultra-long energy storage and sustains a self-standing power supply of 200 kW. By implementing decentralized green energy solutions, it effectively replaces carbon-emitting diesel generators. The process starts with solar energy to produce green hydrogen, which is subsequently utilized in fuel cells to generate electricity. **This innovative configuration not only reduces reliance on diesel for avoiding the consumption of one liter for every three units of power produced, but also simplifies fuel logistics in these remote, high-altitude regions.** Read More…

Source: NTPC

Target of 1GW Hydrogen Manufacturing in India by Advait Energy

Advait Greenergy, a division of Advait Energy Transitions, has introduced a modular assembly line for electrolyzers in Mehsana, Gujarat. The 30 MW facility will utilize cost-effective and reliable alkaline electrolysis technology for hydrogen production. The initiative aims to achieve an annual production capacity of 1 GW, transitioning from 100 to 300 MW in different stages. This setup will incorporate technical expertise in solar EPC and Battery Energy Storage Systems (BESS) to ensure smooth execution of decentralized and grid-scale production of green hydrogen. The primary objective of this project is to fulfill the indigenization goals of the National Green Hydrogen Mission (NGHM) and the Panchamrit climate targets. Read More…

Advait Energy
Transitions Limited

Source: Fuel Cell Works

NEW TECHNOLOGY OUTLOOKS

Global Hydrogen Outlook on Technology Shifts: IEA

The global hydrogen review by the International Energy Agency (IEA) has highlighted that global hydrogen demand reached 100 Mt in 2024, yet only 1% of hydrogen energy generation is carbon-free. The study points to persistent challenges in scaling electrolysis, with project delays and cost pressures contributing to a decline in expected global production capacity from 49 MTPA to 37 MTPA. The report states that 65% of the world's installed electrolysis capacity and 60% of manufacturing is controlled by China. **A notable insight from the review is the emergence of a port-centric development model, where just 17 major ports could serve nearly 60% of global bunkering demand**. Read More…

Source: International Energy Agency

De Nora: Hydrogen from Concept to Reality

The energy transition DE NORA report has emphasized that 2026 is becoming a pivotal year where hydrogen technology is moving from a mere idea to tangible economic applications with effective industrial implementations. **Hydrogen is being recognized as a "System-Level Lever" for converting grid energy into a storable and transportable fuel that can balance power grids and strengthen energy security.** Read More…

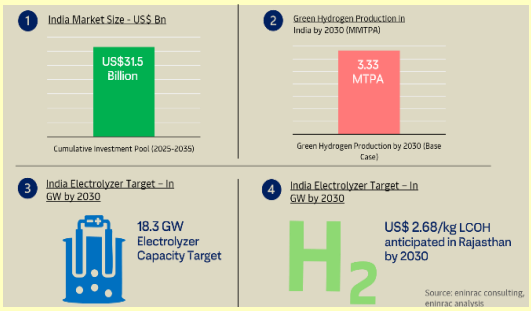
Source: DE NORA

Plug Power: Scaling the Global Hydrogen Footprint

Plug Power has continued to strengthen its position in the hydrogen market in 2025 by supplying 185 MW of electrolyzer capacity to support its expanding GenEco operations. Plug Power's capacity to produce more than 40 TPD hydrogen has surpassed its flagship plant in St. Gabriel, USA.. **The company's GenDrive fuel cell base accomplished a major milestone of 20 million hydrogen refuelings, demonstrating the rising commercial maturity of fuel-cell-powered logistics.** Read More…

Source: Plug Power

India Green Hydrogen Outlook: 2026-2035



According to this outlook, India will mobilize about $31.5 billion in capital for the hydrogen bulk industry. The scenario has also concentrated on Rajasthan, which is using solar tariffs of less than US$ 0.019/kWh to reach a historic LCOH of US$ 2.68/kg by 2030. **The outlook also highlights India's growing export ambitions. Ports in Gujarat, Andhra Pradesh, and Odisha are emerging as strategic gateways for green ammonia exports, targeting rising demand from European Union and Japan.** At the manufacturing level, major players such as Adani Group and Reliance Industries are investing heavily in PLI-supported electrolyzer gigafactories. Read More…

Source: Horizon

Siemens Energy: Powering the Future Hydrogen Grid

Siemens Energy has reached a record order backlog of €146 billion, majorly driven by the expansion of data centers worldwide, highlighting the global demand for power infrastructure. The company has seen a 22% rise in orders linked to data centre infrastructure, particularly within its grid technologies business. Siemens Energy's growing order pipeline reflects how power transmission and grid modernization are becoming critical enablers of the next phase of hydrogen development worldwide. Read More…

Source: Siemens Energy

STARTUPS

h2e Power: Advancing Efficient On-Site Hydrogen Production

h2e Power is emerging as a notable player in the green hydrogen space through its solid oxide fuel cell (SOFC) technology, designed to make on-site hydrogen production more efficient and cost-effective than conventional systems. The company's unique ability includes directly supply of steam to the electrolysis module, improving energy utilization and reducing overall production costs.
It offers flexible hydrogen output ranging from 0 to 125 percent of rated capacity, allowing users to adapt production based on changing demand. This operational flexibility makes the company's solution well suited for decentralized renewable hydrogen generation, an area expected to play a major role in India's future hydrogen economy. Read more...

homiHydrogen: Accelerating India's Electrolyzer Revolution

An Indian company, homiHydrogen, is known for its specialization in electrolyzer manufacturing for the production of green hydrogen. The organization is a joint venture of h2e Power Systems Private Limited and BlueBasic AMA Engineering Private Limited, intending to produce all five types of efficient electrolyzers, AEM, SOE, AMSE, PEM, AWE, with a scale ranging from KW to MW.
Recently, the company announced an investment of $50 million in an electrolyzer plant in Pune, along with signing pacts with Oil India Ltd. (OIL). Backed by Adar Poonawalla, homiHydrogen aims to strengthen India's domestic hydrogen equipment supply chain and support the country's expanding green hydrogen ecosystem. Read more...

Atom H_2 : Revamping Hydrogen Storage

The Spanish startup, Atom H_2, is establishing itself as an organization innovative startup focused on scalable hydrogen-based energy storage systems that help businesses use renewable power more reliably. The company is developing solutions that convert surplus renewable electricity into stored hydrogen, which can later be used to deliver uninterrupted power when solar or wind generation drops.
Few of the companies targeted applications include designing off-grid telecom towers, data centers and essential infrastructures needing continuous power. The startup has already reported pilot deployments in Catalonia, demonstrating the practical potential of its systems in real-world environments..
The company is supported by Industrial as well as research partners such as ELISAVA, IQS School of Engineering, Cellnex, Estabannel etc positioning itself as a leader in next generation energy storage. Read more...

Discovering the power of Natural Hydrogen: Mantle8

Based in Grenoble, France, Mantle 8 is a deep-tech geoscience startup that aims identify 10 million tonnes of natural hydrogen resources by 2030, potentially opening a new low-cost pathway for clean hydrogen supply. The company uses their patented technologies, GeoLogix HOREX, and APoGeh to detect underground hydrogen reservoirs with greater precision. These techniques integrate geology, geophysics and geochemistry data into predictive models that help locate commercially viable hydrogen deposits.
Their latest project involves exploration in the foothills of the Pyrenees, covering 739 square kilometres, across southern France. Mantle8's approach targeting natural hydrogen is positioning them at the forefront of a new segment that could reshape the future economics of the hydrogen industry. Read more...

FUNDING OPPORTUNITIES

AUG 28

India–Finland Joint Innovation Call: DST

Applications are now open for the India–Finland Joint Innovation Call 2026, launched by the Department of Science and Technology in partnership with Business Finland to support industry-led research and innovation projects between the two countries. The programme seeks to accelerate commercialization in priority sectors, including sustainable energy, hydrogen technologies, energy storage, and carbon reduction solutions.

For the hydrogen sector, the call offers an important platform to advance green hydrogen production, storage, and system integration technologies, while encouraging technology transfer and international market access.

Learn more…

प्रौद्योगिकी विकास बोर्ड
TECHNOLOGY DEVELOPMENT BOARD
Department of Science & Technology

MNRE Call for Proposals: National Green Hydrogen Mission

MAY 22

The Ministry of New and Renewable Energy has issued a Call for Proposals under the National Green Hydrogen Mission to support skilling, up-skilling and re-skilling across the green hydrogen value chain. The initiative aims to create a trained, certified and industry-ready workforce to meet the sector's growing demand.

नवीन एवं
नवीकरणीय ऊर्जा मंत्रालय
MINISTRY OF
NEW AND
RENEWABLE ENERGY
सत्यमेव जयते

The scheme will expand national training capacity through State institutions, Centers of Excellence and approved training centers, while encouraging participation from industry, associations and private organizations. This call marks an important step toward strengthening India's human-resource base for the emerging green hydrogen economy and supporting the country's long-term clean energy transition.

Learn more…

MAY 20

Indo-German 2+2 Innovation Proposals: IGSTC

The Indo-German Science & Technology Centre has invited proposals under its "2+2 Project" programme, bringing together research institutions and industry partners from India and Germany to accelerate innovation-driven R&D. The call promotes a 2+2 partnership model, where academic and industrial organizations from both countries jointly develop solutions with strong industrial relevance.

Currently, the focus area is "Economic and Sustainable Solutions," encouraging technologies that combine commercial viability with environmental responsibility. Eligible Indian participants include UGC/AICTE-recognized academic institutions, public or private R&D and companies with majority Indian ownership. The initiative strengthens bilateral technology collaboration while advancing sustainable industrial innovation.

IGSTC
INDO-GERMAN SCIENCE AND TECHNOLOGY CENTRE

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