



Investment Landscape of Green Hydrogen In India

May 2023

USAID SAREP has conducted a comprehensive investment landscape assessment for green hydrogen in India



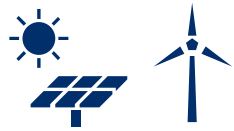
V

The Investment Landscape Report aims to provide stakeholders the necessary context on India's green hydrogen ecosystem

Green Hydrogen Fundamentals	Global Push for Green Hydrogen	India as a Green Hydrogen Destination	Composition of Investment Potential in India	Investment Supply & Bankability Enhancement	Key Challenges and Potential Mitigants
-----------------------------	--------------------------------	---------------------------------------	--	---	--

India has high potential to develop as a green hydrogen hub driven by favorable supply and demand side factors, coupled with a strong enabling environment

Supply-side supporting factors



62 GW & 42 GW
Solar and Wind Capacity (2022)

- ✓ Competitive renewable energy LCOE driven by abundant resources
- ✓ Favorable policies on interstate transmission, grid banking, procurement from power exchange, among other aspects



- ✓ Strong push to ramp up electrolyzer supply through local manufacturing



- ✓ Availability of support infrastructure with initiative for development of production hubs

Demand-side supporting factors



3rd Ammonia Consumption



4th Oil Refining Capacity



2nd Steel Production

- ✓ Large domestic market for existing hydrogen and ammonia use cases
- ✓ Access to key export markets like Japan and South Korea

Enabling Environment

India's National Hydrogen Mission (Targets by 2030)

> 5 MMTPA

Green Hydrogen
Production
Capacity

~97B

Estimated
Total
Investments

125 GW

Renewable
Energy Capacity
Addition

50 MMT

Annual CO₂
Emissions to be
Averted

Apart from these targets highlighted in the National Hydrogen Mission, the government has announced the aim to reduce green hydrogen production costs to **less than US\$2.5/kg by 2025 and US\$1/kg by 2030**

India's public and private sector entities have both come forward to announce ambitious targets, particularly on the production side

Local Electrolyzer Manufacturers	Local Green Hydrogen Producers	Local Green H2 Consumers (Captive / Procured)
Other Stakeholders		
<p>Distribution Technology</p>	<p>Automotive Technology</p>	<p>Ports and Shipping</p> <p>Industry Coalitions</p>

- Public Sector Undertakings are prioritizing **pilot projects** to **build local capacity** for green hydrogen technologies
- Private players are focusing on developing large scale projects and have entered into **MOUs with multiple state governments**
- While a significant production capacity has been announced, its realization is **contingent upon the developers' ability to secure offtake**
- Multiple domestic players have strategically partnered with foreign electrolyzer manufacturers for **joint development of electrolyzer gigafactories in India.**

India's green hydrogen demand is expected to be driven by oil refining, natural gas blending and fertilizers due to better readiness for adoption

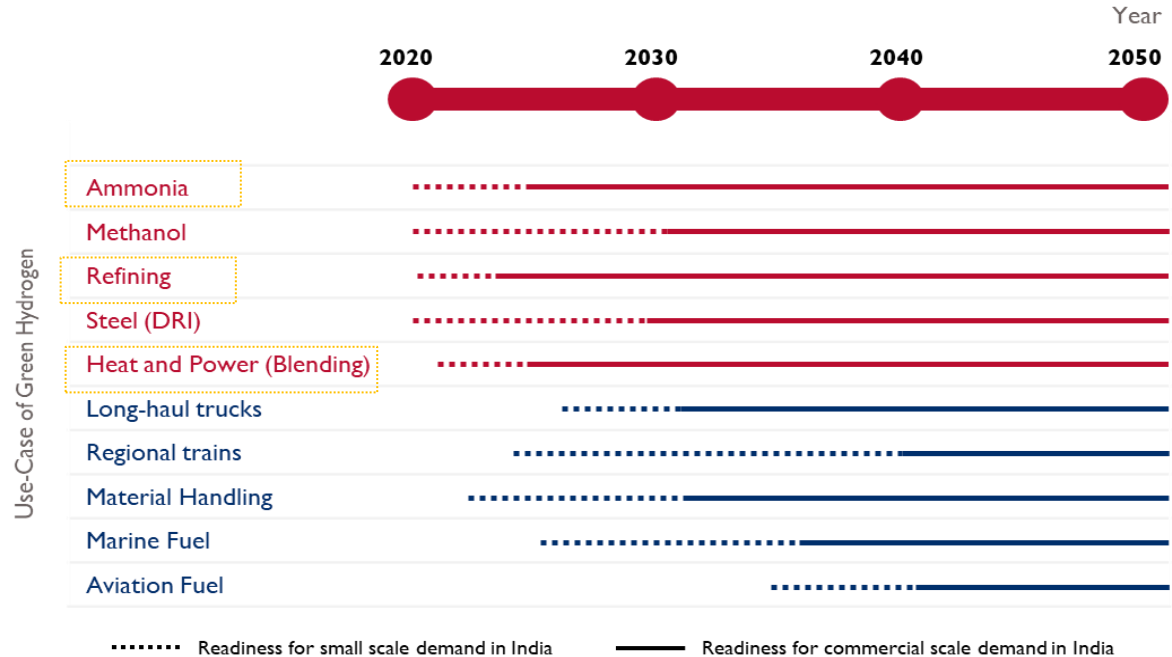
Readiness of Green Hydrogen Adoption by Use Cases

Commercial Readiness by Sector:

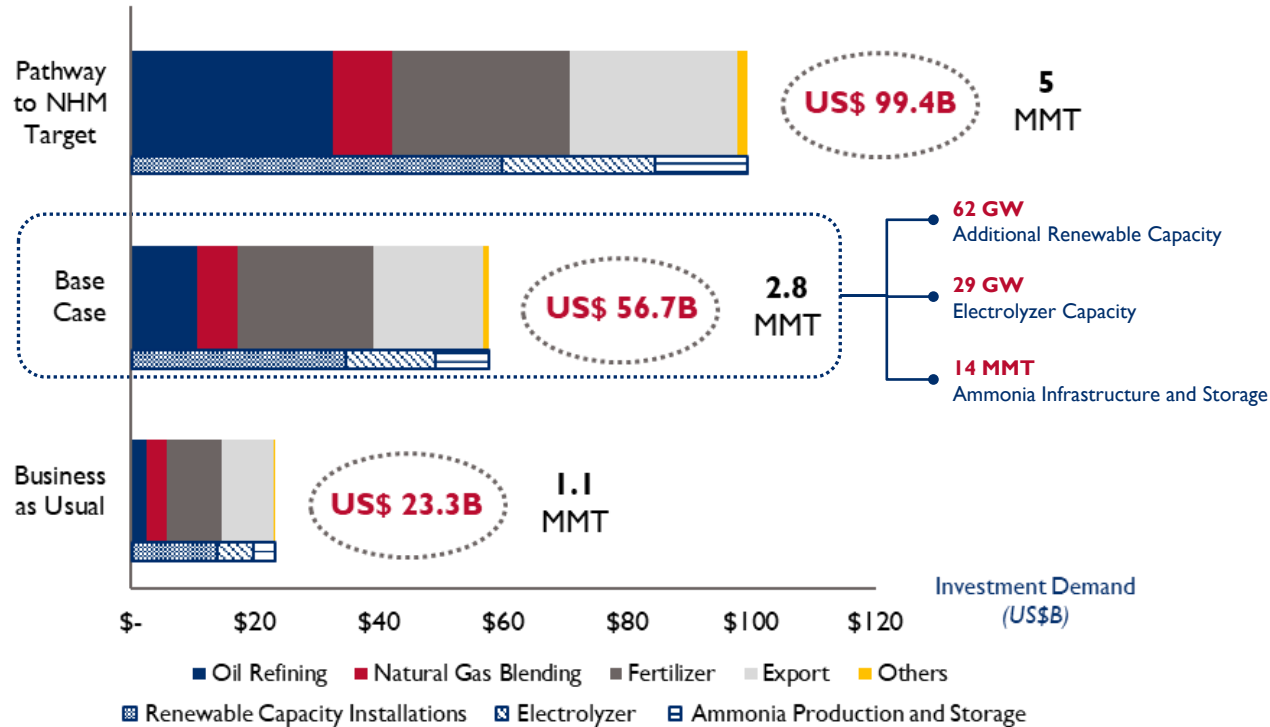
1&2. Refining & Natural Gas: Expected to transition rapidly given its relatively insignificant impact on output economics (~2-4%)

3. Green Ammonia and Fertilizers: driven by government goal to replace all fertilizer imports with green alternatives by 2035

4. Other: Export: NHM target of capturing 10% of global exports



Under our 'Base Case', India is expected to achieve 2.8 MMT p.a. green hydrogen production with an investment potential of US\$ 56.7B by 2030



The investment demand is expected to be primarily driven by the Oil Refining, Export and Fertilizer sectors.

Within the GH2 value chain, renewable energy investments represent nearly 60-70% of the total investment need

Investors have a significant appetite for large-ticket investment in the GH2 sector, considering the strong sustainability and additionality agenda

Types of Lenders	Description and Expected Terms	Potential Investors in India
Development Finance Institutions	<ul style="list-style-type: none"> Typically USD 100-200M and sometimes higher subject to country and/or project caps Long tenor and low-cost financing Smaller DFIs usually prefer to have larger DFIs lead the DD process 	
Domestic and International Commercial Banks	<ul style="list-style-type: none"> Key source of large-scale project finance in India, offering multi-BN financing in consortiums Prefer to lend with insurance cover such as Political Risk Insurance or debt cover from external agencies such as MIGA and Export Credit Agencies (ECAs) Usually have more flexible terms and less time-consuming processes than DFIs 	
Export Credit Agencies	<ul style="list-style-type: none"> Participate against equipment procurement or equity participation from home countries Offer multi-BN financing capacity through direct lending, or unlock investments by commercial lenders through insurance covers 	
Green Bond Market	<ul style="list-style-type: none"> While still nascent, the bond market can emerge as a key source of finance 	

Project bankability remains a key concern for the sector, highlighting the need for support during project's development stages

I Project Completion Risk

Green hydrogen projects are exposed to a higher completion risk due to the nascency of the technology market. Thus, developers experience higher risks during the development and construction phases

Potential Mitigants

Divide the project into stages and optimize capital based on the risk profile in each stage

- **Development Phase: High risk capital** from donors are required as there is significant uncertainty around project feasibility
- **Construction Phase: Medium to high risk** capital from DFIs, Commercial banks is required due to limited experience of EPC and OEM providers in the sector
- **Operations Phase: Low Risk capital** from conservative investors can be employed, as the necessary contracts are already in place, and once operational history is established

Given that developers are uncertain about production technologies, associated risks and standard solutions for project, Project developers can be supported from the project development stages onwards, through Project Preparation Facilities or other development support mechanisms

Project Preparation Facilities: These facilities will help to develop bankable, investment ready projects by financing high quality upstream work such as feasibility studies, ESIA assessments, permitting, certification and other early-stage development work

Government intervention in the form of mandates, incentives and ratification of regulations can also be pivotal in driving investments

	Potential Challenges	Potential Mitigants
2 Price and Volume Risk	<p>Absence of Strong Domestic Consumption Market - High green premium leading to reduced commercial viability</p> <p>Uncertainty around pricing and offtake contracts Current market is working on a spot price basis, however high-capex and longer project lifetime necessitates long-term offtake contracts</p>	<ul style="list-style-type: none">• Industry wide mandates to push demand by setting green hydrogen purchase obligations• Incentives such as green contracts for difference /PLIs• Pricing could be calculated as a weighted average of cost of production (representing the seller's side), cost of replacement (representing the buyers side / cost of grey alternatives) and a green premium (for example pricing of emissions)
3 Interface Risk	<p>Green hydrogen projects involve integration of multiple technologies for a single project output, which could lead to delays / non-completion</p>	<ul style="list-style-type: none">• Introduce a wrap guarantee for overall plant operations• Introduce oversized liquidated damages
4 Uncertain Regulatory Framework	<p>Grey and green hydrogen have the same physical characteristics and as such need the latter needs to be supported with clear green certification standards</p>	<ul style="list-style-type: none">• Introduction of frameworks for regulation and green certification that are well-harmonized with global equivalents