

R&D ROADMAP FOR GREEN HYDROGEN ECOSYSTEM IN INDIA

(DRAFT)



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Preface

The National Green Hydrogen Mission has been approved by the Union Cabinet on 4th January 2023 with an outlay of ₹ 19,744 crore. The Mission aims at making India a global hub of Green Hydrogen production, utilization and export. A key component of the proposed Mission is to establish a conducive Research and Innovation ecosystem for Green Hydrogen in the country.

In the run up to the Mission's launch, it was decided that various stakeholders in the Government, Industry, and Academia should come up with a joint report outlining the current status of research and technology development in the country and provide recommendations for a national research and innovation roadmap to support the Green Hydrogen ecosystem. Accordingly, a drafting committee was constituted with experts and representatives from Office of Principal Scientific Advisor, Council of Scientific & Industrial Research, Ministry of Petroleum and Natural gas, NITI Aayog, Department of Science & Technology, Department of Atomic Energy, Defense Research and Development Organization, Indian Space Research Organization, Indian Oil Corporation Ltd., Indian Institute of Science, IIT Delhi, IIT Madras, IIT Bombay, IIT Kharagpur, IIT Kanpur, IIT Roorkee, IIT Guwahati, IIT Hyderabad, Central Electro Chemical Research Institute, National Chemical Laboratory, NTPC - NETRA , National Institute of Solar Energy, Confederation of Indian Industry, Indian Hydrogen Alliance, Federation of Indian Chambers of Commerce and Industry, Society of Indian Automobile Manufacturers, Council on Energy, Environment and Water, World Resources Institute, The Energy and Resources Institute. Joint Secretary, Ministry of New and Renewable Energy was the convener of the committee.

Thematic sub-committees on hydrogen production, hydrogen storage, hydrogen transportation, and hydrogen applications assisted the committee and provided detailed insights on specific areas. The committee has prepared this draft roadmap through in-depth analysis of the current status of technology and ongoing research, benchmarking and gap. The roadmap recommends research and development actions for each part of the Green Hydrogen value chain. It is expected that this draft roadmap would serve as a guidance for developing a vibrant research and development ecosystem required to commercialize Green Hydrogen and contribute to India's ambitious climate and energy goals.

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Table of Contents

Chapter 1: Green Hydrogen: Initiative for Research and Innovation in India	1
Chapter 2: Hydrogen Production	3
2.1. <i>Introduction.....</i>	3
2.2. <i>Objectives</i>	4
2.3. <i>National and international R&D activities</i>	5
2.4. <i>R&D priorities: Mission Mode Projects.....</i>	9
2.5. <i>R&D priorities: Grand Challenge Projects.....</i>	11
2.6. <i>R&D priorities: Blue Sky Projects.....</i>	13
Chapter 3: Hydrogen Storage	15
3.1. <i>Introduction.....</i>	15
3.2. <i>Objectives</i>	16
3.3. <i>National and international R&D activities</i>	17
3.4. <i>R&D priorities: Mission Mode Projects.....</i>	26
3.5. <i>R&D priorities: Grand Challenge Projects.....</i>	26
3.6. <i>R&D priorities: Blue Sky Projects.....</i>	27
Chapter 4: Hydrogen Transport.....	31
4.1. <i>Introduction.....</i>	31
4.2. <i>Objective</i>	33
4.3. <i>National and international R&D activities</i>	34
4.4. <i>R&D priorities: Mission Mode Projects.....</i>	45
4.5. <i>R&D priorities: Grand Challenge Projects.....</i>	45
4.6. <i>R&D priorities: Blue Sky Projects.....</i>	45
Chapter 5: End-use Applications.....	48
5.1. <i>Introduction.....</i>	48
5.2. <i>Objectives</i>	51
5.3. <i>National and international R&D activities</i>	52
5.4. <i>R&D priorities: Mission Mode Projects.....</i>	71
5.5. <i>R&D priorities: Grand Challenge Projects.....</i>	72
5.6. <i>R&D priorities: Blue Sky Projects.....</i>	73
Chapter 6: Enabling hydrogen framework.....	74
6.1. <i>Hydrogen purification.....</i>	74
6.2. <i>Carbon Accounting Methodology.....</i>	77
6.3. <i>Balance of Plant (BoP) component manufacturing and validation.....</i>	77

List of Figures

Figure 1: Various pathways for hydrogen production.....	3
Figure 2: Different Methods of Hydrogen storage ^[1]	15
Figure 3: Comparison of different Hydrogen storage methods	16
Figure 4: a). H ₂ Storage in a salt cavern, b). H ₂ storage in rock cavern (Source: Google)	17
Figure 5: Filament winding machine	21
Figure 6: FEM Simulation results of Type III composite Cylinder	22
Figure 7: Fabricated Type 3 composite Cylinder prototype by Indian Oil	22
Figure 8: The prototype of Indian Oil (A) before testing, (B) after burst testing, and (C) pressure	22
Figure 9: Pathways for hydrogen transport.....	31
Figure 10: Types of cylinders	33
Figure 11: Multiple use cases relevant in India	49
Figure 12: Testing of CSIR-3 kWe Fuel Cell Stack at Industry site (CSIR-NMITLI Program)	54
Figure 13: Testing of CSIR-10 kWe Fuel Cell Stack for Vehicular platform in collaboration with Industry (CSIR-NMITLI Program)	56
Figure 14: Development of CSIR-5 kW HT-PEMFC system for stationary application in collaboration with Industry	56
Figure 15: A photographic view of a hydrogen-fuelled generator developed in IIT Delhi with MNRE fund support.	59
Figure 16: Process flow chart for green steel production	62
Figure 17: Depiction of Salt Caverns for Hydrogen Storage.	96
Figure 18: Different Types of Cylinders	98
Figure 19: Different classes of materials for solid-state hydrogen storage ^[22]	101

List of Tables

Table 1: Mission Mode projects targets	10
Table 2: Grand Challenge mode project targets	11
Table 3: Blue Sky Projects targets	14
Table 4: Underground storage of hydrogen in Salt cavern worldwide	17
Table 5: Cylinder testing requirement as per ISO 15869	24
Table 6: Mission Mode activities.....	28
Table 7: Roadmap for R&D on Hydrogen Storage	29
Table 8: Summary of technology developments for hydrogen transport	35
Table 9: Concern areas for green hydrogen transport in India.....	43
Table 10: Targets for green hydrogen R&D in India	46
Table 11: Comparison between the Conventional process and Hydrogen Plasma process for clean and green steel	62
Table 12: Typical impurities in the hydrogen produced from different production pathways.....	74
Table 13 : Target of Key Performance Parameters for sustainable development of Electrolyser systems.....	79
Table 14: Hydrogen production-related work at different institutions in India ^[11]	87
Table 15: Indian Patents in Multiple Hydrogen Production Pathways and Key Institutes	93
Table 16: Overview of technologies with their respective power generation capacity	109
Table 17 Technology comparison for light passenger/ commercial vehicles.....	113
Table 18 Technology comparison for heavy commercial vehicles	114
Table 19 Different technologies considering the power generation capacity.....	115

Chapter 1: Green Hydrogen: Initiative for Research and Innovation in India

Technology development and innovation are crucial for achieving India's Green Hydrogen ambitions. A focussed approach would be required to solve critical cost and technology challenges to enhance Green Hydrogen production and use. The National Green Hydrogen Mission proposes a comprehensive R&D programme to drive innovation in various aspects of Green Hydrogen.

Hydrogen technologies across the value chain are currently under development. Mature technologies like electrolysers, fuel cells and carbon composite cylinders are not yet cost-competitive with alternatives; other upcoming technologies promising lower costs are yet to prove long-term performance. The aim is to design affordable, efficient, safe and reliable pathways. At the current levels of technology development, significant scope exists for improvement along each of these aspects. Accordingly, major economies and corporations are heavily invested in R&D.

India's R&D roadmap for green hydrogen technology aims to address these challenges and develop innovative solutions to overcome them. The roadmap focuses on developing new materials, technologies, and infrastructure to improve the efficiency, reliability, and cost-effectiveness of green hydrogen production, storage, and transportation. The R&D program will also prioritize safety and address technical barriers and challenges in developing a hydrogen economy.

Research and Development strategy under the Mission

The National Green Hydrogen Mission proposes the following strategies for R&D:

- a) Support innovation to increase the viability and feasibility of Green Hydrogen production, storage, transportation, and utilization and enhance the systems and procedures' effectiveness, safety and reliability. There is a need to have R&D projects aligned with targets, are time bound, and have a potential for scale-up.
- b) The proposed R&D programme has been drafted in consultation with Council for Scientific and Industrial Research (CSIR). Support is proposed for identified Mission Mode Projects with short-term (0 - 5 years) impact horizon. Development of the final product in partnership with industry will be prioritised, along with leveraging existing capabilities and infrastructure during this period. Projects entailing the development of domestic modular electrolysers, Type III/Type IV compressed hydrogen tanks and Polymer electrolyte membrane (PEM) fuel cells will be included under this. Biomass-based hydrogen generation will also be scaled-up for commercial applications.