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नवीकरणीय ऊर्जा मंत्रालय
MINISTRY OF
NEW AND
RENEWABLE ENERGY

सत्यमेव जयते

Green Hydrogen Standards and Approval Systems in India

Streamlining the Green Hydrogen Ecosystem for Accelerated Implementation of National Green Hydrogen Mission

Report | May 2024

Knowledge Partner

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Acknowledgment: The Council on Energy, Environment and Water (CEEW) is privileged to be associated with the Ministry of New and Renewable Energy (MNRE), Government of India, as Knowledge Partner on this report.

We are grateful to Shri Bhupinder Bhalla, Secretary, MNRE; Shri Ajay Yadav, Joint Secretary, MNRE; Shri Arun Kumar Tripathi, Scientist G, MNRE; Shri Sujit Pillai, Scientist F, MNRE; and Dr Prasad Chaphekar, Deputy Secretary, MNRE for entrusting CEEW with this critical study.

We thank the contributors to this report Dr Chitra Rajagopal, Process Safety And Risk Management Expert in Hydrogen; Deepanshu Philip, Senior Manager, Invest India; Rishabh Patidar, Research Analyst, CEEW; Karthik Shetty, Consultant, CEEW; Deepak Yadav, Programme Lead, CEEW; and Hemant Mallya, Fellow, CEEW for their inputs.

Suggested citation: MNRE and CEEW. 2024. *Green Hydrogen Standards and Approval Systems in India: Streamlining the Green Hydrogen Ecosystem for Accelerated Implementation of National Green Hydrogen Mission*. New Delhi: Ministry of New and Renewable Energy.

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Compiled by

Council on Energy, Environment and Water

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Image: iStock

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FOREWORD

> I am sure that this Seminar on Regulations, Codes and Standards for Green Hydrogen represents a pivotal moment in our collective journey towards a sustainable energy landscape

As we stand at the crossroads of energy transformation, the imperative to embrace sustainable solutions has never been more pressing. The transition to a greener future hinges upon our ability to harness innovative technologies that mitigate environmental impact while advancing economic prosperity. Among these technologies, green hydrogen emerges as a beacon of promise, offering a versatile and clean energy carrier with the potential to revolutionize diverse sectors, from transportation to industrial processes.

I am sure that this Seminar on Regulations, Codes, and Standards for Green Hydrogen represents a pivotal moment in our collective journey towards a sustainable energy landscape. By convening policymakers, industry leaders, researchers, and stakeholders, we embark on a collaborative endeavour to explore the regulatory frameworks, codes, and standards necessary to unlock the full potential of green hydrogen.

The challenges before us are multifaceted, spanning technological innovation, market development, and policy alignment. As we delve into these complexities, it is essential to recognize the interconnected nature of our efforts. Effective regulation must be underpinned by robust standards and codes that ensure safety, reliability, and interoperability across the hydrogen value chain. Moreover, these frameworks must be agile enough to accommodate rapid technological advancements and evolving market dynamics.

In navigating this terrain, collaboration emerges as our most potent asset. By fostering dialogue and knowledge exchange, we can harness the collective expertise of diverse stakeholders to overcome barriers and seize opportunities. Together, we can chart a course towards a future where green hydrogen plays a central role in driving sustainable development, enhancing energy security, and combating climate change.

I congratulate all participants for their commitment to this vital cause. Your insights, experiences, and dedication are instrumental in shaping the policies and standards that will define the future of green hydrogen. May this Seminar serve as a catalyst for meaningful collaboration and catalyze the transformative changes needed to realize a cleaner, more prosperous world.

(Ajay K. Sood)

Dated: 29th April, 2024

"The Government of India is steadfast in its commitment to advancing renewable energy solutions that not only address our energy needs but also contribute to our climate goals"

भूपिन्दर सिंह भल्ला, भा.प्र.से.
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भारत सरकार
नवीन और नवीकरणीय ऊर्जा मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF NEW AND RENEWABLE ENERGY

Dated: 27th April, 2024

PREFACE

It is with great pleasure that I present this document titled Green Hydrogen Standards and Approval Systems in India, which provides a snapshot of the standards and approvals framework in India for Green Hydrogen, to be released at the Seminar on the same theme on 8th May 2024.

As we gather to deliberate on the pivotal role of Green Hydrogen in shaping our energy future, it is imperative to recognize the profound implications of this transformative technology for sustainable development.

The Government of India is steadfast in its commitment to advancing renewable energy solutions that not only address our energy needs but also contribute to our climate goals. Green hydrogen stands out as a cornerstone of our renewable energy strategy, offering a versatile and zero-emission energy carrier that can drive decarbonization across various sectors.

In harnessing the potential of Green Hydrogen, however, we must navigate a complex landscape of regulations, codes, and standards. These frameworks serve as the bedrock of a sustainable hydrogen economy, ensuring safety, reliability, and interoperability while fostering innovation and market growth.

Through concerted efforts and collaboration with stakeholders, including industry partners, academia, and international organizations, India is actively engaged in shaping the regulatory environment for Green Hydrogen. This document serves as a testament to our commitment to transparency, inclusivity, and excellence in regulatory governance.

I extend my heartfelt appreciation to all contributors to this important document, whose expertise and dedication have enriched its content. I am confident that the insights and recommendations presented herein will inform and inspire our discussions at the Seminar, paving the way for informed policy decisions and concerted action towards a cleaner, more sustainable future.

I look forward to fruitful deliberations and meaningful outcomes that will accelerate India's transition to a Green Hydrogen-powered economy.

(Bhupinder S. Bhalla)

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JOINT SECRETARY
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MINISTRY OF NEW AND RENEWABLE ENERGY

MESSAGE

In this dynamic era of energy transformation, Green Hydrogen has emerged as the most promising alternative to fossil fuels. It is now being labelled as "Fuel of the Future".

Hydrogen is one of the most abundant materials in universe, Yet, the journey towards widespread adoption of Green Hydrogen is not solely paved with technological breakthroughs and market demand. It is intricately intertwined with the regulatory frameworks, codes, and standards that govern its production, storage, transportation, and utilization.

India launched the National Green Hydrogen Mission in January 2023. The mission, along with other objectives; also has a mandate to develop an enabling framework of Regulation, Codes and Standards (RCS) for the Green Hydrogen ecosystem.

A Working Group, comprising of members of Government, Industry, and academia have been working on RCS framework for Green Hydrogen. The recommendations of Working Group were forward to the Regulatory bodies like - BIS, PESO, OISD, PNGRB and also to Ministry of Road Transport and Highways. Based on the recommendations, a significant number of standards have been notified.

The mission also envisages setting up of Testing centers for electrolysers, fuel cells, Hydrogen cylinders, Hydrogen safety among others. The Ministry is also working on establishment of these Test centres.

There is also a Single Window portal on Green Hydrogen, which facilitates various regulatory approvals required at Central, State and local Government level relating to production centres of Green Hydrogen and its derivatives.

This publication serves as a guiding light through the labyrinth of codes, standards and regulations shaping the landscape of Green Hydrogen. By dissecting the intricate web of industry standards and regulations, we aim to provide stakeholders with a comprehensive understanding of the regulatory environment governing this transformative sector.

The main theme of this booklet and the seminar is to further streamline these three areas – RCS; Testing Infrastructure and the Regulatory framework of approvals. This document has been prepared after due consultation with the regulatory bodies, industry, academia and other stakeholders. Since, the Green Hydrogen ecosystem is still evolving, this document is a step in an ongoing exercise to strengthen the Green Hydrogen ecosystem.

Together, let us navigate the complexities of Green Hydrogen standards and regulations, acknowledging the challenges and opportunities they present. By fostering dialogue and collaboration among policymakers, industry leaders, and innovators, we can accelerate the transition to a sustainable energy future powered by Green Hydrogen.

Ajay Yadav
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“This publication serves as a guiding light through the labyrinth of codes, standards and regulations shaping the landscape of green hydrogen”

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About the Ministry of New and Renewable Energy (MNRE)

The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to formulate policy and supporting schemes aimed at deployment of new and renewable energy projects in the country.

The role of renewable energy has been assuming increasing significance in recent times with increasing emphasis of clean and sustainable growth. In the wake of the events such as oil shocks of the 1970s, energy self-sufficiency is also one of the major drivers of renewable energy in the country. The sudden increase in the price of oil and other fossil fuels, uncertainties associated with its supply and the adverse impact on the balance of payments position led to the establishment of the Commission for Additional Sources of Energy (CASE) in the Department of Science & Technology in March 1981. The Commission was charged with the responsibility of formulating policies and their implementation, programmes for the development of new and renewable energy apart from coordinating and intensifying R&D in the sector. In 1982, a new department, i.e., Department of Non-conventional Energy Sources (DNES), that incorporated CASE, was created in the then Ministry of Energy. In 1992, DNES became the Ministry of Non-conventional Energy Sources. In October 2006, the Ministry was re-christened as the Ministry of New and Renewable Energy.

About Council on Energy, Environment and Water (CEEW)

The Council on Energy, Environment and Water (CEEW) is one of Asia's leading not-for-profit policy research institutions and one of the world's leading climate think tanks. **The Council uses data, integrated analysis, and strategic outreach to explain — and change — the use, reuse, and misuse of resources**. The Council addresses pressing global challenges through an integrated and internationally focused approach. It prides itself on the independence of its high-quality research, develops partnerships with public and private institutions, and engages with the wider public. CEEW has a footprint in over 20 Indian states and has repeatedly featured among the world's best managed and independent think tanks. Follow us on X (formerly Twitter) @CEEWIndia for the latest updates.

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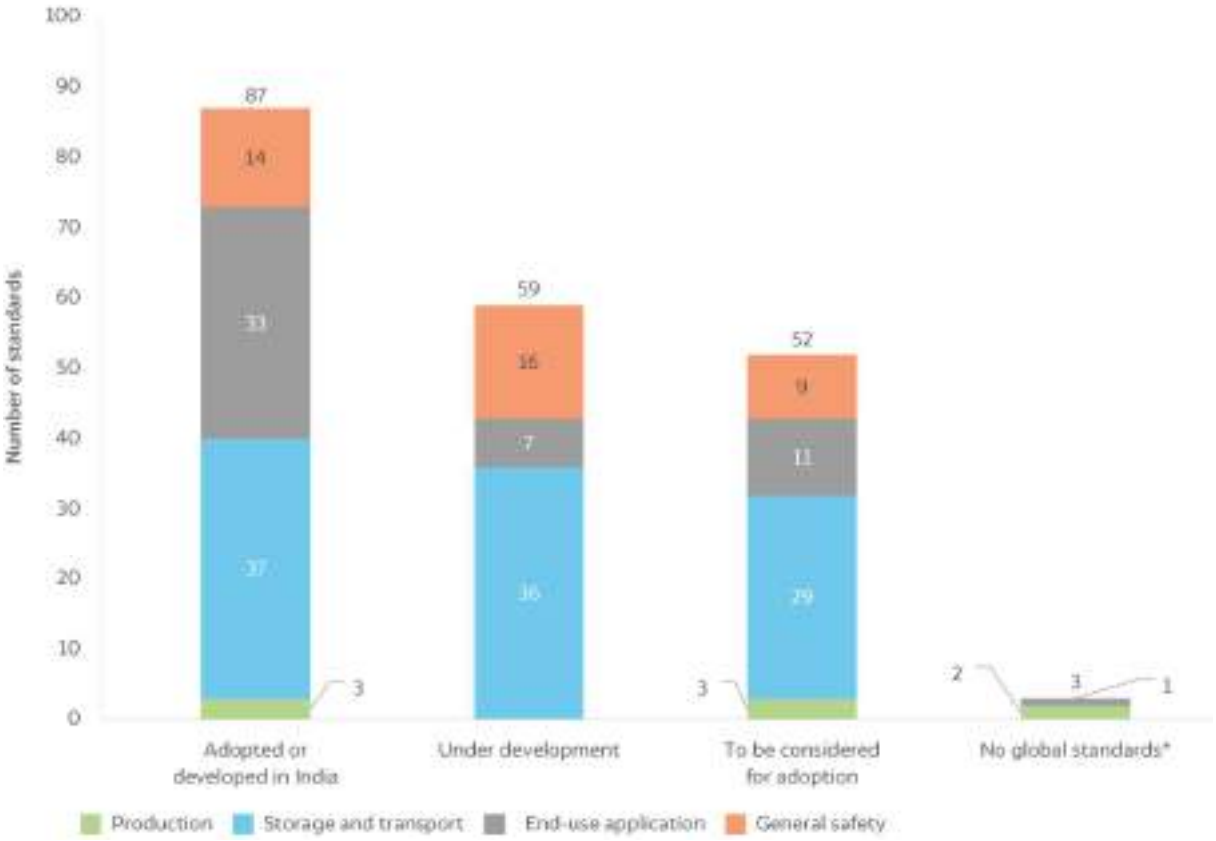
Executive Summary

The Government of India is keen to accelerate the implementation of the *National Green Hydrogen Mission (NGHM)*, which was launched in January 2023 with the aim to position India as a global hub for the production, usage, and export of Green Hydrogen (1). Streamlining the safety and performance standards as well as approval systems in India related to Green Hydrogen projects is critical to upholding the pace of development in the sector. Against this backdrop, this report describes various dimensions of regulatory frameworks, standards, testing infrastructure, and approvals required to set up Green Hydrogen projects in India.

Overview of standards related to Green Hydrogen in India

Standards related to the Green Hydrogen value chain are broadly split into four categories – production, storage and transportation, end-use applications and general safety. Across these categories, 87 standards are already adopted or developed in India, and 59 are under development as depicted in Figure ES 1. Further, there are 52 standards that exist globally, which could be considered for adoption in India. For three components, there are no Indian or international standards available for reference.

Figure ES 1 Status of Green Hydrogen-related standards in India



*Note: Components with no globally existing standards are enumerated

Standards related to the Green Hydrogen value chain are developed or adopted by five entities in India – the Bureau of Indian Standards (BIS), which is the National Standards Body of India, the Oil Industry Safety Directorate (OISD), the Petroleum and Explosives Safety Organization (PESO), the Petroleum and Natural Gas Regulatory Board (PNGRB) and the Ministry of Road Transport and Highways (MoRTH). These entities had issued 53 standards before the launch of the NGHM. In collaboration with the MNRE, 34 new standards have been issued since the launch of the NGHM in a short span of 14 months.

There are multiple international organisations that develop standards for various components across the Green Hydrogen value chain. Indian entities have Memorandums of Understanding with seven such entities for cooperation on standards. Bridging the gap between existing Indian standards and globally available standards could be expedited by collaborating with these entities on developing specific standards.

While the issuing bodies in India issue or adopt standards related to the Green Hydrogen value chain, a separate infrastructure is employed to test qualification against these standards. Each standard consists of multiple tests to be successfully performed under the supervision of a recognised lab to obtain certification. The currently available testing infrastructure in India needs to be strengthened to meet the requirements under NGHM. Corresponding to 87 existing standards in India, recognised labs for testing are available only for six standards, four of which are covered partially. Further, testing infrastructure is under development for 15 more standards.

Overview of approvals required for Green Hydrogen projects

Setting up a Green Hydrogen project requires approvals from the Central Government, State Governments, and local bodies. Out of the total 73 approvals required for Green Hydrogen projects, State Government entities hold jurisdiction for 43, Central Government entities hold jurisdiction for 23 approvals and seven approvals fall under local government bodies. It is seen that 27 out of the 73 approvals are general and legal approvals, 14 approvals are related to renewable energy use, 13 are related to fire safety, pollution control and labour contain eight approvals each and three approvals are for land allocation and use.

Action plan on Green Hydrogen standards and approvals in India

MNRE is focusing on the above-mentioned aspects to accelerate the implementation of NGHM. A coordinated action plan towards this endeavour includes:

- **Addressing the gaps in standards** by developing indigenous standards or by adopting globally existing standards in collaboration with relevant bodies.
- **Expeditiously developing the testing infrastructure** in a prioritised manner and with a focus on involving testing labs (both public and private) and academic and research institutes
- **Instituting sub-groups for standards on upcoming application areas,** such as the use of Green Hydrogen in shipping, aviation, railways and steel manufacturing
- **Expanding the mandate of regulators** to include Green Hydrogen alongside their existing domain to handle technical aspects related to Green Hydrogen-related standards
- **Developing an online portal** to present information related to Green Hydrogen standards, such as the scope and details of the standard, reference benchmarks, testing and evaluation procedures, and recognised labs at a single website

1. Introduction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At the Conference of Parties (COP) 26, India announced Panchamrit, which included a pledge to achieve net zero emissions by 2070 (2). India also aspires to become energy self-reliant or *AtmaNirbhar* by 2047 (3). Green Hydrogen will help the country in the achievement of these goals through multi-sectoral interventions. Recognising this opportunity, the Government of India launched the *National Green Hydrogen Mission* (NGHM) in January 2023 with the aim of positioning India as a global leader in the production, usage, and export of Green Hydrogen (4). India has set an ambitious target of producing 5 million tonnes per annum (MTPA) of Green Hydrogen by 2030, which is the third highest target in the world after the European Union (EU) and the United States of America (USA).

India has made significant progress in developing a Green Hydrogen ecosystem. The *NGHM* was launched on 4 January 2023 (1). India has also notified the definition of Green Hydrogen, developed an R&D roadmap and released guidelines covering various aspects of the Mission. Further, bids have been awarded to produce 0.412 MTPA of Green Hydrogen and manufacture 1.5 GW electrolyser capacity through the production-linked incentive (PLI) scheme. In India, the State Governments will play a crucial role in the implementation of the NGHM. In this direction, six State Governments have released state-level Green Hydrogen policies, and many states are in the process of formulating Green Hydrogen policies.

The Government of India is keen to accelerate the implementation of NGHM. A crucial consideration in scaling up the production of Green Hydrogen is the establishment of safety and performance standards tailored to India's ecosystem. These standards play a crucial role in ensuring the quality, safety, and interoperability of all technologies, equipment and processes in the Green Hydrogen value chain. By

providing a common framework for evaluation and assessment, these standards facilitate synergy, collaboration, efficiency, innovation, and market competitiveness. Further, setting up new hydrogen production capacities needs approvals from various levels of government, i.e., central, state, and local bodies. The implementation of NGHM can be accelerated by streamlining these approvals and compliance requirements and developing a single window clearance for all Green Hydrogen projects in India.

Against this backdrop, this report describes the various dimensions of regulatory frameworks, standards, testing infrastructure and approvals required for setting up Green Hydrogen projects in India. Additionally, by offering insights into the current status quo and identifying actionable steps for implementing the mission, this report seeks to inform stakeholders on the path forward towards developing a sustainable and resilient Green Hydrogen ecosystem in India.

1.1. Contours of Green Hydrogen standards and approvals in India

Standards related to the Green Hydrogen value chain are broadly split into four categories – production, storage and transportation, end-use applications and general safety. Figure 1 provides an overview of components and sub-components covered across these four categories. It is seen that there are 14 components and 46 sub-components nested across the four categories. As expected, hydrogen storage and transportation and end-use applications have the most exhaustive set of components and sub-components.

Image: iStock

Figure 1: Overview of value chain categories, components and sub-components for which Green Hydrogen standards are assessed

The approvals related to Green Hydrogen projects in India can be categorised by jurisdiction of the approving authority and by category. There exist multiple approving authorities that grant approvals at the Central Government, State Governments and local government bodies at the pre-establishment and pre-operation stages. The approvals fall under the categories – general and legal, renewable energy, pollution control, fire safety, labour and land allocation and use.

In this report, Section 1 provides an overview of various international and national bodies for developing and notifying hydrogen standards. Section 2 discusses the status of standards across the Green Hydrogen value chain in India. Section 3 expounds on the infrastructure aspect related to the testing as per safety standards and performance evaluation metrics for various components across the value chain. Section 4 provides an overview of various approvals needed for setting up Green Hydrogen projects in India. Section 5 discusses the way ahead for safety standards, infrastructure development for performance evaluation and approvals related to Green Hydrogen projects in the country.

1.2. Standards bodies for the Green Hydrogen ecosystem in India

MNRE is the nodal ministry for NGHM and, in coordination with other line ministries, is responsible for implementing the mission. State Governments are also involved in the implementation and regulation of the Green Hydrogen ecosystem through state-level policies, as they hold jurisdiction over multiple approvals required for setting up Green Hydrogen projects in India. The equipment and components in the Green Hydrogen value chain shall be manufactured based on the standards developed and notified by various statutory bodies in India. Table 1 provides an overview of five such entities that have developed or adopted standards or are developing standards pertaining to Green Hydrogen in India.

Table 1: Overview of Indian entities involved in developing standards for Green Hydrogen

Sr. no.	Name	Description
1	Bureau of Indian Standards (BIS)	BIS is the National Standard Body of India established under the BIS Act 2016 for the harmonious development of the activities of standardisation, marking and quality certification of goods and for matters connected therewith or incidental thereto
2	Oil Industry Safety Directorate (OISD)	OISD is a technical directorate under the Ministry of Petroleum and Natural Gas that formulates and coordinates the implementation of a series of self-regulatory measures aimed at enhancing the safety of the Oil and gas industry in India
3	Ministry of Road Transport and Highways (MoRTH)	MoRTH is entrusted with the task of formulating and administering standards related to mobility in consultation with other Central Ministries/Departments, State Governments/UT Administrations, organisations and individuals.
4	Petroleum and Explosives Safety Organization (PESO)	The PESO is the nodal agency for regulating the safety of hazardous substances such as explosives, compressed gases and petroleum products
5	Petroleum and Natural Gas Regulatory Board (PNGRB)	The PNGRB's mandate is to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas and to promote competitive markets in matters connected therewith or incidental thereto

1.3. International organisations that develop Green Hydrogen standards

There are multiple international organisations that develop standards for various components across the Green Hydrogen value chain. As shown in Figure 2, these organisations are primarily based out of the USA and EU. It should also be noted that there are multiple national-level institutes that develop and notify safety standards on Green Hydrogen that have jurisdiction within their national boundaries. However, for brevity, only international organisations involved in the original development of safety standards are indicated in Figure 2, along with Indian organisations.

Figure 2: Overview of international entities involved in developing standards on Green Hydrogen

Table 2 provides an overview of the international entities involved in developing standards across the Green Hydrogen value chain. These include statutory or advisory bodies, like the International Organization for Standardization (ISO), the American Society of Mechanical Engineers (ASME), and the International Electrotechnical Commission (IEC) etc. The national bodies responsible for developing and/or notifying safety standards across various countries are also members of these international entities. Therefore, these organisations play a critical role in creating consensus-based, market-relevant, consistent standards that provide technical support and guidance for developing standards across the value chain in their member countries.

Out of the twenty-one international entities listed in Table 2, India partners with seven on the development of standards. Through the BIS, India is a member of the International Organization for Standardization (ISO) (5) and the International Electrotechnical Commission (IEC) (6) and has signed a Memorandum of Understanding (MoU) with The European Committee for Standardization (CEN), and the American National Standards Institute (ANSI) (6) to cooperate on standards. Similarly, the OISD has signed an MoU with the American Petroleum Institute (API) (7) and PNGRB had an MoU with the American Society of Mechanical Engineers (ASME) which is currently under the process of renewal (8). The standards developed by these international entities could be considered for adoption in India with contextual modifications.

Table 2: Overview of international entities involved in developing standards on hydrogen

Sr. no.	Name	Description	Headquarters
International entities having an MoU with a corresponding Indian entity			
1	International Organization for Standardization (ISO)	The International Organization for Standardization is an independent, non-governmental, international standard development organisation composed of representatives from the national standards organisations of member countries.	Geneva, Switzerland
2	American Society of Mechanical Engineers (ASME)	ASME is a not-for-profit membership organisation that enables collaboration, knowledge sharing and skills development across all engineering disciplines.	New York City, USA
3	American Petroleum Institute (API)	The API sets global technical standards for the oil and gas industry to enhance environmental, health, safety, and personnel performance.	Washington, D.C, USA
4	American National Standards Institute (ANSI)	The ANSI is a not-for-profit organisation that develops voluntary, consensus-based standards and codes for products, systems, services, and personnel in the United States.	Washington, D.C, USA
5	The European Committee for Standardization (CEN)	The European Committee for Standardization is an association that brings together the National Standardization Bodies of 34 European countries.	Brussels, Belgium
6	International Electrotechnical Commission (IEC)	The IEC is an international organisation that develops and publishes standards for electrical, electronic, and related technologies.	Geneva, Switzerland
7	Institute of Electrical and Electronics Engineers (IEEE)	IEEE is the world's largest technical professional organisation dedicated to advancing technology for the benefit of humanity. IEEE and its members inspire a global community through its highly cited publications, conferences, technology standards, and professional and educational activities.	New Jersey, US
Other international entities			
8	Institution of Gas Engineers and Managers (IGEM)	IGEM is the professional engineering institution for gas, representing thousands of engineers, technicians, managers, and other non-engineering roles across the UK and overseas, as well as hundreds of businesses that are a significant part of the emerging hydrogen supply chain.	Kegworth, UK

Sr. no.	Name	Description	Headquarters
9	American Gas Association (AGA)	American Gas Association (AGA) educates the public about the importance of natural gas, supports natural gas utilities in their efforts to make their operations safer, more efficient and more environmentally friendly, and serves as a resource for policymakers when it comes to regulating the natural gas industry.	Washington, D.C, USA
10	Compressed Gas Association (CGA)	The CGA develops specifications and safety standards pertaining to industrial gases, primarily in North America.	McLean, Virginia, USA
11	Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)	MSS is a non-profit technical association organised for the development and improvement of industry, national, and international codes and standards related to the valve and fittings industry.	New York, USA
12	Association for Materials Protection and Performance (AMPP)	Association for Materials Protection and Performance is a global community of professionals dedicated to materials protection through the advancement of corrosion control and protective coatings.	USA
13	International Society of Automation (ISA)	The International Society of Automation (ISA) is a non-profit professional association founded in 1945 to create a better world through automation.	North Carolina, USA
14	Occupational Safety and Health Administration (OSHA)	A wing of the United States Department of Labour, OSHA directs standards for employee safety in the construction, maritime, and industrial sectors.	Washington, D.C., USA
15	Society of Automotive Engineers (SAE)	The SAE is a US-based organisation that develops standards for aerospace, automotive, and commercial vehicles.	Warrendale, Pennsylvania, USA
16	Underwriters Laboratories (UL)	The UL is a safety organisation that assesses and formulates safety standards for testing, manufacturing, and performance of products globally.	Northbrook, Illinois, USA
17	European Industrial Gases Association (EIGA)	The EIGA sets and enforces technical standards for the production and distribution of industrial, medical, and food gases, particularly in the European Union.	Brussels, Belgium
18	National Fire Protection Association (NFPA)	The NFPA is an international non-profit organisation that develops standards and safety protocols to eliminate the chance of fire and electrical and related hazards.	Quincy, Massachusetts, USA

Sr. no.	Name	Description	Headquarters
19	CSA Group (CAN/SA)	The CSA Group formulates standards across a wide range of areas, including construction and infrastructure, electronics, environment, and natural resources, etc.	Toronto, Canada
20	United States Department of Energy (DOE)	The DOE is an executive arm of the US government that oversees the national energy policy and mandates standards for topics under its jurisdiction.	Washington, D.C, USA
21	GuoBiao Standards (GB)	GB standards are China's national standards. They are enforced by laws and administrative regulations and concern the protection of human health, personal property and safety.	Beijing, China

1.4. Methodology for the compilation of existing standards and assessment of gaps in Indian standards

The findings on hydrogen standards are based on a detailed mapping of the Green Hydrogen value chain to a component and sub-component level. MNRE had created a working group, with three sub-groups under it, to assess gaps in standards in the Green Hydrogen value chain across production and use, storage and transport, and hydrogen-based mobility. These subgroups included representatives from standard issuing bodies, other government entities, industry chambers, and academia. In the first phase, the working group evaluated the existing standards across various components and sub-components. Subsequently, gaps in the value chain were identified and at this stage, India-specific published literature (9) and (10) was reviewed. Based on the reports of these subgroups, MNRE made recommendations to the Indian standards issuing bodies to update the set of standards.

2. Overview of standards on Green Hydrogen in India

The safety and performance standards across the Green Hydrogen value chain are split across four major categories – existing standards adopted or developed in India, standards under development, standards to be considered for adoption and components for which no standards exist globally. These categories are summarised in Table 3. Out of the total 201 standards assessed, 87 standards have already been adopted or developed in India, 59 are under development by various issuing bodies, and 52 could be considered for adoption as these are potential gaps that are not assessed by issuing bodies. In three instances, there were no Indian or international standards available for value chain categories. Within each component of the value chain, the number of standards assessed are as follows – 8 in production, 102 in storage and transport, 52 in end-use applications and 39 in general safety.

Table 3: Summary of Green Hydrogen-related standards in India

Sr. no.	Status	Production	Storage and transport	End-use application	General safety	Total
1	Adopted or developed in India	3	37	33	14	**87**
2	Under development	0	36	7	16	**59**
3	To be considered for adoption	3	29	11	9	**52**
4	No global standards*	2	0	1	0	**3**
Total		**8**	**102**	**52**	**39**	**201**

*Note: Components with no globally existing standards are enumerated

2.1. Existing standards in India

This section reports the existing standards in India across the Green Hydrogen value chain. Figure 3 captures the entire spectrum of standards across the value chain categories. 37 standards pertain to the storage and transport of Green Hydrogen, 33 pertain to end-use application, 14 pertain to general safety aspects, and three standards pertain to Green Hydrogen production. Further, out of the 87 standards issued in India, BIS has issued the most standards at 62. OISD has issued 13 standards, PESO has issued five standards, MORTH has issued five standards, and PNGRB has issued two standards.

Figure 3: Overview of existing standards related to Green Hydrogen in India

Further, the existing standards are bifurcated into those developed or adopted before and after the launch of the NGHM. The bifurcation helps to track the progress made in the development of Green Hydrogen standards in India. A detailed analysis reveals that 53 standards were developed and issued before the launch of NGHM. Table 4 provides the details of the standards launched before the NGHM. BIS, with 49 standards, has issued the most among these.

Table 4: List of Indian standards issued before the launch of NGHM

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
Production					
1	H_2 Generators	Water electrolysis systems	IS 16509: 2020	Hydrogen Generators Using Water Electrolysis — Industrial, Commercial And Residential Applications	BIS
2	Balance of System	Water electrolysis systems	IS 1070: 2023	Reagent grade water- specification	BIS
3	Balance of System	Pump	IS 5639: 1970	Pumps Handling Chemicals and Corrosive Liquids Technical requirement for rotodynamic pumps for handling corrosive liquids	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
Storage and transport					
4	Liquid/ Cryogenic Transport	Fuel tanks	IS/ISO 13985: 2006	Liquid hydrogen — Land vehicle fuel tanks	BIS
5	Gaseous Transport	Gas infrastructure	IS 17613: 2021	Gas Cylinders refillable welded aluminium alloy cylinders design and construction & Testing	BIS
6	Gaseous Transport	Gas infrastructure	IS 16507: 2017	Transportable Gas Cylinder Cascades	BIS
7	Gaseous Transport	Gas infrastructure	IS 12620: 1989	Seamless Steel tubes for Manufacturing high pressure gas cylinders	BIS
8	Gaseous Transport	Piping and pipelines	IS 14885: 2022	Polyethylene Pipes for the Supply of Gaseous Fuels — Specification	BIS
9	Gaseous Transport	Gas infrastructure	IS 3224: 2021	Valve fittings for compressed gas cylinders excluding LPG cylinders	BIS
10	Gaseous Transport	Gas infrastructure	IS/ISO 15761: 2020	Steel gate GLOBE and check valves for sizes DN 100 and smaller for petroleum and natural gas industries	BIS
11	Gaseous Storage	Gas cylinders and tanks	IS/ISO 11114 Part 4: 2017	Transportable gas cylinders - Compatibility of cylinder and valve materials with gas contents (Part 4: Test methods for selecting steels resistant to hydrogen embrittlement)	BIS
12	Gaseous Storage	Gas cylinders and tanks	IS 15660: 2017	Gas cylinders — Refillable transportable seamless aluminium alloy gas cylinders - Specification (First Revision)	BIS
13	Gaseous Storage	Gas cylinders and tanks	IS 7285: Part 1 : 2018	Refillable Seamless Steel Gas Cylinders- Specification Part 1 Normalized Steel Cylinders (Fourth Revision)	BIS
14	Gaseous Storage	Gas cylinders and tanks	IS 19035 : 2023	Gas cylinders — Flexible hoses assemblies — Specification and testing	BIS
15	Gaseous Storage	Gas cylinders and tanks	IS 7285: Part 2: 2017	Quenched and Tempered Steel Cylinders With Tensile Strength Less Than 1100 MPa	BIS
16	Liquid/ Cryogenic Storage	Cryogenic vessel	EN1345 8	Cryogenic Vessel-Static Vacuum insulated vessels	PESO
17	Gaseous Storage	Gas Cylinders and Tanks	IS 16735 : 2018	Cylinders for on - Board Storage of Compressed Gaseous Hydrogen and	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
				Hydrogen Blends as a Fuel for Automotive Vehicles - Specification	
18	Gaseous Storage	Gas Cylinders and Tanks	IS 8198 : 2004	Steel cylinders for compressed gases (Atmospheric gases, hydrogen, high pressure liquefiable gases and dissolved acetylene gases) - Code of practice	BIS
19	Gaseous Storage	Gas cylinders and tanks	IS 5903 : 2014	Recommendation for safety devices for gas cylinders (First Revision)	BIS
			End-use application		
20	Refuelling stations	Dispensing equipment	IS/ISO 17268: 2020	Gaseous Hydrogen Land Vehicle Refuelling Connection Devices	BIS
21	H_2 fuel quality	Fuel for vehicles/ stationary applications	IS 16061: 2021	Hydrogen Fuel Quality Product specification	BIS
22	H_2 fuel quality	Fuel for vehicles/ stationary applications	IS 1090:2002	Compressed hydrogen - Specification	BIS
23	Land vehicles	Vehicle safety	AIS 137 Part 4	Test Method, Testing Equipment and Related Procedures for Type Approval and Conformity of Production (CoP) Testing of M & N Category Vehicles having GVW exceeding 3500 kg for Bharat Stage VI (BS-VI) Emission Norms as per CMV Rules 115, 116 and 126.	MORTH
24	Land vehicles	Vehicle safety	AIS 137 Part 3	Test Method, Testing Equipment and Related Procedures for Type Approval and Conformity of Production (COP) Testing of M and N Category Vehicles having GVW not exceeding 3500 kg for Bharat Stage VI (BS VI) Emission Norms as per CMV Rules 115, 116 and 126	MORTH
25	Land vehicles	Compressed gaseous FCEV	AIS 195	Safety and procedural requirements for type approval of hydrogen powered vehicles (liquid / compressed gaseous hydrogen).	MORTH
26	Land vehicles	Fuel system components	IS/ISO 12619 (Part 1)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — General requirements and definitions	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
27	Land vehicles	Fuel system components	IS/ISO 12619 (Part 2)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Performance and general test methods	BIS
28	Land vehicles	Fuel system components	IS/ISO 12619 (Part 3)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Pressure regulator	BIS
29	Land vehicles	Fuel system components	IS/ISO 12619 (Part 4)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Check valve	BIS
30	Land vehicles	Fuel system components	IS/ISO 12619 (Part 5)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Manual cylinder valve	BIS
31	Land vehicles	Fuel system components	IS/ISO 12619 (Part 6)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Automatic valve	BIS
32	Land vehicles	Fuel system components	IS/ISO 12619 (Part 7)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Gas injector	BIS
33	Land vehicles	Fuel system components	IS/ISO 12619 (Part 8)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Pressure indicator	BIS
34	Land vehicles	Fuel system components	IS/ISO 12619 (Part 9)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Pressure relief valve (PRV)	BIS
35	Land vehicles	Fuel system components	IS/ISO 12619 (Part 10)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Pressure relief device (PRD)	BIS
36	Land vehicles	Fuel system components	IS/ISO 12619 (Part 11)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Excess flow valve	BIS
37	Land vehicles	Fuel system components	IS/ISO 12619 (Part 12)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Gas-tight housing and ventilation hoses	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
38	Land vehicles	Fuel system components	IS/ISO 12619 (Part 13)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Rigid fuel line in stainless steel	BIS
39	Land vehicles	Fuel system components	IS/ISO 12619 (Part 14)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Flexible fuel line	BIS
40	Land vehicles	Fuel system components	IS/ISO 12619 (Part 15)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Filter	BIS
41	Land vehicles	Fuel system components	IS/ISO 12619 (Part 16)	Road vehicles — Compressed gaseous hydrogen (CGH_2) and hydrogen/natural gas blends fuel system components — Fittings	BIS
42	Land vehicles	Energy consumption measurement	IS/ISO 23828: 2013	Fuel cell road vehicles - Energy consumption measurement - Vehicles fuelled with compressed hydrogen	BIS
43	Land vehicles	Fuel system components	IS 17314: 2019	Hydrogen Enriched Compressed Natural Gas (HCNG) for Automotive Purposes — Specification	BIS
44	Land vehicles	Fuel system components	IS/ISO 13985: 2006	Liquid Hydrogen - Land Vehicles Fuel Tanks	BIS
			General safety		
45	H_2 safety	Electrical installations	IS 5572: 2009	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation	BIS
46	H_2 safety	Electrical installations	IS 16724: 2018	Explosive atmospheres - Electrical installations design, selection and erection	BIS
47	H_2 safety	Fire and explosive safety	IS 16253: 2016	Hydrogen detection apparatus - Stationary applications	BIS
48	H_2 safety	Fire and explosive safety	IS 1642: 2013	Code of practice for fire safety of buildings	BIS
49	H_2 safety	Fire and explosive safety	IEC or IS/IEC 60079: 2015	Series Explosive Atmosphere Standards	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
50	H_2 safety	Process safety	IS 1893 : 1984	Criteria for earthquake resistance design of structures	BIS
51	H_2 safety	Fire and explosive safety	IS 16749: 2018	Basic considerations for the safety of hydrogen systems.	BIS
52	H_2 safety	Process safety	IS 16017: 2013	Transportable gas cylinders - Periodic inspection and testing of seamless aluminium alloy gas cylinders	BIS
53	H_2 safety	Process safety	IS 15319: 2020	Natural Gas — Organic Components Used as Odorants — Requirements and Test Methods	BIS

After the launch of NGHM, MNRE has instituted a mechanism to expedite the development of standards across the Green Hydrogen value chain in order to accelerate the implementation of the mission. In this phase, there has been an emphasis on developing the supply chain linkages for Green Hydrogen, and the focus has been on aspects related to the storage and transportation of hydrogen and its derivatives. Out of 34 standards notified after NGHM, 22 have been for the storage and transportation component of the Green Hydrogen value chain. Table 5 provides details of standards issued after the launch of NGHM.

Table 5: List of Indian standards issued post the launch of NGHM

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
Storage and transport					
1	Gaseous transport	Reversible metal hydride	IS 19037 : 2023/ISO 16111	Transportable gas storage devices - Hydrogen absorbed in reversible metal hydride	BIS
2	Gaseous transport	Piping and pipelines	ASME B31.12	Hydrogen piping and pipelines	OISD
3	Gaseous transport	Piping and pipelines	ASME B31.3	Process Piping	OISD
4	Gaseous transport	Piping and pipelines	ASME B31.8	Gas transmission & distribution piping systems	OISD
5	Gaseous transport	Piping and pipelines	API/ANSI 5L	Pipe specification	OISD
6	Gaseous transport	Gas infrastructure	API 579	Fitness for service	OISD
7	Gaseous transport	Metering	API MPMS Chapter 5.1 and 13	Metering - general considerations and statistical aspects of measuring and sampling respectively	OISD

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
8	Gaseous transport	Gas infrastructure	IGEM/D/13	Installations for natural gas, liquefied petroleum gas and liquefied petroleum gas/air	OISD
9	Gaseous transport	Metering	AGA Report No. 5	Fuel gas energy metering	OISD
10	Gaseous transport	Metering	AGA Report No. 3	Orifice metering of natural gas and other related hydrocarbon fluids	OISD
11	Gaseous transport	Metering	ANSI/API 2530	Orifice metering of natural gas	OISD
12	Gaseous transport	Gas infrastructure	AGA Report No. 8	Compressibility factors of natural gas and other related hydrocarbon gases	OISD
13	Gaseous transport	Metering	MFC.4M – 1986 (R2016)	Measurement of Gas Flow by Turbine Meters	OISD
14	Gaseous transport	Metering	IS 17288: 2021	Measurement of fluid flow Procedures for the evaluation of uncertainties	BIS
15	Gaseous transport	Gas infrastructure	CEN-EN 12245	Transportable gas cylinders- Fully rapped composite cylinders	PESO
16	Gaseous transport	Cryogenic vessel	EN13530-2:2002/A1:2004	Large transportable vacuum insulated vessel-part-2:Design Fabrication and Testing	PESO
17	Gaseous storage	Gas cylinders and tanks	IS/ISO 9809-2 : 2019	Design, construction and testing of refillable seamless steel gas cylinders and tubes - Part 2: Quenched and tempered steel cylinders and tubes with tensile strength greater than or equal to 1,100 MPa	BIS
18	Gaseous transport	Piping and pipelines	OISD–STD–241	Safety in production, storage and transportation of hydrogen and hydrogen blends	OISD
19	Gaseous storage	Gas cylinders and tanks	IS/ISO 11515 : 2022	Gas cylinders refillable composite reinforced tubes of water capacity between 450 L and 3,000 L design construction and testing	BIS
20	Gaseous storage	Gas infrastructure	AGA Report No 8	Compressibility factors of natural gas and other related hydrocarbon gases	PNGRB
21	Gaseous storage	Gas infrastructure	IS 15677	Metering of natural gas - code of practice	PNGRB

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
22	Gaseous transport	Gas infrastructure	BS-EN 17339	Transportable gas cylinders	PESO
			End-use application		
23	Refuelling stations	Gaseous hydrogen refuelling stations	IS 18538 (Part 1): 2023	Gaseous hydrogen fuelling stations: General requirements	BIS
24	Refuelling stations	Gaseous hydrogen refuelling stations	IS 18538 (Part 3): 2023	Gaseous hydrogen fuelling stations: Valves	BIS
25	Refuelling stations	Gaseous hydrogen refuelling stations	IS 18538 (Part 5): 2023	Gaseous hydrogen fuelling stations: Dispenser hoses & hose assemblies	BIS
26	Refuelling stations	Gaseous hydrogen refuelling stations	IS 18538 (Part 8): 2023	Gaseous hydrogen fuelling stations: Fuel quality control	BIS
27	Land vehicles	Compressed gaseous FCEV	AIS 206	(L-category vehicle): Safety and procedural requirements for type approval of hydrogen powered vehicles (compressed gaseous hydrogen).	MORTH
28	Land vehicles	Vehicle safety	IS 19036: 2023	Fuel cell road vehicles- safety specifications	BIS
29	H_2 fuel quality	Fuel for vehicles/ stationary applications	IS 16061	Hydrogen fuel quality — Product specification	BIS
30	Land vehicles	Compressed gaseous FCEV	AIS 195 A	(CEV Application): Safety and procedural requirements for type approval of hydrogen powered construction equipment vehicles (liquid / compressed gaseous hydrogen).	MORTH
			General safety		
31	H_2 safety	Materials safety	IS 18463: 2023	Metallic and other inorganic coatings — Pre-treatment of iron or steel to reduce the risk of hydrogen embrittlement.	BIS
32	H_2 safety	Materials safety	IS 18436: 2023	Metallic and other inorganic coatings post coating treatments of iron or steel to reduce the risk of hydrogen embrittlement.	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
33	H_2 safety	Materials safety	IS 18435 (Part 11): 2023	Corrosion of metals and alloys — Stress corrosion testing. Guidelines for testing the resistance of metals and alloys to hydrogen embrittlement and hydrogen-assisted cracking	BIS
34	H_2 safety	Process safety	IEC 61882	HAZOP study	PESO

2.2. Standards under development in India

Table 6 lists the standards under development in India. Out of the total 59 standards under development, 27 standards are being developed by OISD, 16 by PESO, 15 by BIS, and one by MORTH. 36 standards are related to the storage and transportation of Green Hydrogen and derivatives, while 16 are general hydrogen safety standards, and 7 are related to end-use applications. It may also be noted that OISD is consolidating existing standards and standards under development with regards to hydrogen under its purview under one standard. However, this report lists the constituent standards in Table 5 and Table 6 to present the underlying details.

Table 6: List of standards under development in India

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
Storage and transport					
1	Liquid/ cryogenic transport	Cryogenic vessel	ISO 21029-1:2018	Cryogenic vessels: Transportable vacuum insulated vessels of not more than 1,000 litres volume – Design, Fabrication, Inspection and Tests	BIS
2	Liquid/ cryogenic transport	Cryogenic vessel	ISO 21029-2:2018	Cryogenic vessels: Transportable vacuum insulated vessels of not more than 1,000 litres volume – Operational Requirements	BIS
3	Liquid/ cryogenic transport	Cryogenic vessel	ISO 20421-1:2019 (part1)	Cryogenic vessels: Large transportable vacuum-insulated vessels	BIS
4	Gaseous transport	Gas infrastructure	-	Bulk hydrogen supply systems	PESO
5	Gaseous storage	Gas cylinders and tanks	ISO 11119: Parts 1 : 2020	Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes — Part 1: Hoop wrapped fibre reinforced composite gas cylinders and tubes up to 450 l	BIS
6	Gaseous storage	Gas cylinders and tanks	ISO 11119: Part 2 : 2020	Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes — Part 2: Fully	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
				wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with load-sharing metal liners	
7	Gaseous storage	Gas cylinders and tanks	ISO 11119: Part 3 : 2020	Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes —Part 3: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with non-load-sharing metallic or non-metallic liners or without liners	BIS
8	Gaseous storage	Underground storage	API RP 1114	Recommended practice for the design of solution-mined underground storage facilities	BIS
9	Gaseous storage	Underground storage	API RP 1115	Design and operation of solution-mined salt caverns used for liquid hydrocarbon storage	BIS
10	Liquid/cryogenic storage	Bulk liquid	CGA P-41	Locating bulk liquid storage systems in courts	PESO
11	Gaseous storage	Gas cylinders and tanks	GCR2016	Gas Cylinder Rules, 2016	PESO
12	Gaseous transport	Gas infrastructure	API -617	Centrifugal gas compressors	OISD
13	Gaseous transport	Gas infrastructure	API- 618	Reciprocating gas compressors	OISD
14	Gaseous transport	Gas infrastructure	API- 11P	Other small gas compressors	OISD
15	Gaseous transport	Piping and pipelines	API 1102	Recommended practice for steel pipelines crossing rail roads and highways	OISD
16	Gaseous transport	Piping and pipelines	API 1104	Standard for welding pipelines and related facilities	OISD
17	Gaseous transport	Piping and pipelines	API 1107	Recommended pipeline maintenance welding practices.	OISD
18	Gaseous transport	Piping and pipelines	API 1109	Recommended practice for marking liquid petroleum pipeline facilities.	OISD
19	Gaseous transport	Piping and pipelines	API 1110	Recommended practice for pressure testing of liquid petroleum pipelines.	OISD
20	Gaseous transport	Piping and pipelines	API- 6D	Pipeline valves	OISD
21	Gaseous storage	Gas cylinders and tanks	ASME Section VIII	Boiler and pressure vessel code	OISD

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
22	Gaseous transport	Piping and pipelines	ASME Section IX	Welding qualifications	OISD
23	Gaseous transport	Piping and pipelines	MSS-SP-50	Pipe hangers and supports materials, design and manufacture	OISD
24	Gaseous transport	Piping and pipelines	MSS-SP-69	Pipe hangers and supports - selection and application	OISD
25	Gaseous transport	Piping and pipelines	NACE-RP-01-69	Recommended practice control of external corrosion on underground or submerged metallic piping systems	OISD
26	Gaseous transport	Piping and pipelines	NACE-RP-01-75	Recommended practice - control of internal corrosion in steel pipelines systems	OISD
27	Gaseous transport	Metering	ISA S-75.01	Flow evaluation for sizing control valve	OISD
28	Gaseous transport	Gas infrastructure	ISA S-75.02	Control valve test procedure	OISD
29	Gaseous transport	Gas infrastructure	OISD-STD-120	Design consideration for compressors handling hydrogen on rpm, pressure, and temperature	OISD
30	Liquid/ cryogenic storage	Bulk liquid	OISD-STD-116	Requirement of automatic water spray in hydrogen storage vessels	OISD
31	Gaseous transport	Metering	ISO 5167-1:2022	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 1: General principles and requirements	BIS
32	Gaseous storage	Gas cylinders and tanks	-	Compressed gaseous hydrogen CGH_2 and hydrogen natural gas blends valve integrated with solenoid operation remotely controlled for automotive use specification	BIS
33	Liquid/ cryogenic transport	Cryogenic vessel	-	Cryogenic vessels - valves for cryogenic vessels	BIS
34	Gaseous transport	Gas infrastructure	CGA-H-5	Bulk hydrogen supply systems	PESO
35	Liquid/ cryogenic transport	Cryogenic vessel	CGA-341-2017	Specification for insulated cargo tank for non-flammable cryogenic liquids	PESO

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
36	Gaseous transport	Piping and pipelines	EIGA IGC DOC 121/14	Managing stress corrosion cracking using design and inspection techniques similar to those employed for any underground pipeline.	PESO
			End-use application		
37	Land vehicles	Fuel system components	ISO 13984	Liquid hydrogen - Land vehicle fuelling system interface	BIS
38	Refuelling stations	Gaseous hydrogen refuelling stations	ISO 16923	Natural gas fuelling stations CNG stations for fuelling vehicles	PESO
39	Refuelling stations	Gaseous hydrogen refuelling stations	ISO 16924	Natural gas fuelling stations LNG stations for fuelling vehicles	PESO
40	Refuelling stations	Gaseous hydrogen refuelling stations	ISO-10380	Minimum requirements for the design, manufacture, testing and installation of corrugated metal hose and metal hose.	PESO
41	Refuelling stations	Gaseous hydrogen refuelling stations	EN-14585-1	General requirements for material, design, manufacture, testing, marking and documentation of corrugated metal hose assemblies.	PESO
42	Land vehicles	Vehicle safety	IS-14812	Rear under run protective device	BIS/PESO
43	Land vehicles	Compressed gaseous FCEV	AIS 157 A	(CEV Application): Safety and procedural requirements for type approval of compressed gaseous hydrogen fuel cell vehicles	MORTH
			General safety		
44	H_2 safety	Fire and explosive safety	CGA G-5.5	Hydrogen vent systems	PESO
45	H_2 safety	Fire and explosive safety	NFPA 2	Hydrogen Technologies Code-2	PESO
46	H_2 safety	Fire and explosive safety	ANSI/CSA CHMC 1	Test methods for evaluating material compatibility in compressed hydrogen applications – metals.	BIS
47	H_2 safety	Materials safety	GBIT-34542.3	Storage and Transportation systems for gaseous hydrogen - Part 3. Test method	BIS

Sr. no.	Component	Sub-component	Code	Standard title	Issuing body
				for determination of the susceptibility of metallic materials to hydrogen.	
48	H_2 safety	Electrical installations	IEC – 79	Electrical Apparatus for Explosive Gas Atmosphere	OISD
49	H_2 safety	Process safety	1IEC – 529	Degree of protection provided by Enclosures	OISD
50	H_2 safety	Materials safety	OISD-STD-141,134,133,131,130,128	Inspection aspects related to hydrogen induced cracking and high temperature hydrogen attack in pipelines, pipes, valve, fittings, flanges bolting, and other equipment exposed to hydrogen	OISD
51	H_2 safety	Process safety	OISD-STD-113	Separation distances for Hydrogen reactor	OISD
52	H_2 safety	Process safety	OISD-STD-114	Safety data sheet of hydrogen	OISD
53	H_2 safety	Process safety	OISD – STD – 153	Inspection requirement of safety requirement handling hydrogen	OISD
54	H_2 safety	Process safety	OISD – STD – 173	Safety of batteries due to evolution of hydrogen	OISD
55	H_2 safety	Process safety	OISD – STD – 152	Safety instrumentation in units handling hydrogen	OISD
56	H_2 safety	Process safety	IS-875	Code of Practice For Design Loads	PESO
57	H_2 safety	Process safety	ASCE 7-16	Means for determining design loads, as well as how to assess load combinations.	PESO
58	H_2 safety	Process safety	ISO 13850	Standard specifies functional requirements and design principles for the emergency stop function on machinery, independent of the type of energy used.	PESO
59	H_2 safety	Electrical installations	IEC 60204/1 - ESD	To cover the electrical equipment of machines that operate in the low-voltage range, generally accepted to be 1000 V AC. or less, or 1500 V DC. or less.	PESO

2.3. Proposed standards to be considered for adoption in India

While there has been significant progress in developing safety standards after the launch of NGHM, there are still a few missing components where safety standards are yet to be developed. Table 7 identifies 52 sub-components where the hydrogen standards have not yet been developed or are yet to be considered for development in India. The table also indicates potential alternatives for adoption and suggests issuing bodies for a few sub-components. There are three standards related to hydrogen production, 29 related to storage

and transportation, 11 related to end-use applications and 9 for general hydrogen safety, which have been identified below.

Table 7: List of standards to be considered for adoption in India

Sr. no.	Component	Sub-component	Code	Title of the available international standard	Suggested issuing body
Production					
1	H_2 Generators	Water electrolysis systems	VDI 4634	Protocols for testing of low temperature water electrolysers, JRC 2021, VDI 4634 Power-to-X	-
2	Balance of System	Power system	IEEE Std. 1547	Interconnection of energy storage distributed energy resources with electric power systems	BIS
3	Balance of System	PSA	ISO/TS 19883: 2017	Safety of pressure swing adsorption systems for hydrogen separation and purification	BIS
Storage and transport					
4	Gaseous Transport	Gas infrastructure	EN ISO 10961: 2012	Transportable Gas Cylinders. Cylinder Bundles. Design, Manufacture, Identification And Testing	PESO
5	Gaseous Transport	Gas infrastructure	BS EN-13807	Transportable gas cylinders - Battery vehicles and multiple-element gas containers (MEGCs)	PESO
6	Gaseous Transport	Gas infrastructure	ISO 10961:2019	Gas cylinders. Cylinder bundles. Design, manufacture, testing and inspection	BIS
7	Gaseous Transport	Piping and pipelines	ISO 15649:2001	Petroleum and natural gas industries: Piping	BIS
8	Gaseous Transport	Gas infrastructure	ISO 18119 : 2018	Seamless steel and seamless aluminium-alloy gas cylinders and tubes	BIS
9	Liquid/ Cryogenic Transport	Shipping Vessels	IGC code /MSC.420 (97)	Carriage of liquefied hydrogen in bulk	-
10	Gaseous Transport	Gas infrastructure	EN 720-1	Transportable gas cylinders - Gases and gas mixtures - Part 1: Properties of pure gases	BIS/PESO
11	Gaseous Transport	Gas infrastructure	EN 17649: 2022	Gas Infrastructure - Safety Management System (SMS) and Pipeline Integrity Management	BIS/PESO

Sr. no.	Component	Sub-component	Code	Title of the available international standard	Suggested issuing body
				System (PIMS) - Functional requirements	
12	Gaseous Transport	Gas infrastructure	EN 1594: 2013	Gas infrastructure - Pipelines for maximum operating pressure over 16 bar - Functional requirements	BIS/PESO
13	Gaseous Transport	Gas infrastructure	EN 12732: 2021	Gas infrastructure - Welding steel pipework - Functional requirements	BIS/PESO
14	Gaseous Transport	Gas infrastructure	EN 15001-1/-2: 2009	Gas Infrastructure - Gas installation pipework with an operating pressure greater than 0,5 bar for industrial installations and greater than 5 bar for industrial and non-industrial installations	BIS/PESO
15	Gaseous Transport	Gas infrastructure	EN 334	Gas pressure regulators for inlet pressure up to 10 MPa	BIS/PESO
16	Gaseous Transport	Gas infrastructure	EN ISO 10297: 2024	Gas cylinders, Cylinder valves: Specification and type testing	BIS
17	Gaseous Transport	Gas infrastructure	EN ISO 11117	Gas cylinder: Valve protection caps and guards	BIS
18	Gaseous Transport	Gas infrastructure	EN ISO 15996	Gas cylinder: Residual pressure valves	BIS
19	Gaseous Transport	Gas infrastructure	EN ISO 23826	Gas cylinders: Ball valves, specification and testing	BIS
20	Gaseous Storage	Underground storage	CGA PS-17	Underground installation of liquid hydrogen storage tanks	PESO
21	Gaseous Storage	Gas cylinders and tanks	CGA S-1.1	Pressure Relief Device Standards-Part-1- Cylinder for compressed Gases	PESO
22	Gaseous Storage	Portable containers	CGA S-1.2	Pressure Relief Device Standards-Part-2- Portable containers for compressed Gases	PESO
23	Gaseous Storage	Stationary containers	CGA S-1.3	Pressure Relief Device Standards-Part-3- Stationary Storage Containers for compressed Gases	PESO
24	Liquid/ Cryogenic Storage	Cryogenic storage	EIGA06/19	Safety in storage, handling and distribution of liquid Hydrogen	PESO

Sr. no.	Component	Sub-component	Code	Title of the available international standard	Suggested issuing body
25	Gaseous Storage	Gas cylinders and tanks	ISO 11623 : 2023	Gas cylinders: Composite cylinders and tubes – Periodic inspection and testing	BIS/PESO
26	Gaseous Storage	Gas cylinders and tanks	ISO 19078 : 2013	Gas cylinders: Inspection of the cylinder installation, and requalification of high-pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles	BIS/PESO
27	Liquid/ Cryogenic Storage	Cryogenic vessel	ISO 21012 : 2018	Cryogenic vessels — Hoses	BIS
28	Liquid/ Cryogenic Storage	Cryogenic storage	OISD 169	OISD guidelines on small LPG bottling plants (design and fire protection facilities)	PESO
29	Gaseous Storage	Gas cylinders and tanks	1. EN ISO 9809-4 2. EN 17533	1. Design, construction and testing of refillable seamless steel gas cylinders and tubes Part 4: Stainless steel cylinders with an R m value of less than 1 100 MPa 2. Cylinders and tubes for stationary storage	BIS/PESO
30	Gaseous Storage	Gas cylinders and tanks	ASME STP/PT-0005	Design factor guidelines for high-pressure composite hydrogen tanks	BIS/PESO
31	Liquid/ Cryogenic Storage	Bulk liquid	CGA P-28	Risk management plan guidance document for bulk liquid hydrogen systems	BIS/PESO
32	Liquid/ Cryogenic Storage	Cryogenic storage	1. EIGA Doc. 24/18 2. CGA H-3-2019	1. Vacuum Insulated Cryogenic Tank Pressure Relief Devices 2. Standard For Cryogenic Hydrogen Storage	BIS/PESO
			End-use application		
33	Refuelling stations	Fuelling protocol	SAE J2601	Fuelling protocols for light duty gaseous hydrogen surface vehicles	BIS
34	Refuelling stations	Fuelling protocol	EN 17127	Outdoor hydrogen refuelling points dispensing gaseous hydrogen and incorporating filling protocols	BIS

Sr. no.	Component	Sub-component	Code	Title of the available international standard	Suggested issuing body
35	Land vehicles	Hydrogen based railways	IEC 63341 - part 1	Propulsion systems for railway locomotives	BIS
36	Aviation	Safety	1. IEC 62282-3-100: 2019 2. NFPA 853	1. Fuel cell technologies - Part 3-100: Stationary fuel cell power systems – Safety 2. Standard for the Installation of Stationary Fuel Cell Power Systems	BIS
37	Aviation	Aviation turbine fuel	ASTM D7566	Standard specification for aviation turbine fuel containing synthesized hydrocarbons	BIS
38	Fuel cells	Stationary fuel cells	1. IEC 62282-3-100: 2019 2. NFPA 853	1. Fuel cell technologies - Part 3-100: Stationary fuel cell power systems – Safety 2. Standard for the Installation of Stationary Fuel Cell Power Systems	BIS
39	Fuel cells	Portable fuel cells	IEC 62282-5100: 2018	Fuel cell technologies - Part 5-100: Portable fuel cell power systems - Safety	BIS
40	Fuel cells	Micro fuel cells	IEC 62282-6-101: 2024	Fuel cell technologies - Part 6-101: Micro fuel cell power systems - Safety - General requirements	BIS
41	Maritime applications	Bulk liquid	IGC code/MSC.420	Interim recommendations for carriage of liquefied hydrogen in bulk	-
42	Distributed applications	Heating boilers	EN 303-3	Heating boilers - Part 3: Gas-fired central heating boilers - Assembly comprising a boiler body and a forced draught burner	BIS
43	Distributed applications	Gas fired central heating	EN 15502-2-2: 2014	Gas-fired central heating boilers Specific standard for type B1 appliances	BIS
			General safety		
44	H_2 safety	Process safety	CGAP-12	Safe handling of cryogenic liquids	PESO
45	H_2 safety	Process safety	29CFR1910.119	Process safety management of highly hazardous chemicals	PESO
46	H_2 safety	Fire and explosive safety	29CFR1910.103	Hydrogen	PESO

Sr. no.	Component	Sub-component	Code	Title of the available international standard	Suggested issuing body
47	H_2 safety	Fire and explosive safety	CGA-PS-46	Roofs over hydrogen storage systems	PESO
48	H_2 safety	Fire and explosive safety	IS/ISO 14001: 2015	Environment management system	PESO
49	H_2 safety	Process safety	IS/ISO 14001: 2015	Environment management system	PESO
50	H_2 safety	OSHS	OSHA 1910.103	Hydrogen - occupational safety and health standards	-
51	H_2 safety	Fire and explosive safety	ANSI/AIA AG-095A-2017	Guide to safety of hydrogen and hydrogen systems	BIS
52	H_2 safety	Process safety	EN 437	Test gases - test pressures - appliance categories	BIS

There are a few components and sub-components for which there are no standards either at the International level or in India. These components are listed in Table 8. Developing standards for these components will ensure that the value chain for Green Hydrogen is covered in its entirety. It may further be noted that these are non-exhaustive lists and more standards may be added as we move forward.

Table 8: Components with no existing global standards

Sr. No.	Category	Component	Sub-component
1	Production	H_2 Generators	Natural gas or biomass pyrolysis
2	Production	Balance of System	CO analyser in SOECs
3	End-use application	Distributed applications	Iron and steel (shaft furnace)

3. Infrastructure for implementation of standards in India

Image: iStock

Performance testing of components across the hydrogen value chain would be critical for developing investor's confidence in Green Hydrogen. The PLI scheme on electrolyser manufacturing also links the support based on parameters like specific power consumption. Further, there are many technology start-ups that can benefit from an accredited laboratory equipped to test various technologies and components related to Green Hydrogen. A few end-use applications like fuel cells need a guarantee of the purity of hydrogen. While the issuing bodies in India issue or adopt standards related to the Green Hydrogen value chain, a separate infrastructure is employed to test qualification as per these standards. Each standard consists of multiple tests to be successfully performed to obtain certification.

The current state of the testing infrastructure in India needs to be strengthened. Corresponding to 87 existing standards in India, recognised labs for testing are available only for six standards, four of which are covered partially. Further, testing infrastructure is under development for 15 more standards.

The testing infrastructure in India needs to grow in accordance with the overall Green Hydrogen ecosystem. Gaps in the testing infrastructure need to be urgently identified and catered to, following a prioritisation among existing standards. Over the long term, entities such as private testing labs, and academic and research institutions could be accredited and recognised as per the BIS's institutional mechanisms. The facilities available with these entities could be augmented to enable them to support testing fully or partially against standards.

BIS's Laboratory Recognition Scheme (LRS) can be leveraged to enable the inclusion of newer labs. The recognition is granted against a specific Indian Standard as per its conformity assessment scheme. The prerequisite for recognition is that the laboratory shall be accredited to the Laboratory Quality Management System as per IS/ISO/IEC 17025. The accreditation body through which the laboratory is accredited shall be a full member of the International Laboratory Accreditation Cooperation (ILAC) and/or Asia Pacific Accreditation Co-operation (APAC) or any other regional accreditation cooperation body. The MNRE plans to launch a scheme for strengthening the testing infrastructure available in the country.

4. Approvals for Green Hydrogen projects

Setting up Green Hydrogen projects will require permission from the Central Government, State Government, and local bodies. Figure 4 summarises the approvals required for Green Hydrogen projects by jurisdiction and category. Out of the total 73 approvals required for Green Hydrogen projects, State Government entities hold jurisdiction for 43, Central Government entities hold jurisdiction for 23 approvals and seven approvals fall under local government bodies. It is seen that 27 out of the 73 approvals are general and legal approvals, 14 approvals are related to renewable energy use, 13 are related to fire safety, pollution control and labour contain eight approvals each and three approvals are for land allocation and use.

Figure 4: Number of approvals required by jurisdiction and by category

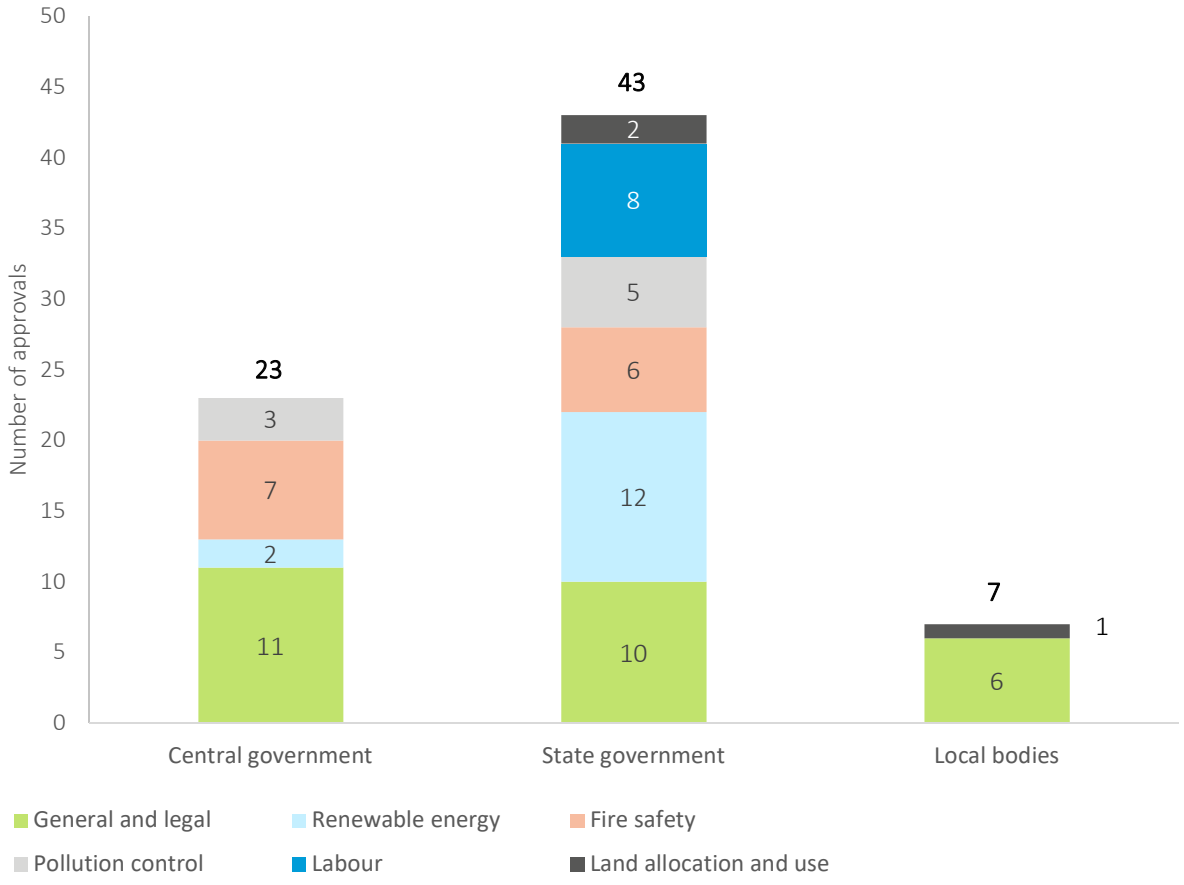

Table 9 presents an indicative list of approvals required for hydrogen projects under the jurisdiction of Central Government entities. The specific approvals and approving authorities are also indicated. This list is indicative by nature, and the number of approvals required may vary depending on the location of the project and the manufacturing process.

Table 9: Indicative list of approvals required from Central Government entities for Green Hydrogen projects

Sr. no.	Category	Approval	Approving authority
		Pre-establishment	
1	General and legal	Registration	DPIIT, Entrepreneurs Assistance Unit of Secretariat for Industrial Assistance
2	General and legal	Certificate of Incorporation-Legal Entity	Registrar of Companies, GoI
3	General and legal	PAN Registration	Income Tax Department (Finance), GoI
4	General and legal	TAN Registration	Income Tax Department (Finance), GoI
5	General and legal	GST Registration	Central Board of Indirect Taxes, GoI
6	General and legal	Approval for use of communication devices like walkie-talkie, etc.	Department of Telecommunication
7	Renewable energy	Clearance from Central Transmission Utility (CTU), as applicable, confirming the technical feasibility of connectivity of the plant to the CTU substation	Central Electricity Regulatory Commission (CERC)
8	Pollution control	Consent for Establishment under Water & Air Act (all categories)	Central Pollution Control Board (CPCB)
		Pre-operation	
9	General and legal	Export Permission and License	Directorate General of Foreign Trade (DGFT)
10	General and legal	Registration of Trademark	Government of India
11	General and legal	Code Number for Export and Import	Regional Office of DGFT
12	General and legal	Custom Duty Clearance for import of equipment	Central Customs Authority
13	General and legal	Infrastructure Development, Ports & Inland Water Transport Department Clearance	Infrastructure Development, Ports & Inland Water Transport Department
14	Renewable energy	Application for HT & EHT/transformers/line equipment/U.G. cables energization under regulation 43 of CEA 2010	CERC
15	Pollution control	Consent to Operate under Water & Air Act	CPCB
16	Pollution control	Approval for Hazardous Waste Disposal and Management: • Hazardous Waste Handling and Management Rules 2003 • Municipal Solid Waste Rules 2000 • Bio-Medical Waste Rules 1998.	CPCB

17	Fire safety	Petroleum & Explosives Clearance	Petroleum and Explosives Safety Organisation (PESO)
18	Fire safety	Clearance for approval for operation	DPIIT, PESO
19	Fire safety	Indian Boiler Regulation (IBR) Approval	Inspection company approved by the Central Boiler Board
20	Fire safety	Source return certificate, Source seal certificate, Nucleonic Instruments	Department of Atomic Energy, Atomic Energy Regulatory Board appointed under the Atomic Energy Act, 1972
21	Fire safety	Flare Designs approval if any	Directorate General of Civil Aviation
22	Fire safety	Explosive License	PESO
23	Fire safety	• Individual Units and Facilities Licenses for storage of inflammable products • Clearance for manufacture, storage and import of hazardous chemicals • Approval for product dispatch facilities • Certificate of Testing & Safety for pressure vessels • Layout for Overall Plant & Individual Units and Facilities • P&IDs Equipment Drawings (without holds)	PESO

Since State Governments have also set up their own plans for the expansion of Green Hydrogen infrastructure, the approvals required at the state and local government level may vary from state to state. Table 10 and Table 11 present an indicative list of approvals required for hydrogen projects under the jurisdiction of state and local government entities. This list is indicative by nature and the number of approvals required may vary depending on the location of the project and the process adopted for manufacturing.

Table 10: Indicative list of approvals required from State Government entities for Green Hydrogen projects

Sr. no.	Category	Approval	Approving authority
		Pre-establishment	
1	General and legal	Issue of No Due / Encumbrance Certificate	Department of Stamps & Registration
2	General and legal	Approval of plan and permission to construct/extend/or take into use any building as a factory under the Factories Act, 1948	Factories, Boiler, Industrial Safety & Health (FBIS)
3	General and legal	Factory License	FBIS
4	General and legal	Ownership Certificate / Extract	Rural Development Authority

5	General and legal	In principle approval by the State Udyog Mitra	State Udyog Mitra or equivalent statutory body
6	Renewable energy	• Generator Permission Certificate • Transformer/Line energization Certificate	State Electrical Inspector
7	Renewable energy	Clearance for safe electrical installation	State Electrical Inspector
8	Renewable energy	Application for diesel generator/solar power/wind power and other renewable energy sources energization under regulation 32 of CEA 2010	State Electrical Inspector
9	Renewable energy	Clearance from State Transmission Utility (STU, as applicable, confirming the technical feasibility of connectivity of the plant to the STU substation	State Electricity Regulatory Commission (SERC)
10	Renewable energy	• Registration in principle for solar/wind power projects • Signing of PPA, if applicable	State Renewable Energy body
11	Pollution control	Environmental Impact Assessment	State Environment Impact Assessment Authority
12	Pollution control	Consent for Establishment under Water & Air Act (all categories)	State Pollution Control Board (SPCB)
13	Labour	Registration under the Building & Other Construction Workers (regulations of employment and conditions of service) Act, 1996	State Labour Commissioner
14	Land allocation and use	Registration of Land/Property	Inspector General, Department of Stamps & Registration
15	Land allocation and use	Land Allotment	State Industrial Area Development Board or State Industrial Development Authority
		Pre-operation	
16	General and legal	Training Centre or Institute for Training of Workers Under Factories Act, 1948	FBIS
17	General and legal	Clearance for testing and examination of equipment used in the factory/plant	Legal Metrology (Weights & Measures) Inspection company of specific equipment
18	General and legal	Clearance from the Directorate of Industrial Safety and Health	State Directorate of Industrial Safety and Health
19	General and legal	New Water Connection	State Industrial Authority
20	General and legal	State Town Planning Board & Local Planning Clearance	State Town Planning Board & Local Planning Authorities
21	Renewable energy	Application for HT & EHT/transformers/line equipment/U.G. cables energization under regulation 43 of CEA 2010	SERC

22	Renewable energy	New Electricity Connection	State distribution company
23	Renewable energy	Electrical Drawing Approval for New Electricity Connection	State Electrical Inspector
24	Renewable energy	Issue of Commissioning Approval for New Electricity Connection	State Electrical Inspector
25	Renewable energy	Electrical Drawing Approval for DG Set	State Electrical Inspector
26	Renewable energy	Issue of Commissioning Approval for DG Set	State Electrical Inspector
27	Renewable energy	Approval for commissioning of project (solar/wind/biomass power project)	State Renewable Energy body
28	Pollution control	Consent to Operate under the Water & Air Act	SPCB
29	Pollution control	Authorization under Solid Waste Management (processing, recycling, treatment, and disposal of solid waste) Rules, 2016	SPCB
30	Pollution control	Approval for Hazardous Waste Disposal and Management: • Hazardous Waste Handling and Management Rules 2003 • Municipal Solid Waste Rules 2000 • Bio-Medical Waste Rules 1998.	SPCB
31	Fire safety	Registration of Boilers, Economisers and Steam Pipelines	FBIS
32	Fire safety	Approval of Boiler and Pressure Part Manufacturing Drawing and Steam Pipeline And Pipeline Layout Drawings	FBIS
33	Fire safety	Certificate for Recognition as Boiler Erector or Repairer	FBIS
34	Fire safety	Firefighting facilities	Loss Prevention Association / Competent Authority
35	Fire safety	No Objection Certificate for Building	State Fire and Emergency Services Department
36	Fire safety	State Fire and Emergency Services Department Clearance	State Fire and Emergency Services Department
37	Labour	Registration of Establishment Employing Contract Labour	Labour Department
38	Labour	New License to the contractor under the Contract Labour Act	Labour Department
39	Labour	Registration of Establishments under BOCW	Labour Department
40	Labour	Notice of Commencement or Completion of BOCW by the Employer	Labour Department
41	Labour	Registration of Establishment employing migrants under the ISMW (RE&CS) Act, 1979	Labour Department
42	Labour	License for Employment under the 15MW Act, 1979	Labour Department

43	Labour	• Registration for Principal Employer under Contract Labour (regulation and abolition) Act,1970 • Registration for Contractor under Contract Labour (regulation and abolition) Act, 1970 • Registration for Principal Employer under Contract Labour (regulation and abolition) Act, 1970 for temporary employment • Registration for Principal Employer under the Inter-State Migrant Workmen (RE & CS) Act, 1979 • Registration for Contractor under the Inter-State Migrant Workmen (RE & CS) Act, 1979	State Labour Commissioner

Table 11: Indicative list of approvals required from local government entities for Green Hydrogen projects

Sr. no.	Category	Approval	Approving authority
		Pre-establishment	
1	General and legal	Building Plan & Construction Clearance	Based on the location of the industry, this approval needs to be taken prior to the commencement of construction from the following authorities as per applicability: • Panchayat Raj • Improvement Trust • Special Planning Authority • Developmental Authority • Municipality
2	Land allocation and use	• Allotment of land use in urban/rural areas • Change of land use in urban areas • Conversion of agricultural land • Issuance of Lease Deed • Layout Plan Approval • Registration under the RERA Act, if applicable • Subdivision/reconstruction of plots	Local self-government, state revenue body
		Pre-operation	
3	General and legal	Signage Permission	Urban local bodies (ULBs)
4	General and legal	Building License/Permit (Building Plan Approval, Commencement Certificate, Plinth Inspection, Occupancy Certificate)	ULBs
5	General and legal	Right of Way permission for Water Connection	ULBs
6	General and legal	Municipal Administration Department Clearance	Municipal Administration Department
7	General and legal	Right of Way permission for Electricity Connection	ULBs

5. Action plan on Green Hydrogen standards and approvals in India

This report identifies the progress and gaps in hydrogen standards, performance evaluation and approvals required for setting up Green Hydrogen projects in the country. Going ahead, MNRE will focus on the following aspects to accelerate the implementation of NGHM:

- **Addressing the gaps in standards**: The development of domestic standards or the adoption of globally recognised standards will be prioritised in a time-bound manner. MNRE will work with all relevant bodies that are issuing safety standards in India and accelerate the process.
- **Expeditiously developing the testing infrastructure**: MNRE will collaborate with the standards issuing bodies to recognise standards for which the development of testing infrastructure must be prioritised. Existing recognised labs will be augmented to test for these standards. Over the long term, entities such as private testing labs, and academic and research institutions could be accredited and recognised as per established institutional mechanisms.
- **Constituting sub-groups for standards on upcoming application areas**: Sub-groups for standards related to Green Hydrogen use in mobility applications such as shipping, aviation and railways will be constituted to guide pilot projects and eventual deployments.
- **Expanding mandate of regulators and testing laboratories to include Green Hydrogen**: For testing, assessment, and enforcement of Green Hydrogen standards, wherever applicable, the mandate of existing regulators and standards issuing bodies needs to be expanded to include aspects related to Green Hydrogen alongside their existing domain.
- **Developing an online portal for Green Hydrogen standards:** Information on all green-hydrogen-related standards in India would be made accessible to the public through a portal developed by the MNRE. The portal will provide information on the evaluation criteria and testing procedures for each standard and would provide contacts of recognised labs where the equipment can be tested for certification. This would help project developers evaluate the compatibility of various components with the standards prescribed by issuing bodies in India.

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Acronyms

AGA	American Gas Association
AMPP	Association for Materials Protection and Performance
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BIS	Bureau of Indian Standards
CASE	Commission for Additional Sources of Energy
CEN	The European Committee for Standardization
CERC	Central Electricity Regulatory Commission
CGA	Compressed Gas Association
CPCB	Central Pollution Control Board
CSA	CSA Group
DGFT	Directorate General of Foreign Trade
DOE	United States Department of Energy
DPIIT	Department for Promotion of Industry and Internal Trade
EIGA	European Industrial Gases Association
FBIS	Factories, Boiler, Industrial Safety & Health
GB	GuoBiao Standards
GoI	Government of India
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IGEM	Institution of Gas Engineers and Managers
ISA	International Society of Automation
ISO	International Organization for Standardization
MNRE	Ministry of New and Renewable Energy
MoRTH	Ministry of Road Transport and Highways
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
MTPA	million tonnes per annum
NDCs	Nationally Determined Contributions
NFPA	National Fire Protection Association
NGHM	*National Green Hydrogen Mission*
OISD	Oil Industry Safety Directorate
OSHA	Occupational Safety and Health Administration
PESO	Petroleum and Explosives Safety Organization
PNGRB	Petroleum and Natural Gas Regulatory Board
SAE	Society of Automotive Engineers
SERC	State Electricity Regulatory Commission
SPCB	State Pollution Control Board
UL	Underwriters Laboratories
ULBs	Urban Local Bodies

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