

GOVERNMENT OF INDIA
MINISTRY OF NEW AND RENEWABLE ENERGY
RAJYA SABHA
UNSTARRED QUESTION NO. 1105
ANSWERED ON 09.12.2025

RESEARCH IN RENEWABLE ENERGY TECHNOLOGIES

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Will the MINISTER OF NEW & RENEWABLE ENERGY be pleased to state:

- (a) the total number of research and development projects funded by the Ministry during the last three years;
- (b) the amount allocated and utilised for research and development in green hydrogen, energy storage and advanced solar technologies;
- (c) the list of institutions or private firms that received such funding; and
- (d) the measurable outcomes achieved from these projects so far?

ANSWER

THE MINISTER OF STATE FOR NEW & RENEWABLE ENERGY AND POWER

(SHRI SHRIPAD YESSO NAIK)

(a) A total number of 16 research and development projects has been funded by the Ministry during last three years in Renewable Energy technologies, and 23 number of research projects have been supported in the field of Green Hydrogen.

(b) The amount allocated and utilised for research and development projects in renewable energy are given below: -

<i>Amount in crores</i>			
Year	Budget Estimate (BE)	Revised Estimate (RE)	Expenditure
2022-23	35.00	45.00	40.39
2023-24	70.00	4.00	1.96
2024-25	46.00	30.00	29.56
2025-26	46.00	36.00	16.56 (Till November)
Total	197	115	88.47
R&D for National Green Hydrogen Mission			
2025-26	--	115.05 cr	Nil

(c) The list of institutions including private firms that received funding in these areas is placed at the **Annexure-I**

(d) The continuous R&D efforts in the area of renewable energy have resulted in enhancement of overall efficiency, cost reduction, and better reliability of renewable energy systems/ projects being deployed in the country. The specific outcome from R&D projects are placed at **Annexure-II**

Annexure-I

List of Institutions that received funding for research and development projects in green hydrogen, energy storage and advanced solar technologies during last 3 years

Under Renewable Energy Research and Technology Development Programme

S. No.	Project	Location	Implementing Agency
Solar PV			
1	National Centre for Photovoltaic Research and Education (NCPRE) - Phase III	Mumbai, Maharashtra	Indian Institute of Technology (IIT), Bombay
2	National Primary Standard Facility for Solar Cell Calibration	New Delhi	CSIR-National Physical Laboratory,
3	Flexible Perovskite Solar Cells and Intermediate Module	Mumbai, Maharashtra	Indian Institute of Technology (IIT), Bombay
4	Scale-up of Perovskite Tandem Solar Cells (Phase I)”	Mumbai, Maharashtra	Indian Institute of Technology (IIT), Bombay
5	Perovskite Solar Modules	Mumbai, Maharashtra	Indian Institute of Technology (IIT), Bombay
Hydrogen Energy			
1	Green Hydrogen Mobility Projects	Leh	NTPC Ltd., Noida, U.P
2	Design & development of 20kW Low Temperature Polymer Electrolyte Membrane Fuel Cell (LTPEMFC) with high indigenous content	Chennai, Tamil Nadu	ARCI-Centre for Fuel Cell Technology, Chennai
3	Setting Up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy	Gurugram, Haryana	National Institute of Solar Energy (NISE), Gurugram

Under National Green hydrogen Mission

S. No	Project	Location	Implementing Agency
1	Development and Demonstration of Direct Injection Hydrogen Fuelled Internal Combustion Engines (H2ICE) for Heavy Duty Commercial	Pune, Maharashtra	Automotive Research Association of India
2	Development of retrofitted kit for H2ICE Application	Gurugram, Haryana	Shigan Nexgen Technologies Private

			Limited (promoted by IOCL)
3	Development and Demonstration of Hydrogen fueled Internal Combustion Engine for Agricultural tractor	Chennai, Tamil Nadu	Mahindra and Mahindra Ltd
4	Prototype Development of a Highly Efficient Compression Ignition Hydrogen Engine for the Agriculture Sector Using a Novel High-Pressure Direct Injection (HPDI) Strategy	Kanpur, Uttar Pradesh	IIT Kanpur
5	Development of hydrogen-powered high-power density fuel cell drone for oil & gas applications (TRL -3/4)	Gurugram, Haryana	Hypace Solutions Private Limited, Gurugram
6	Development of Fuel cell powered high endurance UAVs for niche strategic and societal applications	Bengaluru, Karnataka	Magic Myna Private Limited, Bengaluru
7	Green Hydrogen Generation via Direct seawater electrolysis: A systematic bottom-up approach using selective electrocatalyst and electrochemical cell designs	Karaikudi, Tamil Nadu	CSIR-Central Electrochemical Research Institute, Karaikudi
8	A Supramolecular Approach to Improve the Stability and Efficiency of Alkaline Electrolyzer Membranes	Chennai, Tamil Nadu	SRM Institute of Science & Technology, Chennai
9	Integrated Heat Management for Energy-Efficient Membrane-Based Direct Seawater Desalination Enabling Green Hydrogen Production	Pune, Maharashtra	CSIR-National Chemical Laboratory, Pune
10	Development of High-Performance PEM Membranes for application in Electrolyzer and Fuel Cell	Gujarat	GFCL Solar and Green Hydrogen Products Limited, Gujarat
11	Clean Hydrogen: Enhancing Biohydrogen Purity through Advanced Adsorption Purification	Karaikudi, Tamil Nadu	CSIR-Central Electrochemical Research Institute, Karaikudi
12	Synergistic Biohythane Production: Integrating Biohydrogen and Biomethane Bioprocesses	Pune, Maharashtra	Texol Energy Private Limited
13	Technology Demonstration Plant for the Production of 0.5 TPD Green Hydrogen from Pyrolysis +	Goa	Institute of Chemical Technology, Mumbai

	Gasification of Coconut Shell and Cashew Nutshell		
14	Biomass to Green Hydrogen: Development of 100 kg/day H ₂ production via oxy-steam-CO ₂ gasification integrated with catalytic CO conversion and continuous H ₂ separation using a mixed matrix hollow fibre membrane system	Pilani, Rajasthan	Birla Institute of Technology and Science - Pilani
15	Pilot plant demonstration of Hydrogen production from agricultural waste through integrated pyrolysis and catalytic steam reforming process	Ropar, Punjab	Indian Institute of Technology Ropar
16	AI based smart sensors for rapid and real time detection of ppm level H ₂ leaks in hydrogen storage and distribution structures	Thiruvananthapuram, Kerala	Indian Institute of Science Education and Research
17	Securing the Future: AI-Driven Insights into Global Hydrogen Incidents for Enhanced Safety and Risk Management	Patiala, Punjab	Thapar Institute of Engineering & Technology
18	Spontaneous Combustion Behaviour of Pressurized Hydrogen Leaks	Varanasi, Uttar Pradesh	IIT BHU
19	Application of Causal Analysis and Machine Learning for Risk Severity Prediction in Hydrogen Facilities	Gurugram, Haryana	Engineers India Limited
20	Electronic Hydrogen Leak Detector based on MEMS Integrated 1-D Nanofibers and Nanotubes of Semiconductor Oxides	Thiruvananthapuram, Kerala	CSIR - NIIST
21	CFD Modelling in Flacs-Hydrogen software for Hydrogen Safety and Risk Assessment	Gurugram, Haryana	Shriram Institute for Industrial Research
22	Hydrogen Explosions- Developing Phenomenological Models from Fundamental Experiments	Varanasi, Uttar Pradesh and Hyderabad, Telangana	IIT BHU+ IIT Hyderabad
23	Design, Development and Manufacturing of Indigenous Solid Oxide system for Electrolyser and Fuel Cell application	Bengaluru, Karnataka	Hylan Power One

The measurable outcomes from R&D Projects supported by the Ministry during last 3 years**I. Solar Cell**

National Primary Standard facility for cell calibration by NPLCSIR-NPL has established India's first National Primary Standard Facility for Solar Cell Calibration, making India the fifth country with a World Photovoltaic Scale (WPVS)-recognized setup. The Laser-based Differential Spectral Responsivity (L-DSR) system, developed with PTB Germany, achieves a world-leading 0.35% uncertainty (highest accuracy), enhancing precision and self-reliance in solar metrology.

II. Perovskite Solar Cell

In the area of perovskite solar cell, IIT Bombay has developed world second highest efficiency cell with 26% against world efficiency of 26.7%. The institute is now working on establishing a production line to scale up this technology. Additionally, IITB has achieved 30.2% power conversion efficiency for four-terminal Perovskites Silicon tandem cell.

III. National Centre for Photovoltaics Research & Education Phase III

The National Centre for Photovoltaics Research & Education (NCPRE), a centre of Excellence in solar energy has made significant achievements in the area of solar research and development. NCPRE has advanced PV testing, reliability, and material technologies, developing an IoT-based I-V tracer, fast QE setup, low-cost albedometer, and non-destructive EQE system. Its R&D achievements include perovskite-silicon tandem cells with 29.14% efficiency and CdTe tandems with 24.2% power conversion efficiency and 3,000-hour stability as well as SiC-based inverters and reliability algorithms.

Following instruments are developed and then commercialized by the instrument makers,

- Thermal Atomic Layer Deposition (ALD), costing ~INR 50Lacs which can replace the imported ones (~INR 1.5-2 Crore)
- Ozone cleaner - commercialized by Indian manufacturer and exporting even to the USA.
- Laser Scriber - commercialized by an Indian manufacturer and then sold globally, including Singapore, and ISRO. Imported INR 2 Crore and our product sold in ~INR 50Lacs.
- Laser Beam Induced Current (LBIC) - Currently developed and is in the marketing stage

IV. Hydrogen

The NTPC Green Hydrogen Mobility Project in Leh, India's first fully operational green hydrogen-based mobility initiative, integrates a 1.70 MW solar plant with a system producing 80 kg of hydrogen per day. Five hydrogen fuel cell buses with 200 km range operate successfully in high-altitude conditions, demonstrating the technology's reliability. Commissioned in November 2024, the project marks a major achievement in renewable energy and sustainable transport integration.

The project achieved the design of a 20 kW LT-PEM fuel cell stack with 95% indigenous components and demonstrated a scalable 100 kW system. It established India's first automated PEM fuel cell pilot line (100 kW/year capacity), achieved 5000 hours durability with over 45% efficiency, and reduced costs to ₹2 lakh/kW. Two patents have been filed, and the project has laid a strong foundation for the indigenous commercialization of fuel cell technologies