HYDROGEN INDIA

| Pages: 24 |

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Editorial

Progress has been made on India's National Green Hydrogen Mission, launched in 2023, which aims at making India a global hub for the production, usage, and export of green hydrogen and its derivatives, whilst recognising that India's renewable energy potential is high enough to cater to both national and international demand for green hydrogen. But over two years down the line, significant challenges persist despite plentiful project announcements and private sector financial commitments, leading to slow execution and raising concerns about meeting this goal, as outlined in a Viewpoint Article this time.

India continues to collaborate with other countries to make this goal happen. For example, Germany adopted its National Hydrogen Strategy in 2020, which was updated in 2023 and aims at assuming global leadership in green hydrogen technologies, while recognizing that it will have to import an estimated 1.5 to 3 million tons of green hydrogen by 2030. The country then adopted its Import Strategy for Hydrogen and Hydrogen Derivatives in 2024, which sets out a clear and reliable framework for the urgently needed imports of hydrogen and hydrogen derivatives to Germany.

Both India and Germany are cooperating closely on green hydrogen within various multilateral initiatives and institutions, such as the International Renewable Energy Agency (IRENA), the International Energy Agency (IEA), Technology Collaboration Programmes (TCPs), and the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), and bilaterally within the Indo-German Energy Forum (IGEF) and the Indo-German Green Hydrogen Task Force, which was established in 2022.

Both countries reaffirmed their commitments under the Paris Agreement to achieve net-zero emissions by 2070 and 2045 respectively, in the light of the global stocktake adopted at COP28, and signed the **Indo-German Green Hydrogen Roadmap** in October 2024. The Roadmap recognizes that common goals can be better achieved with close cooperation, and building on their individual strengths and capacities, and will remain in effect for the next five years. Further details are inscribed in an article within, along with private and public sector collaborations from both countries.

Technip Energies—a French engineering and technology company for the energy industry and chemicals sector—was awarded a contract by India's Hindustan Petroleum Corporation Ltd. (HPCL) for a grassroots Green Hydrogen Generation Unit (GHGU). The project is part of the brownfield expansion for HPCL's Visakh Refinery Modernization Project located in India. HPCL then went on to invite bids for the supply of 5,000 tons (5 KTPA) of green hydrogen per year to its Visakh Refinery for 25 years, earlier this year.

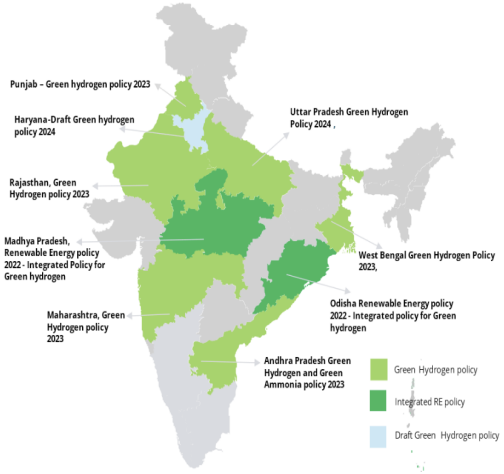
Among other partnerships, GAIL (India) Limited and Accelera by Cummins signed a Memorandum of Understanding (MoU) to

contd on pg 6

CONTENTS

Punjab Unveils Draft Green Hydrogen Policy

The Government of Punjab introduced the draft 'Punjab Green Hydrogen Policy 2023' in April 2025, to promote green hydrogen and ammonia production using renewable energy sources, particularly from agricultural biomass. This initiative supports India's climate goals and aims to establish Punjab as a leader in the green hydrogen sector.



The policy aligns with the objectives of the National Hydrogen Mission 2022 and India's net-zero carbon commitment by 2070. With global green hydrogen markets expanding rapidly and expected to grow into a USD 2.5 trillion industry by 2050, Punjab sees a strong opportunity to contribute significantly to this shift. The state is already rich in biomass from crops like paddy, sugarcane, and cotton, which can be converted into biogas and then into green hydrogen.

Punjab is targeting a production capacity of 100 kilotons per annum of green hydrogen and ammonia by 2030. To support this, the policy encourages innovative technologies such as biomass gasification, electrolysis of wastewater, and hydrogen blending. It also aims to build a complete value chain including production, storage, transport, and usage of hydrogen across sectors like transport, steel, and fertilizers.

To facilitate project development, the state government will offer fiscal incentives, regulatory simplification, and infrastructure support. This includes a 100% exemption on electricity duty during construction, stamp duty waivers for land lease and registration, and exemption from certain charges on green energy use. A special capital subsidy of up to Rs. 15 crore will be provided to biomass-based hydrogen production units, and financial incentives are announced for hydrogen-powered vehicles and refueling stations.

The Punjab Energy Development Agency (PEDA) is appointed as the nodal agency for this policy. All project developers must seek validation and approval through PEDA, and the Punjab Bureau of Investment Promotion will provide single-window clearances to simplify processes.

The policy also gives importance to research, development, and innovation. The government plans to set up a Centre of Excellence to work with research institutions and industry to overcome technological challenges. It will also promote skills development for hydrogen sector jobs.

Infrastructure development is another key pillar. The policy proposes creating hydrogen parks, developing transmission networks, and building hydrogen-ready pipelines. Preference will be given to projects using treated wastewater for electrolysis and to those located in designated safe zones.

Banking facilities for renewable energy used in hydrogen production are also provided, and incentives will be over and above those announced by the central government. The aim is to attract investment, generate employment, and transition the economy toward sustainable development.

Overall, this policy marks a significant step towards making Punjab a hub for clean energy production while supporting economic growth and environmental goals.

For further details, refer:

https://www.peda.gov.in/assets/media/news/GH_Policy.pdf

or contact PEDA at:

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EU-India Cooperation on Waste to Renewable Hydrogen Innovation

The Ministry of New and Renewable Energy (MNRE) is driving India's clean energy transition to enhance energy security and self-reliance. The National Green Hydrogen Mission (NGHM), launched by MNRE in 2023, targets a production capacity of 5 million tons of Green Hydrogen per annum by 2030, supported by the Strategic Interventions for Green Hydrogen Transition (SIGHT) program to bolster electrolyser manufacturing and green ammonia production. This mission aims to position India as a global hub for green hydrogen, thus fostering decarbonisation and reducing fossil fuel imports.

In alignment with India's commitment to the global clean energy transition and pursuance of the decision taken during the European Union (EU)-India Trade and Technology Council (TTC) Ministerial Meeting on 16 May 2023, MNRE has issued detailed guidelines for a joint call for proposals under the EU-India Strategic Partnership and the EU-India TTC Working Group 2 commitment on Waste to Renewable Hydrogen (W2rH) Innovation. The call unites India's MNRE and the EU to advance W2rH technologies. This collaboration enhances sustainability, safety, and affordability, strengthens research ties, and expands technology portfolios, reinforcing bilateral efforts towards a greener future.

EU-India Trade and Technology Council (TTC)

The EU-India TTC, established in April 2022 by Hon. Prime Minister Shri Narendra Modi and European Commission President H.E. Ms Ursula von der Leyen, is a strategic platform to enhance cooperation on trade, technology, and security. Created to strengthen bilateral ties amid a multipolar world, it leverages the shared democratic values and economic strengths of India and the EU. The TTC's importance lies in fostering innovation, market access, and sustainable growth, aligning the two regions' ambitions for a resilient, tech-driven future.

Working Group 2 (WG2) on Green and Clean Technologies under the TTC drives this agenda by accelerating the shift to sustainable, low-carbon economies. As of March 2025, WG2 prioritizes joint research in renewable energy, circular economy solutions, and pollution mitigation, with recent projects focusing on green hydrogen, sustainable urban mobility, and climate-resilient infrastructure. By connecting Indian and EU innovators, WG2 scales clean tech solutions, emphasizing practical implementation and capacity building for a greener tomorrow.

Participating Funding Organisations

MNRE has issued detailed guidelines for a joint call for proposals under the EU-India Strategic Partnership and the EU-India TTC WG2 commitment on W2rH Innovation. Joint funding totals INR 90 crore from MNRE for Indian organizations and EUR 10 million from the EU side. Funding is provided through the EU's Horizon Europe program for EU Member States/Associated Countries (MS/AC).

Call Timeline

Event	Date
Launch of the Call for Proposals	06 May 2025
Deadline for Europeans to submit proposals to Horizon Europe	02 September 2025
Deadline for Indians to submit proposals to MNRE	05 September 2025
Notification of call results to EU & Indian applicants	December 2025 (TBC)
Grant agreement signature for successful projects	By April 2026 (TBC)
Start of first India-funded projects	June 2026 (TBC)

Expected Outcomes

In addition to renewable hydrogen produced by water electrolysis, there is a need to develop other technologies to cover the sustainable hydrogen demand of future society, including industry, energy and transport sectors. Agricultural, forest and industrial biogenic waste resources may offer significant potential for bio-based hydrogen production. Research and innovation (R&I) in this area has been identified as a priority by the EU-India TTC's WG2 to reinforce bilateral cooperation.

Project results are expected to contribute to all of the following expected outcomes:

- Renewable hydrogen producers and consumers based in the EU and India benefit from improved sustainability, safety, and affordability of renewable hydrogen production technologies from biogenic wastes (compared to existing ones);
- Technology developers based in the EU and India benefit from the expanded portfolio of renewable hydrogen production concepts through biogenic wastes use;
- Stakeholders on renewable hydrogen production based in the EU and India benefit from each other's experience on

renewable hydrogen from biogenic wastes; and

- The cooperation between EU and India key researchers, institutions and industries, which are active in biogenic waste to renewable hydrogen research, is supported and strengthened.

Scope

This activity aims at developing innovative technologies to produce renewable hydrogen from biogenic wastes without recycling potential such as agricultural, forest, and the biogenic part of municipal wastes, sewage sludge and industrial waste waters, through biochemical and thermochemical W2rH pathways. Focus will be on increasing the resource efficiency (carbon to hydrogen yield), reducing the greenhouse gas (GHG) emissions or even generating a negative carbon footprint, decreasing environmental footprint for pollution and water consumption, and significantly reducing the production cost of hydrogen. Use of advanced catalysts to enhance primary conversion or upgrading of the intermediate from primary conversion or process intensification methods, including advanced reactor technologies, are in the scope. Utilization of side streams such as aqueous and gaseous streams from primary conversion and/or their further conversion using biological, electrochemical, biochemical and/or catalytic technologies are in the scope as well. Development of feedstock pretreatment methods, including sorting and post-treatment technologies required for hydrogen purification, could be included in the projects.

An assessment of the feedstock cost supply at regional and local level suitable for the selected conversion technology, and improvement of feedstock mobilisation patterns including via enabling technologies, such as digitalisation, should be performed. Preliminary economic feasibility as well as socioeconomic and environmental sustainability of the developed concept including assessing potential impacts on land use, water use, biodiversity, and GHG emissions, as well as social impacts, are expected to be assessed by the project on a life-cycle analysis basis. The production cost of the W2rH pathway should be compared to the state-of-the-art production technologies of renewable hydrogen with the aim to be reduced. Projects should develop an overall process concept using advanced modelling techniques including flowsheet modelling for mass and energy flows.

Safety aspects and ways to increase safety concerning the hydrogen and other gaseous and system component leakages are expected to be addressed in a 'Hydrogen safety planning and management' plan at the project level. Project developers are encouraged to contact the European Hydrogen Safety Panel (EHSP) established under the Clean Hydrogen Partnership to benefit from the developed experience in safety issues for hydrogen systems. The projects should lead to commercially viable and economically interesting pathways when up-scaled.

This topic aims at exploiting synergies between India and Europe in terms of scientific expertise and resources in topics related to W2rH production by implementing coordinated projects. Potential areas for collaboration (i.e. the coordinated part of the call) could include (but are not limited to) optimising fermentation and thermochemical processes, developing new catalysts, and improving separation techniques, as well as assessment of sustainability, technoeconomic feasibility and safety aspects including by using advanced process modelling.

Type of Research to be Funded by MNRE India

MNRE encourages projects combining applied research with demonstration/pilot phases up to Technology Readiness Level (TRL) 5 (see Guideline 3), focusing on advanced catalysts, process intensification, feedstock pretreatment, and hydrogen purification. Coordinated efforts with EU partners will leverage India's expertise in waste-to-hydrogen conversion, targeting scalable, cost-effective pathways that align with the NGHM, and add value through practical implementation and regional feedstock optimization.

Criteria

The projects are expected to run for either 36 or 48 months and must start after June 2026. Linked EU and Indian projects are required to share the same start and end dates to ensure close coordination.

Indian applicants must be academic institutions, public R&D organizations, government autonomous bodies, or industries including startups. The participation of technology designers and providers is encouraged. Private sector involvement is welcomed under certain financial and operational guidelines, and funding to these entities is subject to reimbursement based on performance and expenditure documentation.

Key expectations from selected projects include increased efficiency in converting carbon to hydrogen, significant reduction in greenhouse gas emissions, and lower environmental impact. Advanced modeling and safety planning for hydrogen systems are essential components. Applicants are required to perform a lifecycle assessment covering economic, social, and environmental sustainability.

Indian submissions must include a consolidated budget in Indian Rupees, and various certifications, and follow MNRE's financial and technical formats.

Evaluation of proposals will be based on excellence, impact, and the quality of implementation, each assessed independently by peer reviewers. The final decision will be based on a consensus report prepared by a joint evaluation panel. Successful proposals must also establish a Consortium

Category	Details
Call Text	HORIZON-CL5-2025-04-D2-13: EU-India Cooperation on Waste to Renewable Hydrogen Innovation EU Horizon Europe: HORIZON-CL5-2025-04-D2-13
Technology Readiness Level (TRL)	Research and Innovation Actions (RIA) up to TRL 5, aiming for TRL 5+ as an outcome
Submission Deadlines	o Horizon Europe (European Coordinator): **02 September 2025** (17h00 CET) o MNRE (Indian Coordinator): **05 September 2025** (17h00 IST) (electronic)
Minimum Participants	At **least 3 independent entities from India and 3 from Europe** (3 distinct legal entities from 3 different EU Member States/Associated Countries, per Horizon Europe rules)
Indian Eligible Organizations (MNRE)	**Indian Coordinator Institution:** Faculties/scientists in regular positions at recognized Academic Organizations, Public-funded R&D Institutions/Laboratories, Central/State Government autonomous organizations in consortium mode (Academia/Industry). **Participating Entities:** Includes DSIR-recognized SIRO organizations, industry associations, industries, etc. Participation of industries/PSUs/startups encouraged, with at least one technology designer and provider. Must be distinct legal entities; multiple investigators from the same entity allowed. **Submission Requirements:** Evidence of resources/finances, audited accounts (last 3 years). **Ineligible:** Sole proprietors, partnership firms, companies owned/headquartered outside India or their subsidiaries.
Total Funding Commitment for Call	o MNRE: INR 90 crore (only for Indian consortium) o Horizon Europe: **EUR 10 million** (only for EU consortium)
Maximum Funding per Project	o MNRE: **INR ~ 45 crore** per project for Indian Consortium o EU: **EUR ~5 million** per project for European Consortium Up to **2 projects** may be funded. The per-project funding ensures these outcomes are addressed effectively. However, proposals with different funding requests can still be submitted and considered.
Duration of Project	Either **36 or 48 months**, to be decided by the joint consortium and must be same for both European and Indian partners
Funding and Eligible Costs (MNRE)	Indian academic institutions, public R&D labs, government autonomous organizations may receive up to 100% of approved costs as grant-in-aid, covering personnel, equipment (max 30%), consumables, travel, subcontracting (max 20%, in India), and overheads, per MNRE rules
Proposal to Horizon Europe F&T Portal	European Project Coordinator submits full proposal (Part A + B) to Horizon Europe F&T Portal as per the European Commission Rules by **02 September 2025**
Submission of Proposal to MNRE India	Indian Project Coordinator submits full proposal (Part B, identical to Horizon Europe submission + Consortium and Financial details) as a consolidated PDF to MNRE R&D Portal (https://research.mnre.gov.in) by **05 September 2025 (17h00 IST)**, with budget (Annex) and certificates (Annex)

Agreement to manage intellectual property rights, responsibilities, and result dissemination.

The guidelines stress that proposals must reflect genuine EU-India cooperation and must clearly show how joint efforts will add value. Emphasis is also placed on gender balance and transparency in fund usage. All partners are expected to engage in common networking and joint activities throughout the project duration to foster deeper collaboration and knowledge exchange.

Contact Points:
o Primary: Mr. Sujit Pillai, Scientist F, MNRE; Email: sujit.pillai@gov.in
o Secondary: Mr. Prashant Dwivedi, Scientist C, MNRE; Email: prashant.mnre@gov.in

Information Sources:
o MNRE: https://mnre.gov.in/ & https://research.mnre.gov.in/home
o Horizon Europe: https://research-and-innovation.ec.europa.eu/index_en

Editorial... contd from page 1

collaborate on clean energy projects, focusing on hydrogen production, blending, transportation, and storage. The agreement, signed during India Energy Week 2025 in New Delhi, aims to accelerate India's transition towards sustainable energy. GAIL, a Maharatna public sector unit (PSU) under the Ministry of Petroleum and Natural Gas (MoPNG), plans to leverage its natural gas infrastructure, while Accelera by Cummins will provide expertise in hydrogen technologies. The partnership will explore integrating hydrogen into existing energy networks, including natural gas pipelines, and its application in transport, power, and industrial sectors. GAIL installed its first green hydrogen plant at GAIL Vijaipur in Madhya Pradesh.

The Ministry of New and Renewable Energy (MNRE), under the Government of India, has also issued detailed guidelines for a joint call for proposals in partnership with the European Union, with a deadline of September 2025. The initiative is part of the EU-India Trade and Technology Council (TTC), specifically under Working Group 2 focused on Green and Clean Technologies. This collaborative effort is aimed at advancing technologies that convert biogenic waste into renewable hydrogen, an area that supports both India's National Green Hydrogen Mission and Europe's sustainability goals.

The call, titled "EU-India Cooperation on Waste to Renewable Hydrogen Innovation", invites project proposals from consortia comprising at least three entities from India and three from the EU, each from different countries. The goal is to develop innovative biochemical and thermochemical technologies that can efficiently and sustainably produce hydrogen from waste sources such as agricultural residues, forest waste, sewage sludge, and industrial wastewater.

Solar Energy Corporation of India Ltd. (SECI), under MNRE, signed an MoU with H2Global Stiftung (H2Global) to enhance knowledge exchange on market-based mechanisms and foster cooperation between India and importing countries, thereby contributing to the global advancement of the green hydrogen economy.

As global aviation grapples with its environmental footprint, hydrogen is emerging as a promising path forward—a clean, efficient fuel source that could reimagine and re-cast how we fly. Among the early movers in this domain is MEHAIR, India's pioneering seaplane operator, which has taken a bold leap into hydrogen-electric propulsion in partnership with ZeroAvia, a global leader in hydrogen aviation technologies.

Xynteo continues to roll along its firm path to support hydrogen start-ups. Its Energy Leap initiative introduces us to three more innovative start-ups tackling the sector's biggest challenges with ground-breaking solutions. These companies are leading this transformation by addressing different aspects of the hydrogen value chain—from sustainable production using agricultural waste to cutting-edge electrolysis technology and practical retrofit solutions for existing diesel vehicles.

Diesel generators (DG sets) have been the go-to backup solution. But today, they come with serious drawbacks. Not only are they noisy and polluting, but they are also facing strict regulatory scrutiny. Several countries have placed tough regulations on diesel generator emissions, especially nitrogen oxides (NOx) and particulate matter (PM). Managing diesel leaks, spills, and refuelling logistics is also becoming a costly affair.

More importantly, DG sets run on fossil fuel, making them incompatible with a net-zero carbon future. Fuel cells offer a promising alternative. They generate electricity using hydrogen and oxygen through an electrochemical process that produces only water and heat as by-products. Unlike combustion-based generators, fuel cells have zero harmful emissions—making them ideal for use in urban, indoor, or sensitive environments. One of the biggest advantages of hydrogen fuel cells (HFCs) is their runtime flexibility.

Also, diesel continues to power over 95% of long-haul logistics in emerging economies like India, alongside a vast network of earthmovers, and vessels that have no viable green alternative—yet. This is where hybrid hydrogen-diesel retrofits come into play—not as a stopgap, but as a transformational bridge, as detailed within.

Finally, in the run-up to State Initiatives, the Government of Punjab introduced the draft 'Punjab Green Hydrogen Policy 2023' in April 2025, to promote green hydrogen and ammonia production using renewable energy sources, particularly from agricultural biomass. This initiative supports India's climate goals and aims to establish Punjab as a leader in the green hydrogen sector.

As we continue to bring you updates in the green hydrogen space, the Cogeneration Association of India (Cogen India) is poised at the right junction to assist industry to achieve their maximum potential. We look forward to your feedback to make this newsletter more useful to our readers, and hope all stakeholders will join us as members to take this "Green Revolution" forward.

Courtesy:
Cogeneration Association of India

Indo-German Partnership to Drive Green Hydrogen & Ammonia In India

Renewable energy firms from India and Germany are teaming up to drive green ammonia in India.

The Juno Joule Green Energy-SET Select Energy Partnership

Juno Joule Green Energy Private Limited and Germany-based energy trading company SET Select Energy, together with its green energy subsidiary Select New Energies, signed a memorandum of understanding (MoU) to jointly develop and market green ammonia produced in Andhra Pradesh. The agreement was formalised during the World Hydrogen Summit 2025 in Rotterdam.

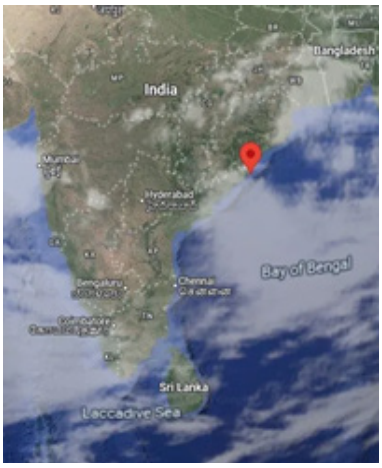
The project, strategically located on the East Coast of India near the under-construction Mulapeta Port *(refer maps),* is designed to produce up to 1 million tons a year of green ammonia, derived from approximately 180 ktpa (kilo tons per annum) of green hydrogen.

Developed in three phases, the project represents one of India's most ambitious green fuel infrastructure initiatives, with an expected total investment of INR 10,000 crores (USD 1.3 billion).

Construction on the project, which will be built to meet stringent European Union RFNBO (EU Renewable Fuels of Non-Biological Origin) norms, is expected to commence in 2026. The project is expected to generate around 5,000 to 6,000 direct and indirect jobs across operations, construction, logistics, and support sectors. It will also lead to technology transfer, upskilling of local talent, and the emergence of the Andhra Pradesh and Telangana region as a clean energy hub on the global map.

The facility will include an advanced desalination plant to sustainably source high-purity water from seawater, electrolysers powered by a diversified mix of solar, wind, and hydropower, and port-connected pipeline infrastructure for efficient large-scale exports to Europe and Asia.

The project will also integrate cutting-edge technologies from global leaders such as Thyssenkrupp Nucera and KBR Inc, and will be supported by international logistics collaborations with partners in Germany and the Netherlands. This strategic move is set to unlock substantial industrial and economic opportunities for both Andhra Pradesh and Telangana. The MoU was signed by Juno Joule Green Energy CEO Nagasharath Rayapati and Select New Energies GmbH Managing Director Felix Danger at Rotterdam.



Once operational, the project is expected to avoid over 1.8 million tons of CO_2 emissions annually.

The location of the under-construction Mulapata Port, where the project is due to be built. Photo: Google Maps

Source: https://apiic.in/wp-content/themes/custom-theme/assets/Pdfs/2024INFRA_MS21.pdf

The Indo-German Green Hydrogen Roadmap

The Indo-German Green Hydrogen Roadmap, agreed upon in October 2024, supports collaborations between both countries, and aims to promote private sector investment and hydrogen trade. This Roadmap was signed as part of the 7th German-Indian government consultations, to make green hydrogen economically viable in the long term and

support global production and trade, the German economy ministry said. A major focus is placed on promoting private-sector investments.

"With its highly competitive renewable energy prices, India has the potential to produce green hydrogen at a globally competitive level. India aims to become a global hub and major exporter of green hydrogen. German energy companies see key investment opportunities in India. At the same time, Germany's economy will increasingly need large quantities of imported green hydrogen. Through collaborations with many hydrogen-exporting countries, we are laying the groundwork for these imports – now including India," German economy minister Robert Habeck said.

Germany needs large amounts of green hydrogen to decarbonize its industry. According to data cited by the ministry, demand is expected to reach between 95 TWh and 130 TWh, equivalent to over 3 million tons, by 2030. Germany's National Hydrogen Strategy aims to import a significant portion of its hydrogen needs. India, at the same time, plans to build a production capacity of 5 million tons of hydrogen per year by 2030 to meet global demand – making this a win-win situation for both countries. The two countries have been collaborating in the field of energy since 2006.

The Roadmap includes the following:

1. Identification and Promotion of Investment Opportunities
2. Global Trade of Green Hydrogen and its Derivative Products
3. Promotion of Private Sector Networks and Partnerships
4. Promotion of Joint Development of Research and Development (R&D) Projects and Partnerships
5. Identification of Instruments to Support Investment in Flagship Projects
6. Sharing Knowledge and Experiences in Regulation, Standards, and Safety Procedures as well as Sustainability Criteria of Green Hydrogen
7. Cooperation on Certification Schemes for Green Hydrogen
8. Exploring Opportunities for Manufacturing
9. Capacity Building
10. Establishment of Indo-German Energy Forum (IGEF) Working Group on Green Hydrogen
11. Status and Implementation
12. Annex 1: Partners of Indo-German Green Hydrogen Task Force
13. Annex 2: Relevant trade fairs and conferences
14. Annex 3: Selection of sources for the roadmap
15. Annex 4: Activities carried out under the Indo-German Green Hydrogen Task Force
16. Annex 5: List of green hydrogen training courses

RWE and AM Green Ammonia Partnership

German energy companies RWE and Uniper have already agreed to import green ammonia from India – both companies will buy part of the output of AM Green's facility in Kakinada, Andhra Pradesh.

In September 2024, RWE Supply & Trading agreed to source green ammonia for its global supply portfolio from the Indian production sites of AM Green Ammonia BV.

Source: AM Green Ammonia B.V.

Ammonia production facility and port infrastructure on the East Coast of India

The parties signed an MoU that will provide the German company with up to 250,000 tons of green ammonia annually. The contracted volumes will come from AM Green's facilities in Kakinada and Tuticorin in the state of Andhra Pradesh and Tamil Nadu, respectively, which use solely carbon-free energy sources such as solar, wind, and hydroelectric power in the production process.

Initially, 50,000 tons of green ammonia will be produced at the Kakinada site, while the remaining 200,000 tons will be sourced from the Tuticorin facility.

The produced ammonia will be certified to meet EU RFNBO standards. AM Green's Kakinada site has already received pre-certification and the same process is underway for its other locations.

As agreed in the MoU, deliveries of the green ammonia are due to begin by 2027. The partners are expected to sign an offtake agreement that will detail the contractual provisions.

KBR has been actively involved in developing and supporting hydrogen projects in India, particularly in the field of green ammonia production. KBR's green ammonia technology (K-GreeN) has been selected by OCIOR Energy for a plant in Odisha, Gopalpur, India, marking the first green ammonia plant in India using KBR technology. KBR's K-GreeN technology is also being considered for a green ammonia project by Avina Clean Hydrogen in the U.S., where KBR will provide the process technology license and engineering design. KBR also plays a role in the development of ammonia cracking technology for hydrogen projects, like the one with Hanwha in Korea, using its H2ACT technology to produce clean hydrogen. In addition, KBR is involved in the development of green hydrogen projects, including the H2OK project by Woodside in Ardmore, Oklahoma, where KBR will provide the FEED (Front-End Engineering Design) for the project.

Sources: Hydrogen Insight, h2-view.com, timesofindia.indiatimes.com, renewablesnow.com

Greenzo Energy Receives Rs. 320 Crore Green Hydrogen Deal from Oswal Energies for 20 MW Plant

Greenzo Energy India Limited, a leading domestic manufacturer of hydrogen electrolysers, has secured an order worth Rs. 320 crore from Oswal Energies Limited for a 20 MW green hydrogen project. The order includes the supply of Greenzo's indigenously developed electrolysers and Balance of Plant (BoP) equipment. The project will be implemented under a Build-Operate-Transfer (BOT) model, marking a key step in advancing India's green hydrogen ecosystem.

Under this partnership, Greenzo Energy will be responsible for the manufacturing and delivery of high-efficiency electrolysers and integrated BoP systems. The company's solutions are designed for scalability and cost-effectiveness, aiming to support the deployment of clean hydrogen across various sectors. Oswal Energies Limited will lead the engineering, procurement, and construction (EPC) aspects of the project. With its extensive experience in delivering turnkey energy infrastructure, Oswal brings deep expertise in both hydrocarbon and clean energy segments.

This collaboration is expected to accelerate India's green hydrogen journey by combining advanced manufacturing capabilities with strong EPC execution. Greenzo Energy focuses on providing end-to-end hydrogen infrastructure, including BOT models, and collaborates with industries in sectors such as chemicals, refining, and mobility. The company is committed to making India a global center for green hydrogen production and innovation through indigenous development and technology integration.

Mr. Ratan Bokadia, Managing Director of Oswal Energies, said in a statement, "This order marks more than a business transaction—it's a decisive step toward India's clean energy future. By partnering with Greenzo for this hydrogen project, we're investing in sustainable, indigenous technology that will power industries and reinforce our commitment to a greener, self-reliant India."

Mr. Sandeep Agarwal, Managing Director, Greenzo Energy India Ltd., stated, "This partnership represents a shared vision to create green hydrogen infrastructure that is scalable, efficient, and aligned with India's net-zero ambitions. Oswal's proven EPC capabilities and global track record, combined with Greenzo's next-generation hydrogen technologies, form a powerful alliance. Together, we aim to build a benchmark project that reflects India's leadership in clean energy manufacturing and execution."

Oswal Energies Limited, headquartered in Ahmedabad, Gujarat, has grown from a small fabrication firm into a full-service EPC provider with a strong track record across upstream, midstream, and downstream energy projects. Since its founding in 2013, the company has delivered over 250 projects across Asia, Europe, and Africa, including complex installations such as gas processing plants, pipelines, and carbon capture systems. Oswal serves major international clients including Shell, ExxonMobil, ONGC, and Cairn Oil & Gas. The Greenzo-Oswal partnership represents a significant milestone for India's green energy ambitions, supporting both domestic manufacturing and infrastructure development in the emerging hydrogen economy.

For further details, contact:
Oswal Energies (https://www.oswalenergies.com/)
Greenzo Energy (https://www.greenzoenergy.com/)

Green Hydrogen Production Using Agricultural & Forestry Waste

Agricultural and forestry waste can be converted into hydrogen through various thermochemical and biological processes, offering a sustainable and renewable energy source. These methods can help reduce agricultural waste, mitigate greenhouse gas (GHG) emissions, and potentially provide additional income for farmers

Biezel Green Energy Pvt. Ltd. (BGE) is an Indian renewable energy company that indigenously developed an electrically-powered Thermochemical Cell that utilizes a novel fractionation process called TAD (Thermally-accelerated Anaerobic Digestion) technology to convert biomass into bio-coal along with the production of hydrogen and methane (natural/biogas). The TAD technology achieves a feed-to-fuel conversion efficiency of close to 45% by weight and 75% by mass with complete fragmentation of biomass in hydrogen, methane, bio-coal, carbon dioxide, and tar. BGE's electrically-powered Thermochemical Cells (TAD reactors) can process any biomass and organic wastes to convert them into carbon-neutral biofuels. In addition, net carbon neutrality can be achieved in one cropping season. This is achieved as the environment in these TAD reactors is similar to the earth's crust to convert bio-waste into useful fuels.

BGE TAD Reactors: Fragmentation of Biomass

BGE`s trademark TAD technology involves a novel fractionation process that extracts hydrogen (3-4%), methane (12-14%), and bio-tar (1-2%) by weight from bio-waste, and converts it into smokeless bio-coal (25%).

BGE`s TAD reactors utilize 10 MT of biomass in a one-time operation of 96 hours. The reactors are equipped with in situ Water Gas Shift (WGS) catalysis. There is no external water requirement for the processing conversion of biomass into biofuels. Almost 72 hours are for running/operation, and 24 hours is the shut-down time for cooling and cleaning (removal of bio-coal) and recharging the reactors with biomass. The TAD reactor needs 1 kWh to process complete fractionation of 1 kg of biomass.

The TAD exhaust (Biezel Bio-Hythane; BBH) after carbon dioxide scrubbing from the TAD reactor contains 65-75% hydrogen and methane or natural gas with HHV close to 64-76 MJ/kg. Then the BBH is separated into ultra-high purity (UHP) hydrogen and LNG through our indigenously developed cryo-separator, which uses the hydrogen's high heat conducting property to separate it from Hythane or BBH using a well of liquefied nitrogen.

The fuel composition is highly dependent on the type of raw material used.

In addition to environmental protection, BGE also proposes ex-situ stubble and agro-forestry waste management to counter stubble burning. With the higher fuel conversion efficiency of TAD reactors, agro-forestry waste can be collected at fair prices. As one acre of land generates about 2 MT of crop residue *(Source: Down to Earth*), farmers can get additional income from the agricultural residue or agro-forestry waste. TAD reactors can process these residues of all the crops grown in the state: bagasse, wheat, rice, cotton, sugarcane, pearl millet, maize, barley, fruits, coconut, lentils, etc.

BGE invented and scaled up the TAD process. We have designed the TAD reactors up to 2 MT biomass capacity. Our TAD system now converts ~45% of the biomass into fuel (~4% hydrogen, 14-16% CNG, 28-30% bio-coal, 2-3% bio-tar). The total output of our process is 4-5 times more efficient than any existing biomass gasification or digestion technology in the world. Our technology is disruptive to the existing fossil fuel-based economy. It is entirely green technology with zero carbon footprint and is pro-environment in nature.

BGE Plant at Mirzapur

Organic waste

TAD reactors

Biezel Bio-Hythane (BBH)

A green solution of industrial gas fuel

- High energy density green fuel
- Absence of corrosive gasses such NOx and SOx (>1%)
- Low carbonaceous exhaust
- Can be used in internal combustion engines as fuel
- Owing to the high energy density and large H_2 content, it can be utilized as jet fuels
- Can be used as high energy fuel in gas-based blast furnaces especially for ceramic, glass and steel industry
- Owing to high temperature melting of glass, ceramic and metals, it is especially useful for clean production of glass, steel cement and ceramics

Village-to-Village-Scale Power Plant

Generally a Tehsil or Vikas-Khand produces 10,000 to 15,000 MT biomass annually. With BGE's TAD Technology 1 kg of bio-waste can produce ~2 kWh (Unit) electricity. Thus a Tehsil or Vikas-Khand can produce 20,000 to 30,000 MWh power/electricity annually. Thus Village-to-Village level 10-25 MW per day capacity power plants can be established. With this technology every village can be self-sustainable in power/energy production.

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Hydrogen Takes Flight

MEHAIR & the Second Green Revolution in Indian Aviation

When the first Green Revolution transformed Indian agriculture in the 1960s and 70s, it wasn't just a triumph of technology—it was a shift in national destiny. Today, as the world races to combat climate change, India is once again on the cusp of a transformation of similar scale. This time, the revolution is in the skies, and Hydrogen is the catalyst.

As global aviation grapples with its environmental footprint, Hydrogen is emerging as a promising path forward—a clean, efficient fuel source that could reimagine and re-cast how we fly. Among the early movers in this domain is **MEHAIR (Maritime Energy Heli Air Services Pvt. Ltd.)**, India's pioneering seaplane operator, which has taken a bold leap into Hydrogen-electric propulsion in partnership with **ZeroAvia**, a global leader in Hydrogen aviation technologies.

Together, they are writing the next chapter of aviation—and potentially ushering in, what can perhaps be referred to as '***India's second Green Revolution***'.

The Case for Hydrogen(erated) Power: The Dance of Water & Fire

At the heart of this shift is the mounting pressure on aviation to decarbonize. Commercial aviation contributes roughly 2.5% of global carbon dioxide emissions, and its broader climate impact—when one accounts for nitrogen oxides, contrails, and high-altitude effects—the figure is closer to 3.5%. While sustainable aviation fuels (SAFs) and improved aircraft efficiency offer partial solutions, neither fully eliminates emissions. Hydrogen, especially in its green form, does. It is creating (fire)power from Water, seemingly an implausible but beautiful dance.

When used in fuel cells, Hydrogen produces only water vapor as a byproduct. Simply put, it is from Water to Water! It eliminates the combustion process entirely, meaning no CO_2, no particulates, and no Nitrogen Oxides. Unlike SAFs, which still rely on carbon combustion (although more efficiently), Hydrogen-Electric power promises genuine zero-emission operations.

From a mechanical standpoint, Hydrogen-electric powertrains are also a leap forward. With fewer moving parts, less heat, and lower pressure, they demand far less maintenance than conventional jet engines. This mechanical simplicity translates into tangible cost savings over time—not just in operational maintenance but in crew training as well. Flight and ground crews can be trained faster and more affordably, with less complexity involved.

Source: https://zeroavia.com/hare/

What makes this even more compelling is that Hydrogen fuel cell (HFC) systems can achieve efficiencies of up to 60%, nearly double that of conventional gas turbines, which typically operate around the 30–35% mark. They are Cleaner, Simpler and Cheaper.

Cost Benefits: Green Cost, Lean Cost

A common misconception is that Hydrogen is prohibitively expensive. That used to be true—but may not hold true anymore. In several parts of the world, particularly where renewable energy is abundant, Hydrogen prices have begun nearing parity with Jet A-1 fuel on an energy-equivalent basis. And as production scales up and technologies mature, Hydrogen is expected to become even more cost-competitive—possibly outperforming traditional aviation fuels in operational economics.

Even today, when factoring in higher efficiency, lower maintenance costs, and training simplification, Hydrogen-electric aircraft show a strong total-cost-of-ownership advantage. This is particularly significant for regional aviation, where frequent, short-haul routes benefit from lower fuel and upkeep burdens.

Which makes MEHAIR's move to integrate Hydrogen-electric propulsion into its fleet not just an environmental statement—it's also a smart business decision.

MEHAIR & ZeroAvia: A Defining Relationship for India

With plans to induct 30 Cessna 208 Caravans—many of which will be retrofitted with ZeroAvia's Hydrogen-electric powertrains—**MEHAIR is setting the stage for India's first fleet of zero-emission aircraft**. The Caravan, long regarded as a reliable workhorse for regional aviation, is ideally suited for Hydrogen conversion thanks to its size, performance, and short-haul capabilities.

This partnership goes beyond technology—it represents a shared vision to make clean aviation commercially viable,

scalable, and regionally impactful. As India revives its seaplane and short-haul networks under regional connectivity programs like UDAN[1], MEHAIR's green aviation initiative is poised to make Hydrogen-powered flights a reality—connecting remote communities, island destinations, and key tourism circuits with zero-emission air mobility.

What sets MEHAIR apart is not just early adoption—but the intent and timing behind it. By introducing ZeroAvia's cutting-edge propulsion systems to India, MEHAIR isn't waiting for the future—it's building it. This is more than a fleet upgrade; it's a declaration of leadership, signalling to policymakers, industry, and the public that **sustainable aviation is not a distant vision—it's within reach, here and now**.

India's Green Hydrogen Ambitions: A National Movement

What adds real momentum to this story is India's deepening commitment to green Hydrogen. The Government of India's **National Green Hydrogen Mission**, backed by an initial investment of Rs. 19,744 crore (USD 2.3 billion), aims to produce 5 million tons of green Hydrogen annually by 2030. The mission's goals are ambitious: reducing fossil fuel imports, creating a clean economy, and positioning India as a global Hydrogen hub.

There's already movement on the ground. India has recently flagged off pilot projects in Hydrogen-powered trains and green Hydrogen manufacturing clusters. States like Gujarat, Rajasthan, and Tamil Nadu are racing to build electrolysis and storage infrastructure, while public and private sectors collaborate to develop a national Hydrogen ecosystem. For a Hydrogen-powered aviation sector to thrive, this ecosystem is crucial. Luckily the signs are promising.

Environmental Gains: From High Altitude to High Impact

Switching from aviation-turbine fuel (ATF) to Hydrogen in aviation has profound environmental implications. Where conventional aircraft emit tons of CO_2 per flight, Hydrogen-electric aircraft emit none. Each Cessna 208 converted to Hydrogen could potentially save several hundred tons of CO_2 annually. When scaled to a fleet, this becomes a significant contribution to both national and global decarbonization goals.

And it's not just carbon. Hydrogen-electric engines reduce noise pollution, lower contrail formation, and eliminate the toxic emissions (like NOx) that contribute to local air quality deterioration around airports. With civil aviation poised

[1] The UDAN scheme, or Ude Desh Ka Aam Nagrik, is a regional connectivity scheme in India aimed at boosting air travel to and from smaller, underserved airports. It achieves this by offering financial incentives to airlines to operate on these routes and by capping airfares for certain routes to make air travel more affordable. The scheme also focuses on developing or upgrading regional airports to support these operations.

Source: https://www.flymehair.com/

to become one of the biggest growth sectors in the post-pandemic economy, going green is no longer optional—it's imperative. Hydrogen provides a realistic, impactful way forward.

The Hydrogen Chemistry: Solution in a Gas

As the aviation world searches for answers to climate change, Hydrogen stands out as both a solution and a symbol—of cleaner skies, smarter economics, and a more responsible way to fly. MEHAIR's pioneering efforts with ZeroAvia position India not just as a participant, but as a leader in this global movement. And in doing so, they are helping script a future where flight doesn't come at the cost of the planet.

While the promise of Hydrogen-electric aviation excites me, I would not be responsible if I did not flag the challenges that could slow its adoption in India. Regulatory hurdles—especially around engine certification by the Directorate General of Civil Aviation (DGCA)—along with limited access to affordable green Hydrogen, supply chain constraints, and safety concerns related to transport, storage, and refueling, are all issues that need to be addressed.

Still, with India's aviation sector growing faster than any other in the world, I believe the opportunity is too significant to overlook. The path ahead may not be easy, but the potential rewards make the journey more than worthwhile.

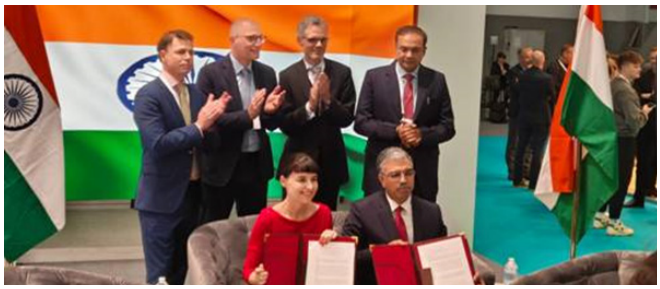
Much like the first Green Revolution transformed India's agricultural self-reliance, this second wave—powered by green Hydrogen—can redefine the nation's independence in clean energy and mobility. Hydrogen is no longer the fuel of tomorrow—it's the revolution of today. And in India, it's taking flight.

Courtesy:
Maritime Energy Heli Air Services Pvt. Ltd. (MEHAIR)
Mumbai
Email: admin@mehair.in
Web: www.flymehair.com

SECI and H2Global Stiftung Sign MoU to Promote Green Hydrogen Initiatives

Solar Energy Corporation of India Ltd. (SECI), under Ministry of New and Renewable Energy (MNRE), signed an MoU with H2Global Stiftung (H2Global) to establish a collaborative framework to promote Green Hydrogen initiatives, on 19 November 2024. The aim of this MoU is to enhance knowledge exchange on market-based mechanisms and foster cooperation between India and importing countries, thereby contributing to the global advancement of the green hydrogen economy.

The MoU was signed by Shri Sanjay Sharma, Director (Solar), SECI, and Dr. Susana Moreira, Executive Director, H2Global, in the presence of Mr Timo Bollerhey, CEO (HintCo), Mr Markus Exenberger, Executive Director (H2Global Foundation), Shri Prashant Kumar Singh, Secretary (MNRE), Shri Abhay Bhakare, Mission Director (NGHM), Dr Prasad Chapekar, DS (MNRE), and Shri K.R. Jyothi Lal, ACS Kerala.



As per the MoU copy on H2Global's website, the areas of cooperation include, but are not limited to:

Joint Tender Design Concept

- Explore the feasibility and design of a joint H2Global tender (export/import variation) for India.
- Explore possibilities to coordinate such joint H2Global tender efforts with SECI's domestic tenders to achieve greater scale and financial impact for Indian bidders.

Information Sharing & Exchange

- Share knowledge about the H2Global mechanism, including outcomes from various research projects and reports produced by H2Global.
- Exchange results and lessons learned from H2Global auctions.
- Share insights on SECI's auction-based models, tender outcomes, and strategies to expand green hydrogen production capacity in India.
- Exchange information about India's domestic green hydrogen market.
- Discuss perspectives on hydrogen trade and logistics, particularly shipping, ports and storage.

Relationship Building

- Foster relationships with hydrogen-related companies and other stakeholders to promote green hydrogen initiatives in India and importing countries.
- Support policy dialogues and stakeholder engagement to enhance renewable energy collaboration.

This MoU will remain in effect for five years and does not create any financial or funding obligations for either party. Such obligations will arise only upon the joint execution of subsequent agreements.

This collaboration offers India the opportunity to work on joint tender design concepts, particularly in structuring joint tenders that align with India's ambition to become an export hub of Green Hydrogen and its derivatives. The cooperation may provide valuable insights into global hydrogen market dynamics, including trade logistics and stakeholder engagement, which can be instrumental in furthering India's Green Hydrogen initiatives.

H2Global is a legal and non-profit foundation in Germany, which aims to accelerate the emergence of markets for clean hydrogen and other low-emission fuels globally through market-based instruments.

SECI is a 'Navratna' Category-I Central Public Sector Undertaking, a nodal agency under the administrative control of MNRE, Government of India. SECI is working with a mission to build a new "Green India" through harnessing abundant solar-wind and other renewable energy resources and to achieve energy security for the country. SECI is also the implementing agency for many of the Government of India (GoI) initiatives under the Strategic Interventions for Green Hydrogen Transition (SIGHT) program under the National Green Hydrogen Mission. SECI has issued tenders for Green Hydrogen Production, Electrolyser Manufacturing, and for Green Ammonia Production till date.

Courtesy:
www.cdn.sanity.io & www.pib.gov.in

Hydrogen: The Catalyst for Decarbonizing Industries & Building a Net Zero Future

By Diganta Sarma, Head – Strategy & Business Development, INOX Air Products

As the world races toward net-zero targets, hydrogen is emerging as a powerful lever in the decarbonization of heavy industries. Its versatility, scalability, and clean combustion profile make it a cornerstone of the emerging green energy landscape. From high-temperature industrial processes to long-duration energy storage, hydrogen bridges critical gaps in the transition from fossil fuels to sustainable alternatives.

At INOX Air Products (INOXAP), we are proud to contribute to this transformation, not just by producing hydrogen, but by delivering integrated solutions that drive adoption at scale. The recent commissioning of our 190 TPA green hydrogen plant for Asahi India Glass at Chittorgarh, Rajasthan is a testament to what can be achieved when vision meets execution.

Hydrogen's Role in the Energy Transition

Hydrogen's potential lies in its ability to decarbonize hard-to-abate sectors such as steel, cement, chemicals, and long-haul transport. Combustion of hydrogen produces only water vapor—eliminating CO_2 emissions at the point of use. It can serve as:

- A reductant in steelmaking to replace coal-based processes
- A fuel for high-temperature furnaces in glass and ceramics
- A feedstock for ammonia and methanol production
- A carrier for long-term energy storage or mobility applications

The spectrum of hydrogen production spans Grey Hydrogen, produced via steam methane reforming (SMR), emits ~9–10 kg CO_2 per kg H_2; Blue Hydrogen, through SMR with carbon capture (60–90% CO_2 reduction); and Green Hydrogen, produced through electrolysis of water using renewable energy, with near-zero emissions.

Scientific & Technical Challenges

Despite its potential, the hydrogen economy faces scientific and engineering hurdles:

1. Electrolyzer Efficiency: Modern PEM electrolyzers operate at ~60–70% efficiency (HHV basis). Research into solid oxide electrolyzers and advanced catalysts could improve this by 10–15%.
2. Storage Complexity: Hydrogen's low volumetric energy density (3 kWh/Nm^3) necessitates compression (~350–700 bar), liquefaction (−253°C), or material-based storage (metal hydrides), each with energy penalties and capital costs.
3. Pipeline Integrity: Hydrogen embrittles steel and diffuses rapidly. Pipelines require special alloys or polymer linings.
4. Safety Protocols: Hydrogen has a wide flammability range (4–75% in air) and low ignition energy (0.02 mJ). Controls and sensors are vital.
5. Lifecycle Emissions: Green hydrogen is only as clean as the power behind it. Water use (~9 L/kg H_2) and overall system design must be considered.

INOXAP's Project at Asahi India Glass – A Real-World Application

At INOXAP, we believe in enabling industrial decarbonization through practical, scalable models. Our commissioned green hydrogen plant at Asahi India Glass Ltd., Chittorgarh, is among the first industrial-scale projects of its kind in India. This is a pioneering project signifying the first instance of a long-term offtake contract in the Indian subcontinent for using green hydrogen. It is also the first instance of use of green hydrogen for float glass manufacturing. Some of the key highlights of the project were:

> Hydrogen Production Capacity: 190 MTPA of green hydrogen using renewable power

> Production Route: Electrolysis

> Estimated CO_2 Reduction: ~1,250 MT per annum

> System Components: On-site generation, compression, cascade storage, safety automation, precision controls

Toward a Scalable Hydrogen Economy: What Must Be Done

To scale hydrogen adoption, coordinated action is needed. Based on our experience, we recommend:

1. Targeted Incentives: Extend Production Linked Incentive (PLI) and Viability Gap Funding (VGF) schemes to industrial hydrogen use
2. Renewable Access: Ensure long-term, open-access renewable power
3. Blending Standards: Develop national safety and blending codes
4. Carbon Pricing: Introduce emissions trading or credits
5. Infrastructure Investments: Develop shared hydrogen logistics
6. Demand Aggregation: Use industrial clusters to pool demand and reduce risk

INOXAP's Vision and Roadmap

With six decades of industrial gas leadership, INOXAP is well-positioned to support India's hydrogen ambitions. Our roadmap includes:

- Scaling electrolytic hydrogen at industrial hubs
- Delivering high-purity hydrogen for semiconductors/solar
- Investing in cryogenic liquid hydrogen logistics
- Collaborating with OEMs, policymakers, academia

Conclusion

Hydrogen will be central to India's industrial decarbonization journey. With demonstrated success, the technology is no longer aspirational—it is already delivering results. INOX Air Products remains committed to powering this transition with safe, reliable, and innovative hydrogen solutions.

Courtesy:
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INOX Air Products Commissions First Green Hydrogen Plant at Asahi India's Chittorgarh Facility

INOX Air Products (INOXAP), India's largest manufacturer of industrial, electronic and medical gases, successfully commissioned its first-ever green hydrogen manufacturing Plant at Asahi India Glass Limited's (AIS) greenfield float glass facility at Soniyana in Chittorgarh, Rajasthan.

AIS, India's leading glass manufacturer, has entered into a 20-year offtake agreement with INOXAP for supply of green hydrogen, to this facility. The plant, powered by solar energy, will have a capacity to generate up to 190 tons of green hydrogen per annum through the electrolysis process. This will be India's first instance of use of green hydrogen in the float glass manufacturing process, paving the way for sustainable glass production.

INOXAP is responsible for the design, engineering, installation, operations and a continuous supply of green hydrogen to the AIS facility for a period 20 years. In the first phase, 95 TPA green hydrogen will be supplied to AIS. As a part of the agreement, the latter has invested in the solar power plant, which is supplying renewable energy for the generation of green hydrogen, which would be further consumed in AIS's float glass manufacturing process.

In his statement, Siddharth Jain, Managing Director – INOX Air Products confirmed that the company's green hydrogen supplies would substantially reduce carbon dioxide emissions at this facility to the tune of 1250 MTPA, thus playing a pivotal role in India's energy transition towards decarbonization.

Rupinder Shelly, COO-Architectural Glass, Asahi India Glass Ltd. added that being the first glass manufacturers in India who are putting green hydrogen to use in the float glass manufacturing process, the company's commitment to sustainability has got stronger. The company aims to fulfil 94% of its power requirements through green and sustainable energy sources at its Soniyana facility.

AIS has commissioned a greenfield project in Chittorgarh, Rajasthan for manufacturing high-quality float glass to be used for automotive and architectural purposes with technology collaboration from its partners – AGC Europe. The agreement with INOX Air Products for setting up a green hydrogen plant for this project is a part of AIS's overall sustainability strategy, and is inspired by their vision to reduce carbon footprint in the glass manufacturing process.

For more information, contact:
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GAIL, Cummins Partner to Expand Hydrogen & Clean Energy Infrastructure

Source: https://fuelcellsworks.com/2025/02/14/clean-energy/gail-cummins-partner-to-expand-hydrogen-and-clean-energy-infrastructure

In February 2025, GAIL (India) Limited and Accelera by Cummins signed a Memorandum of Understanding (MoU) to collaborate on clean energy projects, focusing on hydrogen production, blending, transportation, and storage. The agreement, signed during India Energy Week 2025 in New Delhi, aims to accelerate India's transition towards sustainable energy.

Focus on Hydrogen and Energy Transition

GAIL, a Maharatna public sector unit (PSU) under the Ministry of Petroleum and Natural Gas (MoPNG), plans to leverage its natural gas infrastructure, while Accelera by Cummins will provide expertise in hydrogen technologies. The partnership will explore integrating hydrogen into existing energy networks, including natural gas pipelines, and its application in transport, power, and industrial sectors.

GAIL has already taken steps in clean energy with a 10 MW green hydrogen unit at its Vijaipur plant in Madhya Pradesh, commissioned in April 2024. The plant uses an electrolyzer developed by Accelera. Additionally, GAIL has conducted pilot-scale hydrogen blending in city gas distribution (CGD) networks in Indore, gradually increasing the blend from 2% to 5% in the piped natural gas (PNG) network.

Expansion of Clean Energy Projects

As part of its energy transition strategy, GAIL is setting up multiple projects:

- A 5 TPD compressed biogas (CBG) plant in Ranchi, with plans for 26 more across India in the next three to four years.
- A joint venture (JV) with Leafiniti Bioenergy to establish 10 CBG plants.
- A JV for a 500 KLPD grain-based ethanol plant in Rajasthan.
- A collaboration with Coal India for synthetic natural gas production in West Bengal.

The partnership with Accelera by Cummins aligns with India's broader clean energy goals, focusing on building infrastructure for a hydrogen-based economy while integrating sustainable technologies into the country's energy.

GAIL's 10 MW Green Hydrogen Plant Inaugurated by MoPNG

Marking a major step towards foraying into new and alternate energy, and in line with the National Green Hydrogen Mission, GAIL (India) Limited installed its first Green Hydrogen Plant at GAIL Vijaipur in Madhya

Pradesh, which was inaugurated by the Secretary, MoPNG, Shri Pankaj Jain, in May 2024, wherein GAIL Chairman and Managing Director Shri Sandeep Gupta, Director (Projects), Shri Deepak Gupta, Director (Human Resources), Shri Ayush Gupta, and other senior officials were also present.

This Green Hydrogen plant has the capacity of producing 4.3 TPD of hydrogen, through 10 MW PEM (Proton Exchange Membrane) electrolyzer units, by electrolysis of water using renewable power. The purity of hydrogen from this plant shall be 99.999% (by vol.) and will be produced at a pressure of 30 kg/cm^2.

Initially the hydrogen produced from this unit will be used as a fuel along with natural gas for captive use in the various processes and equipment running in the existing plant at Vijaipur. Further, this hydrogen is planned to be dispensed to retail customers in the nearby geographies, transported through high pressure cascades.

Besides sourcing renewable power through open access, GAIL is also setting up around 20 MW solar power plants at Vijaipur (both ground-mounted and floating) to meet the requirement of green power for the 10 MW PEM electrolyzer.

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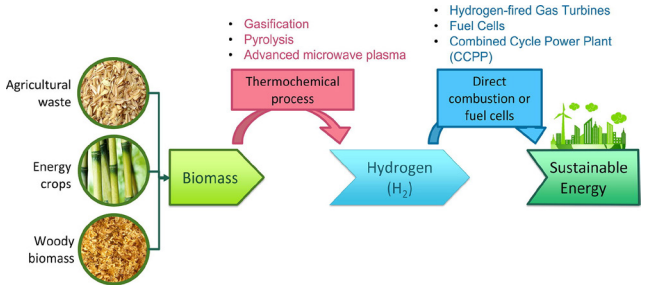
From Farm Waste to Diesel Retrofits: Three Start-ups Redefining India's Clean Energy Future

As India's green hydrogen revolution gains momentum, Xynteo's Energy Leap introduces you to innovative start-ups tackling the sector's biggest challenges with groundbreaking solutions. Three pioneering companies that are part of our cohort are leading this transformation by addressing different aspects of the hydrogen value chain—from sustainable production using agricultural waste to cutting-edge electrolysis technology and practical retrofit solutions for existing diesel vehicles.

BioVikas: Transforming Farm Waste to Green Hydrogen Production



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Founded in 2023 and based in Bengaluru, BioVikas is pioneering a transformative approach to green hydrogen production by utilizing waste such as rice husk, wheat straw, forestry waste, etc., as feedstock. Under the leadership of a seasoned team, including Dinesh Kagathi, Shantonu Ray, and Murali Subramanian, the company has developed an innovative Green Energy-as-a-Service (GEaaS) model that turns farm waste into valuable clean energy.

BioVikas' technology leverages Indian Institute of Science (IISc)-designed gasifiers to create a sustainable, end-to-end solution for converting biomass waste into green hydrogen and other valuable products. Its process not only addresses the critical issue of agricultural waste management but also produces hydrogen at a remarkably competitive cost of less than Rs 350/kg, to a diverse range of potential clients across industries such as oil and gas, chemicals, transportation, glass manufacturing, and energy utilities.

What sets BioVikas apart is its distributed production model, which reduces supply risks and optimizes logistics through AI/ML integration. Its approach delivers multiple benefits: strengthening rural economies, mitigating climate change, and enhancing energy security. The company aims to process 2 million tons of biomass annually by 2030, with a projected impact, including over Rs 700 crore[1] paid to farmers annually and significant CO_2 emissions reduction.

www.biovikas.com

Agastya Hydrogen: Pioneering MW-Scale AEM Electrolysis Technology

Source: https://agastyah2.com/projects/

Agastya Hydrogen is revolutionizing green hydrogen production with the world's first MW-scale Anion Exchange Membrane (AEM) electrolyser technology. Founded in June 2023 at Hyderabad, by serial entrepreneur Shashi Arjula and a team of research scientists, the company is on a mission to make hydrogen affordable for everyone.

The company's breakthrough AEM technology combines the best aspects of existing electrolyser technologies while eliminating their limitations. Agastya's systems operate at up to 2.5X the current density of competitors while achieving a remarkable efficiency of 45.2-54.3 kWh/kg. Their per- and polyfluoroalkyl substances (PFAS)-free membrane technology offers superior safety with no gas storage requirements and rapid response times under one minute.

What makes Agastya truly compelling is its ambitious cost target of achieving USD0.50 per kg of hydrogen by 2030. With eight patents protecting their technology and a team with over 140 years of combined experience in hydrogen generation systems, the company offers scalable solutions from 1 MW electrolyser stations to complete refuelling infrastructure capable of producing up to 11,000 kg of hydrogen daily, to potential clients from heavy industries like steel, mobility and transport, and renewable energy developers.

www.agastyah2.com

Saarthi GreenTech: Retrofitting Diesel Engines for Immediate Decarbonization

Saarthi GreenTech is tackling one of the most stubborn challenges in decarbonization: India's 12+ million diesel trucks and buses that cannot be electrified overnight. Founded in 2023 at Pune by Alok Kumar, the company has

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[1] 1 crore = 10 million

Decarbonizing Diesel: How Hybrid Hydrogen Systems Can Accelerate Emission Cuts Today

By Alok Kumar, Founder & Director, Saarthi GreenTech (An Energy Leap Start-up)

As the global community races toward Net-Zero, the dominant narrative is focused on an all-electric or pure green hydrogen future. However, the hard truth is this—in sectors such as commercial logistics, diesel generators, marine transport, and mining, *the path to zero is neither linear nor immediately feasible.*

Most of today's solutions—battery-electric vehicles (EVs) or hydrogen fuel cell (HFC) systems—require significant infrastructure, policy support, and cost reductions that are still years, if not decades, away. Meanwhile, diesel continues to power over 95% of long-haul logistics in emerging economies like India, alongside a vast network of gensets, earthmovers, and vessels that have no viable green alternative—yet.

This is where hybrid hydrogen-diesel retrofits come into play—not as a stopgap, but as a transformational bridge.

The Efficiency Gap Few Talk About

Converting electricity to hydrogen and then back to mechanical energy in a vehicle is, at best, 35-45% efficient. Similarly, battery EVs charged from fossil-dominated grids can unintentionally shift emissions upstream. In contrast, retrofitting diesel engines with hydrogen-assist systems allows us to utilize the vehicle's existing powertrain, while significantly reducing fuel consumption and tailpipe emissions.

This isn't just theoretical. It's tested, validated, and now deployed.

The Saarthi GreenDrive Innovation

At Saarthi GreenTech, we've developed and patented the GreenDrive System, a compact, AI-integrated hydrogen-diesel hybrid retrofit that:

- Injects on-demand hydrogen, often referring to hydroxyl gas or HHO, into the air-fuel mix of any diesel engine
- Enhances combustion efficiency, resulting in more complete fuel burn
- Cuts fuel consumption by up to 10-30% in commercial transport and stationary gensets
- Reduces PM, NOx, and CO_2 emissions by 30-70%, based on real-world use cases
- Works across BS, Euro, and off-road standards, requiring no changes to OEM components

Most critically, our system delivers a positive ROI in 3-9 months, making it one of the few hydrogen solutions that are economically deployable at scale today. We are proud to share that it is completely made in India.

Real-World Applications: From Roads to Remote Mining Sites

Our pilots and commercial deployments across India have yielded remarkable insights:

- In logistics fleets, trucks covering 400-800 km per day have seen diesel savings of up to 6 liters per 100 km, translating to annual savings of Rs 4-6 lakh[1] per vehicle.
- Similar savings can be achieved in diesel generators used in telecom towers and construction sites.
- There is a significant opportunity in saving emissions in marine engines using our technology.
- In mining, where vehicle idling and low-RPM (revolutions per minute) operations are common, hydrogen improves combustion and reduces soot buildup, extending engine life.

Scientific Underpinning: Why Hydrogen Works Here

The science is compelling. Hydrogen, with its 10x faster flame speed and higher diffusivity compared to diesel, helps

[1] 1 lakh = 100,000

ignite fuel more completely, especially in lean or cold-start conditions. Our system generates hydrogen on board using water electrolysis, eliminating the need for high-pressure storage or refueling infrastructure.

By integrating with vehicle Controller Area Network (CAN) systems, we also capture, analyze, and optimize engine performance in real-time, giving operators actionable insights into fuel economy, engine stress, and carbon footprint.

Policy Implications: A Missing Link in India's Decarbonization Strategy

India has committed to reducing its emissions intensity of GDP by 45% by 2030, and aims for Net-Zero by 2070. But large swaths of diesel consumption—trucks, gensets, ships—lie outside the immediate reach of EV or HFC adoption.

In this context, hybrid retrofits such as GreenDrive offer an untapped opportunity. A 20-30% reduction in diesel use across even 20% of India's heavy-duty fleet could:

- Save 3-4 billion liters of diesel annually
- Cut 8-10 million tons of CO_2
- Generate Rs 20,000-Rs 30,000 crore in cumulative fuel savings

These are not projections 10 years into the future. These are achievable in the next 24-36 months with the right push.

Looking Ahead: From Retrofit to Revolution

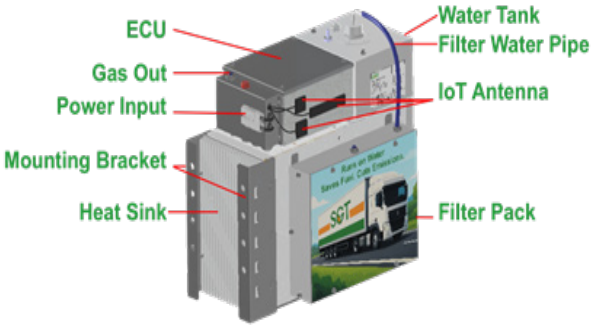
We do not believe hybrid hydrogen is the endgame; however, it is a practical, scalable, and scientifically grounded starting point. While global capital and policy attention are rightly focused on green hydrogen production and hydrogen economy building, we must also ask:

What can we deploy today, at scale, to start cutting emissions fast—without waiting for perfect conditions?

For Saarthi GreenTech, the answer is clear: build affordable, field-tested solutions that work with the reality of current fleets, fuels, and economics. That's how we move the needle—immediately, and at scale.

For further details, refer - www.saarthigreentech.com

From Farm Waste .....contd from pg 17



developed GreenDrive, a hydrogen-assisted retrofit solution that transforms any diesel vehicle into a cleaner, more efficient hybrid using just water.

GreenDrive's technology delivers impressive results with up to 40% diesel savings year-over-year and up to 50% emission reduction across multiple pollutants, including CO_2, NOx, and particulate matter. The system can be installed in under four hours, with zero engine modification required, and operates without gas storage or pressure systems, ensuring complete safety.

What sets Saarthi apart is its practical approach to immediate impact. Rather than waiting for complete fleet replacement, their retrofit solution allows operators to achieve significant cost savings and emission reductions today. With over 150,000 km of commercial testing completed and active pilots across India and Australia, the company has demonstrated real-world performance that delivers both environmental benefits and economic returns, with most customers recovering costs within 3-9 months through fuel savings alone. Over the next two years, they aim to stabilize the supply chain, conduct pilot projects with OEMs, do product marketing, scale up production, and expand their footprint across India.

www.saarthigreentech.com

The Path Forward

These three companies demonstrate that India's green hydrogen ecosystem is rapidly maturing through innovative technology and practical solutions. From BioVikas' waste-to-hydrogen model strengthening rural economies to Agastya's breakthrough electrolysis efficiency and Saarthi's immediate decarbonization impact, each venture addresses critical market needs while building toward a sustainable energy future. Their combined efforts showcase how start-up innovation can accelerate India's transition to clean energy leadership.

For more information about Energy Leap and our initiatives, visit: www.xynteo.com/coalitions-programmes/energy-leap

India's Green Hydrogen Ambitions: Where do we stand?

Authors - Vipul Kumar, Managing Director, India; Varun Desai, Manager; and Bhaskar Jha, Consultant, Xynteo

Green hydrogen, which is produced from renewable energy sources, is a crucial pillar of India's strategy to reduce energy import dependence, enhance energy security, and decarbonize key industrial sectors such as steel, petroleum refining, and fertilizers. The Indian government's National Green Hydrogen Mission, launched in early 2023, set an ambitious target of 5 million tons (MT) of green hydrogen production in India by 2030. However, over two years down the line, significant challenges persist despite plentiful project announcements and private sector financial commitments, leading to slow execution and raising concerns about meeting this goal.

Production Progress: A Reality Check

According to the International Energy Agency, green hydrogen projects announced in India promise at least 6 MT per annum (MTPA)—20% more than the 5 MTPA target. However, only 220,000 tons per annum (TPA) (4% of the announced capacity) have reached the final investment decision (FID) stage, highlighting the gap between planning and execution.

Capital-intensive projects, such as green hydrogen production, progress through four key stages—concept, feasibility, FID, and implementation, with each stage increasing the probability of realization.

Currently, 13% of announced capacity is in the feasibility stage and beyond, while the rest are still in the concept stage.

The slow pace of FID approvals suggests that project promoters are facing barriers related to financing, infrastructure, electricity cost, capital equipment cost, and power availability. Addressing these bottlenecks will be critical to ensuring that the sector transitions from ambitious announcements to real-world implementation.

Examining the Demand Landscape

Export markets: Increasing competition

Major buyers such as the European Union (EU) and Japan have set ambitious hydrogen demand targets.

The EU has projected a demand of 20 MT by 2030—with 10 MT sourced domestically and 10 MT imported. However, only 5 MT is explicitly tied to the EU's Renewable Energy Directive III (RED III) targets, which mandates EU industries using hydrogen to replace a significant portion from renewable sources.

To secure a meaningful share of the EU market, India must compete with exporters from the Middle East and North Africa (MENA) region and North America, who have inherent cost advantages. For example, MENA benefits from abundant, low-cost renewables and natural gas, and proximity to Europe, reducing transport costs.

While in North America, the US has significant incentives through the Inflation Reduction Act (IRA), including subsidies and tax credits, making its green and blue hydrogen highly competitive.

MENA and North America's combined FID-backed hydrogen production projects already total up to 4.8 MT capacity, nearing Europe's legally binding requirements. The EU itself has 12.5 MT of projects in the feasibility stage and 1 MT hydrogen projects in the FID stage.

With FID-backed projects from the EU, MENA, and North America already aligning with EU demand projections by 2030, India must accelerate project execution and enhance cost competitiveness to secure export market opportunities in the EU.

Japan, another major buyer, has a hydrogen demand target of 12 MT by 2040 but appears to be more inclined toward blue hydrogen in the near term (hydrogen produced from natural gas with carbon capture), where India has limited competitiveness due to a lack of domestic natural gas reserves.

Domestic demand: Can India absorb its own hydrogen?

India's current hydrogen demand stands at 6 MT per annum, driven primarily by: Refineries: ~3 MT and, Fertilizers: ~3 MT. With grey hydrogen (hydrogen from fossil fuels) priced at USD1.80-2.5/kg in India, green hydrogen remains expensive, at an estimated 2030 price of USD3.80-4/kg, creating a

USD1.80/kg average price gap.

Given that the green hydrogen use-cases in the petroleum refining and fertilizer sectors directly affect energy and food prices, it is unlikely that these sectors will be willing to pay the price premium to procure green hydrogen at a large scale.

Policy Support: Is it Sufficient?

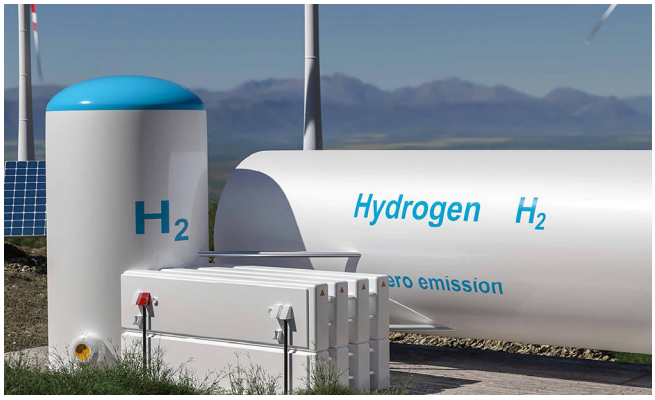
The government has allocated USD900 million (Rs ~7,600 crore) in direct subsidies, primarily for hydrogen production and electrolyser manufacturing. However, this support could enable only 500 ktpa of green hydrogen production, if we account for the price difference of USD1.8-USD2/kg between grey and green hydrogen, and assume incentives will be effectively allocated.

To improve policy effectiveness, the following additional measures are needed:

- Long-term purchase agreements to reduce investment risks
- Well-timed implementation of hydrogen purchase obligations
- Accelerated price discovery mechanisms, such as Solar Energy Corporation of India's (SECI) green ammonia procurement tenders
- Reduction of project development costs for renewable energy projects to lower electricity costs for electrolysis
- Investment in storage and transport infrastructure to ensure the availability of hydrogen at scale

What needs to change from a policy standpoint to:

1. **Stimulate domestic demand:** Mechanisms such as blending mandates for refineries and fertilizers, and green hydrogen purchase obligations, can create a stable market for producers. However, since these sectors are price-sensitive, policies must be developed to minimize adverse economic impacts. Additionally, pilot projects conceptualized for steelmaking and heavy-duty transport, can be expanded for other use cases such as green chemicals and long-duration energy storage.
2. **Accelerate FID for projects:** With India's low FID rate, targeted interventions such as viability gap funding and Paris Agreement Article 6.2 mechanisms (allowing international carbon credit trading) could incentivize project developers to achieve FID.
3. **Bridge cost gap:** Accelerate the price discovery process with the existing tenders with SECI and Oil Marketing Companies, and identify the price gap. Support in the form of subsidies, tax incentives, support for project scale-ups, and blended finance models could help reduce the price gap between green and grey hydrogen, making it viable for domestic consumption.



4. **Support indigenous innovation:** Commercialize hydrogen-related R&D through Centres of Excellence, Hydrogen Innovation Valleys, and technology accelerators. The country's robust startup ecosystem can drive advancements in electrolysis efficiency, hydrogen storage, and transport solutions, and reduce overall costs.

The Way Forward

India's green hydrogen plans are ambitious, but execution remains a major challenge. While the announced capacity is promising, translating these projects into financially backed implementations will determine success.

To close the gap between ambition and reality, India must focus on de-risking investments, improving cost competitiveness, and creating stable demand. The global hydrogen race is intensifying, and India risks falling behind without urgent, decisive action.

With stronger policy frameworks, financial incentives, and strategic demand creation, India can position itself as a key player in the global hydrogen economy. The next few years will be critical in shaping India's role in the future of green hydrogen.

If you would like to get in touch about any of the points raised in this piece or discuss how Xynteo can help your organization, contact Vipul at: hello@xynteo.com

Stay up to date on Xynteo by following us on social media www.linkedin.com/company/xynt-o/, X, or xynteo.com/contact to find out how we can help your leaders and organization accelerate sustainable impact and value creation

Fuel Cells: A Clean & Reliable Solution for Long-Duration Power Backup

By Gaurav Patil, Vice President, Transition VC

In recent years, the world has seen a dramatic rise in climate-related disasters. From more frequent and intense cyclones to raging wildfires and prolonged heat waves, these extreme events have taken a toll on infrastructure, especially power grids. According to the Center for Research on the Epidemiology of Disasters (CRED), the number of natural disasters has increased by over 80% in the last two decades. Meanwhile, power outages have surged, becoming longer and more frequent than ever before.

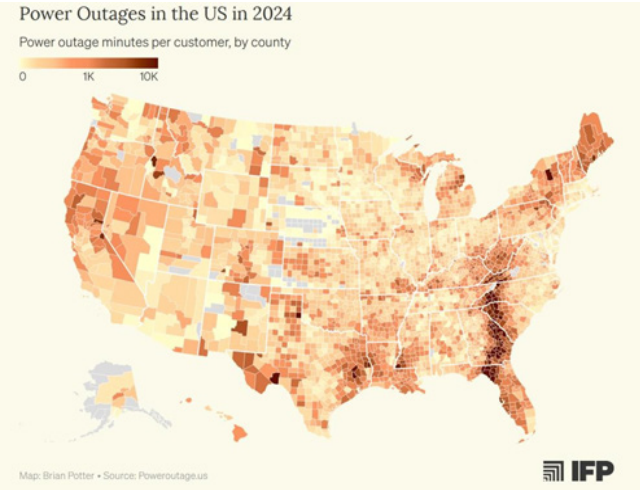
The Growing Problem of Power Outages

Power outages have become alarmingly common across the globe. In the U.S. alone, the number of major power outages (affecting over 50,000 people) increased by 78% from 2011 to 2021, as reported by Climate Central. In 2023, the U.S. experienced more than 470 major outages—many of them caused by weather-related events such as hurricanes, wildfires, and winter storms.

Globally, outages are becoming longer as well. The average outage duration has crossed 8 hours, with some areas facing blackouts for several days. In Texas, for example, the 2021 winter storm led to outages that lasted up to four days, affecting over 4 million homes. With aging infrastructure and climate change increasing the frequency of extreme weather, this problem is only expected to grow.

The Need for Long-Duration Backup Power

As outages increase in frequency and duration, the need for long-duration power backup systems becomes critical. Short-term backup solutions such as batteries can last a few hours, but they fall short in extended blackouts. Critical applications—such as traffic lights, railroad crossings, police stations, fire departments, emergency shelters, and even data centers—cannot afford to go dark. They require reliable power for several hours or even days.



This is where the demand for long-duration backup power is rising. In North America alone, this market is projected to reach USD10 billion over the next few years, driven by infrastructure investments, energy resilience planning, and growing regulatory pressure.

The Limitations of Diesel Generators

For decades, diesel generators (DG sets) have been the go-to backup solution. But today, they come with serious drawbacks. Not only are they noisy and polluting, but they are also facing strict regulatory scrutiny. The U.S. Environmental Protection Agency (EPA) has placed tough regulations on diesel generator emissions, especially nitrogen oxides (NOx) and particulate matter (PM). Managing diesel leaks, spills, and refueling logistics is also becoming a costly affair.

More importantly, diesel generators run on fossil fuel, making them incompatible with a net-zero carbon future. For a world increasingly focused on sustainability and decarbonization, we need cleaner alternatives.

Fuel Cells: Clean, Efficient & Long-Lasting

Fuel cells offer a promising alternative. They generate electricity using hydrogen (H_2) and oxygen (O_2) through an electrochemical process that produces only water and heat as by-products. Unlike combustion-based generators, fuel cells have zero harmful emissions—making them ideal for use in urban, indoor, or sensitive environments.

One of the biggest advantages of hydrogen fuel cells (HFCs) is their runtime flexibility. As long as you can supply hydrogen, the system can keep running for hours—or even days—without interruption. This makes HFCs ideal for long-duration backup power needs. Whether it's a hospital operating through a hurricane or a data center running during a wildfire, HFCs provide a clean and stable power source.

Infrastructure Is No Longer a Barrier

A decade ago, hydrogen infrastructure was almost non-existent, making HFCs impractical for real-world deployment. That's no longer the case. Today, companies such as Air Liquide, Linde, and Plug Power are offering on-demand hydrogen delivery, including tank refueling on a phone call.

In many urban areas, hydrogen tanks can be delivered within hours, and mobile hydrogen refueling units are becoming

increasingly available. This development has removed one of the biggest adoption barriers for fuel cell systems.

The Capital Cost Challenge

Despite their many benefits, HFCs still face one major hurdle: capital cost. Fuel cell systems are more expensive to buy and install compared to traditional generators or lithium-ion batteries. This has limited their adoption, especially in applications that require large capacity or longer runtimes.

Source: https://protonas.tech/applications/

However, this is changing too. Companies such as Protonas are leading the way in making HFCs more affordable. By innovating in design, materials, and manufacturing processes, Protonas is working to lower the upfront cost and make HFCs a cost-competitive option for a wider range of users.

The Road Ahead

With expanding hydrogen infrastructure, growing market demand, and innovation driving costs down, the timing for fuel cell adoption has never been better. The combination of reliability, clean operation, and long runtime makes them an ideal choice for critical infrastructure, commercial applications, and even residential resilience planning.

In a world that's preparing for the next big storm, fire, or blackout, HFCs offer not just a backup plan, but a better one.

Transition VC (*www.transitionventurecapital.com)*
is a Xynteo Energy Leap partner.

Transition Venture Capital (Transition VC) is a Bengaluru-based VC firm established in 2022, dedicated to driving India's shift toward a sustainable, net-zero future. It focuses on early-stage investments in sectors such as electric mobility, green hydrogen, energy storage, and climate-tech. With a mission to empower climate-focused startups, Transition VC plays a key role in accelerating innovations that contribute to environmental sustainability and clean technology development across the country.

Gaurav Patil is Vice President at Transition VC. He comes from a mechanical engineering background and looks after investments in Industrial Decarbonization, and Alternative Fuels like Hydrogen and Compressed Natural Gas.

Green Hydrogen Production .....contd from pg 10

Comparison of TAD with Electrolyzers

Technology	TAD	Electrolyzer
Source/raw material	Biomass or organic waste	High purity water (triple distilled)
Power consumption	~30 kWh/kg of Hydrogen	~55 kWh/kg of hydrogen
Other output	1. CNG/LNG 2. Bio-coal 3. Bio-tar 4. Carbon dioxide & Dry ice	1. Oxygen
Water requirement	Zero Note: Only uses trapped water of biomass	9 liters high purity triple distilled water for 1 kg hydrogen production
Working principle	Fractionation of biomass (chemical/ biomass refining)	Electrolysis of water

Our Products

With our indigenously developed trademark TAD process, the mass conversion of agro and forestry waste into biofuels are obtained in the ratio of:

~ 3.5-4% Hydrogen
~12-14% Methane
~25% Bio-Coal
~1-2% Bio-Tar

Conversion is mentioned by weight/mass from waste
Total conversions = ~45% mass to fuel

BGE is not a known name, except perhaps in the vicinity of Varanasi, where the company has a production unit. But what the company is doing may be a good indicator of the shape of things to come, in the hydrogenisation of the Indian economy.

BGE was set up in 2018 by two scientists from Indian Institute of Science, Bengaluru – Dr. Preetam Singh and Dr. Konda Shiva; both had done their post-doctoral work under the supervision of Prof. John Goodenough, University of Texas, Austin, the 2019 chemistry Nobel laureate. BGE produces hydrogen and other fuels from biomass, using the TAD technology invented by Dr. Singh and Dr. Shiva.

Dr. Singh reports that the TAD reactors can process 10,000 kg of biomass over 96 hours to produce hydrogen, methane, bio-coal and liquefied natural gas. One kg of biomass splits into 35-40 g of hydrogen, 120-140 g of methane, 250 g of bio-coal — of a high calorific value of 6,500–8,000 kCal/kg, depending on the biomass used.

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Energy Leap
WITH xynteo

JOIN ENERGY LEAP WITH XYNTEO

Energy Leap, a platform by Xynteo, aims to accelerate the production and consumption of clean hydrogen in India through technology innovation, commercialisation and deployment.

Are you a leading renewable energy project developer, heavy industrial company, or automotive company looking for technological solutions to produce, transport, utilise clean hydrogen or deploy pilot projects?

Are you a venture capital or private equity investor or project financier, looking for opportunities to invest in clean hydrogen technologies and projects?

Are you a clean hydrogen technology company looking to accelerate your growth through market access and fund raise?

Join us at Energy Leap to accelerate the adoption of clean hydrogen.
Let's connect and explore how we can work together!

WHAT WE DO

- Project Conceptualisation
- Technology Incubation & Acceleration
- Technology Discovery

HOW WE DO IT

- Strategic Partnerships
- Catalytic Funding
- Innovation Challenge

We have discovered 15 clean hydrogen technology companies and are working with several corporates, foundations, investors and eco-system enablers to commercialise these technologies to drive clean hydrogen production and consumption in India.

LEARN MORE

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