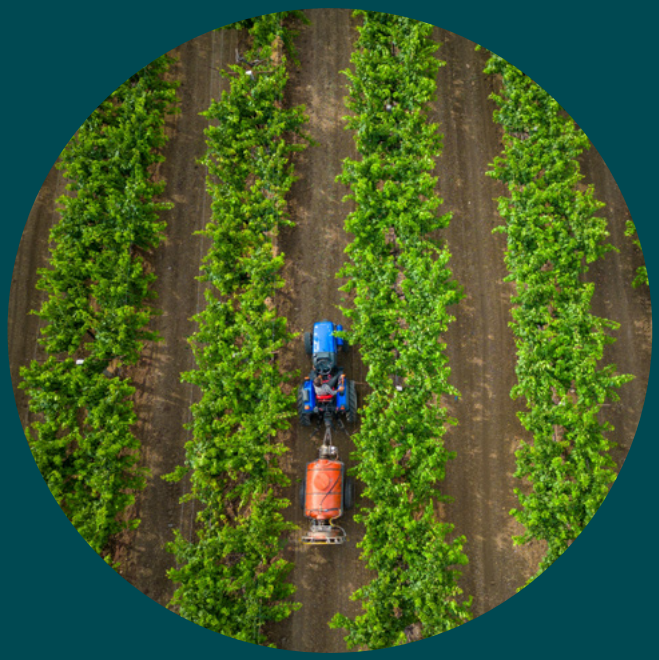
Climate Catalyst



Scaling green ammonia in India

Insights from 50+ civil society experts and industry stakeholders on turning early momentum into a viable market

Team

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Project summary

India's green ammonia sector is beginning to move from ambition to execution. The SECI tender under the National Green Hydrogen Mission has delivered globally competitive prices, a national standard for green ammonia has been notified, and more than 40 projects have been announced across the country.

As these developments take shape, the central questions are changing as well. India's ability to build a viable green ammonia market will require demand, infrastructure, technology and investment to develop at a pace that can support the scale-up of production.

Despite the growing number of projects and initiatives, there is still limited understanding of how the different actors in the ecosystem view these challenges and opportunities. What do companies see as the biggest constraints to scale? Where do civil society organisations and funders see the greatest gaps? And where could targeted research, convening or policy engagement make the greatest difference?

To explore these questions, Climate Catalyst conducted a structured perception study of India's green ammonia ecosystem between March and July 2026. We surveyed and interviewed 57 stakeholders: 26 from civil society and funding organisations, and 31 from industry, covering the value chain from renewable energy and electrolyser manufacturing through to fertiliser production, logistics and shipping.

The industry engagement was undertaken in partnership with FTI Consulting, an organisation that also serves as the secretariat for the Indian Hydrogen Alliance (IH2A). We then brought the emerging findings to a two-day convening in Nandi Hills, Bengaluru, attended by 29 organisations. We are grateful to all experts for sharing their insights on the topic.

This report is a culmination of perspectives together to provide a clearer picture of the emerging ecosystem, the constraints stakeholders believe are most significant, and the interventions that could help unlock the next phase of growth. It looks in particular at the actors shaping the sector, the barriers to scale, gaps in demand and infrastructure, and the potential role of civil society in addressing them.

The findings are intended to inform future research, philanthropic priorities and policy dialogue as India seeks to establish itself as a global hub for green hydrogen and its derivatives.

The insights from this report have also been captured in a deck and can be found here.

Disclaimer: This report presents stakeholder perceptions gathered between March and July 2026. Views are reported in aggregate and should not be attributed to any individual respondent or organisation. The organisations listed in this report took part in the consultation. Their inclusion does not imply endorsement of the findings. Discussions at the Nandi Hills convening were held under the Chatham House Rule. Analysis and conclusions are those of Climate Catalyst alone.

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Abbreviation	Full Form
BOP	Balance of Plant
CAPEX	Capital Expenditure
CSO	Civil Society Organisation
DAP	Di-ammonium Phosphate
FID	Final Investment Decision
GAPA	Green Ammonia Purchase Agreement
GNA	Grid Network Access
ISTS	Inter-State Transmission System
LNG	Liquefied Natural Gas
MMT	Million Metric Tonnes
MNRE	Ministry of New and Renewable Energy
$MtCO_2$	Million Tonnes CO_2
MTPA	Million Tonnes Per Annum
MOP	Muriate of Potash
NBS	Nutrient-Based Subsidy
NPK	Nitrogen, Phosphorus, Potassium
NGHM	National Green Hydrogen Mission
OEM	Original Equipment Manufacturers
PEM	Proton Exchange Membrane
PESTLE	Political, Economic, Sociological, Technological, Legal and Environmental
PSU	Public Sector Undertaking
RFNBO	Renewable Fuels of Non-Biological Origin
RTC	Round-the-Clock
SECI	Solar Energy Corporation of India
SIGHT	Strategic Interventions for Green Hydrogen Transition
SMR	Steam Methane Reforming

Executive summary

India is the second largest consumer of ammonia in the world. The lion's share of ammonia is utilised for a single end-use i.e. fertiliser production for food production that sustains a population of over 1.4 billion. Ammonia production constitutes one-fourth of the emissions from the chemical sector. Green ammonia can cut India's US$1.5-2 billion annual import bill, reduce exposure to volatile global gas and ammonia markets, and support the decarbonisation of a fertiliser sector that consumes 80-85 per cent of the country's ammonia output. Recent geopolitical shocks, particularly the escalation in West Asia and the associated spike in Liquefied natural gas (LNG) prices might have shifted the dominant framing from decarbonisation towards energy and fertiliser security. This study maps the current landscape of green ammonia ecosystem development in India with consultations from civil society organisations (CSO) and industry actors.

Consultations with 26 CSOs and funders, and 31 industry players spanning the value chain, surface some important perspectives on barriers, opportunities, and the overall value chain of green ammonia. The dedicated civil-society capacity remains nascent for most organisations as green ammonia is an emerging area of work. Current CSO engagement is concentrated in policy research, technical assistance, public narrative and communications, philanthropy, and industry engagement. However, CSOs face structural barriers, particularly due to the political sensitivity of fertiliser reform, limited in-house technical expertise, restricted entry points into policy processes, insufficient funding and limited access to industry. The mapping also highlights an uneven distribution of CSO attention across the value chain. CSOs are relatively active on the renewable-energy supply side and policy aspects of offtake and demand creation, while comparatively less attention is directed towards electrolysers, ammonia synthesis, logistics, storage and other midstream/downstream infrastructure.

Across both CSO and industry consultations, there is broad alignment on the principal ecosystem-level barriers. Mapping these through the PESTLE (Political, Economic, Sociological, Technological, Legal and Environmental) framework shows that the most significant constraints sit across the policy, political, economic and technological dimensions. Policy uncertainty includes the absence of long-term incentives, evolving standards and certification requirements, and insufficient market-creation mechanisms. Politically, the sensitivity of fertiliser prices and the existing subsidy burden make reform difficult. Technologically, stakeholders highlighted the scale-up of electrolysers, intermittent renewable operation, existing urea-plant integration and project bankability. Infrastructure constraints such as grid connectivity, land and water availability further compound project execution risks. A central cross-cutting issue is the mismatch between the roughly three-year period of current policy support and the 10+ year investment horizon of green ammonia projects.

At the value-chain level, three bottlenecks consistently emerged: offtake, renewable-energy supply, and electrolysers/balance of plant. Demand creation is the most immediate constraint with developers needing bankable long-term offtake to commit capital, while buyers remain reluctant to contract without competitive prices and policy certainty. The Solar Energy Corporation of India (SECI) tender is viewed as an important first step, but stakeholders do not consider it sufficient to generate demand at the scale required for transition. On the supply side, the challenge is to have reliable round-the-clock renewable power (RE-RTC), transmission connectivity and high electrolyser utilisation. Industry respondents estimate that renewable electricity accounts for over 65 per cent of current hydrogen/ammonia production costs. Electrolyser localisation and reliability are additional concerns, with critical components still substantially dependent on imports and questions around degradation, corrosion, purity and performance under variable renewable power.

Stakeholders identified renewable-energy cost and electrolyser capital expenditure (CAPEX) as the two principal levers for reducing the levelised cost of green ammonia. While CSOs placed greater emphasis on reducing electrolyser costs, industry viewed renewable electricity as the dominant cost driver. Importantly, the relevant cost is the delivered cost of RE-RTC which includes transmission and wheeling charges, grid connection, dedicated renewable capacity with storage required to achieve a 24/7 power profile. Policy support for manufacturing, localisation and sustained production incentives could reduce costs over time, but localisation policies will need to balance domestic capability-building with the near-term economics and reliability of projects.

Export markets offer a significant near-term opportunity, but export readiness is constrained by certification and infrastructure. Both CSOs and industry identified RFNBO (Renewable Fuels of Non-Biological Origin) compliance as challenging, particularly requirements around additionality, geographic correlation and hourly temporal matching. These requirements differ materially from India's current green-ammonia standard, which uses a 12-month emissions-intensity average. Compliance may therefore require additional wind, storage and other system configurations, increasing project costs. India also faces gaps in specialised ammonia storage, transport and port infrastructure, with long lead times for storage equipment and dedicated export terminals.

Scaling green ammonia will ultimately require a shift from project-level support towards sustained demand creation and long-term market. CSOs and industry were unanimous in supporting demand mandates and PSU (Public Sector Undertaking)-backed offtake guarantees. Stakeholders broadly favoured a 6-10 per cent green-ammonia blending

target for urea, while industry supported more than 10 per cent for non-urea applications. However, the technical feasibility of urea blending remains less certain because green ammonia production does not generate the concentrated CO_2 stream required for conventional urea synthesis. The consultations therefore point towards non-urea applications as an important initial domestic market, alongside further technical work on urea. Longer-term policy should provide greater visibility over 10 years or more, strengthen market-creation mechanisms, support infrastructure and technology localisation, and establish clearer domestic end-use and export targets.

Finally, there is no clear consensus on the sequencing of domestic and export markets. Industry survey responses identified exports as an immediate opportunity, reflecting growing interest from Europe and East Asia, while several interviewees emphasised domestic import substitution and fertiliser security. Early exports could help build scale, attract investment and develop the ecosystem, but stakeholders also cautioned against a scenario in which India exports subsidised green ammonia while continuing to import grey ammonia. The emerging consensus is focused on enabling the first wave of both domestic and export-oriented projects to reach final investment decisions (FID), construction and successful commissioning. A credible pipeline of delivered projects, combined with domestic demand mandates and export-market readiness, can provide the foundation for subsequent scale-up.

India has made significant strides towards green ammonia development and discovered globally competitive prices. There is increasing activity across the green ammonia value chain and announcement of export deals to countries including South Korea and Japan. The burgeoning CSO capacity will play an important role in tracking progress towards FIDs, techno-economic assessments, and shaping the next phase of policy development at the national and sub-national level. The consultations suggest that India has moved beyond the question of whether green ammonia is technically and strategically relevant to the more difficult question of how to build a bankable, integrated and demand-led ecosystem at scale. The next phase will require greater coordination across policy, demand, renewable power, technology and infrastructure while ensuring that the transition to green ammonia also addresses the underlying environmental and health concerns associated with excessive fertiliser consumption.

Introduction: Green ammonia's emergence as a strategic opportunity for India's energy security, fertiliser security and industrial decarbonisation

Green ammonia is emerging as a strategic lever for India's energy transition and industrial decarbonisation. India is the world's second largest ammonia consumer, with an annual demand of 17-19 million metric tonnes (MMT), of which 80-85 per cent is used in fertiliser production.[1,2] India produces ~15 MMT of ammonia annually, resulting in around 30 $MtCO_2$ of emissions and accounting for around 25 per cent of the total 140 $MtCO_2$ emissions from India's chemical sector.[3,4] Despite being a major producer, India continues to import 2.5 MMT of grey ammonia annually, primarily for non-urea production, making India susceptible to geopolitical events while also impacting foreign exchange.[5] India spends around US$1.5-2 billion per year on ammonia imports. Moreover, around 80 per cent of total ammonia imports are sourced from Gulf countries, exposing India's supply chains to geopolitical and maritime disruption.[6] Additionally, India's ammonia sector consumed ~17 MMT of imported LNG between April 2025 and January 2026, reinforcing its reliance on imported fossil fuels.[7]

India's policy to support green ammonia has evolved since the launch of National Green Hydrogen Mission (NGHM) in 2023 with an outlay of INR 19,744 crore.[8] Under the mission, SIGHT (Strategic Interventions for Green Hydrogen Transition) Mode 2A scheme was designed specifically around green ammonia with SECI as implementing authority. SECI tendered 0.724 MTPA of green ammonia capacity across 13 fertiliser plants in June 2024, and the auction concluded in August 2025 with bid prices landing at INR 49.75-64.74/kg (US$569-737/MMT).[9] This was followed in February 2026 by Ministry of New and Renewable Energy (MNRE) notification of the green ammonia definition under 0.38 kg CO_2eq/kg NH_3, averaged over a trailing 12-month period giving the sector its first regulatory benchmark for what counts as green ammonia.[10]

Mission Possible Partnership's (MPP) ITA analysis identifies 44 green ammonia projects across India, representing 28-30 MTPA of green ammonia capacity. Odisha leads the pipeline with 14 projects totalling 7.89 MTPA, followed by Andhra Pradesh (8 projects, 7.25 MTPA) and Gujarat (6 projects, 4.11 MTPA). Marquee projects such as AM Green's Kakinada project and NTPC's Green Hub at Pudimadaka (Andhra Pradesh) have already

reached FID, while several projects including ACME's Gopalpur and Jakson Green's Gopalpur project have signed Green Ammonia Purchase Agreements (GAPA) with SECI.[11]

The government's shift from policy to implementation is further highlighted by the recent invitation for Expressions of Interest (EoI) issued jointly by the Department of Fertilisers (DoF) and Projects & Development India Limited (PDIL), which aims to set up commercial-scale production facilities for Green Urea within the country.[12]

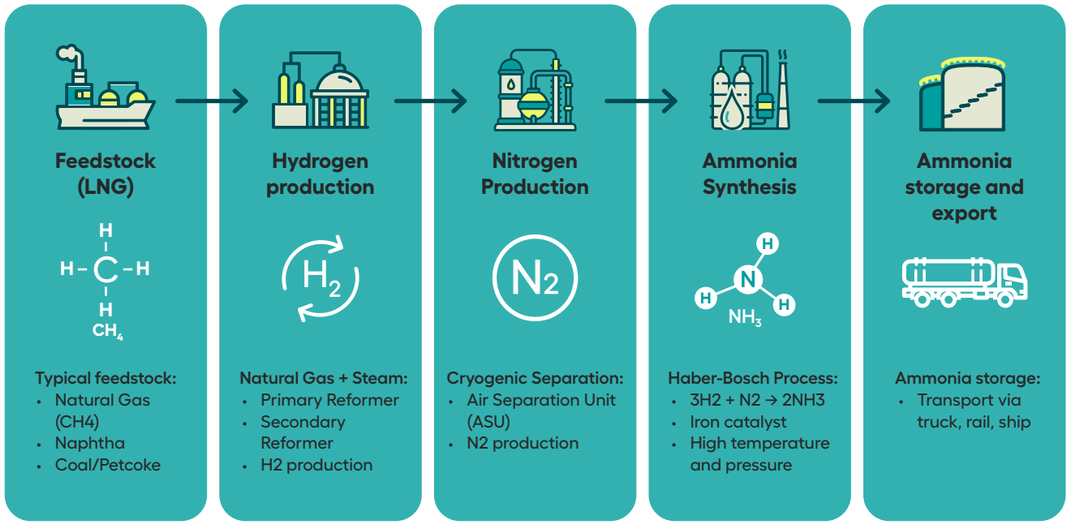


Ammonia production and its use in fertiliser: India's dependence on ammonia-based fertilisers, decarbonisation and subsidy challenge

Green ammonia is produced through three steps: water electrolysis for H_2 production, nitrogen separation from air via air separation units; and the Haber-Bosch process combining H_2 and N_2.

The Haber-Bosch process remains the dominant commercial technology for ammonia synthesis globally due to its maturity and scalability. However, in green ammonia production, the carbon-intensive hydrogen feedstock derived from natural gas is replaced with green hydrogen generated via electrolysis, significantly reducing emissions. Depending on the electricity source, green ammonia production can reduce emissions by up to 90 per cent compared to conventional grey ammonia pathways.

Figure 1: Ammonia production process

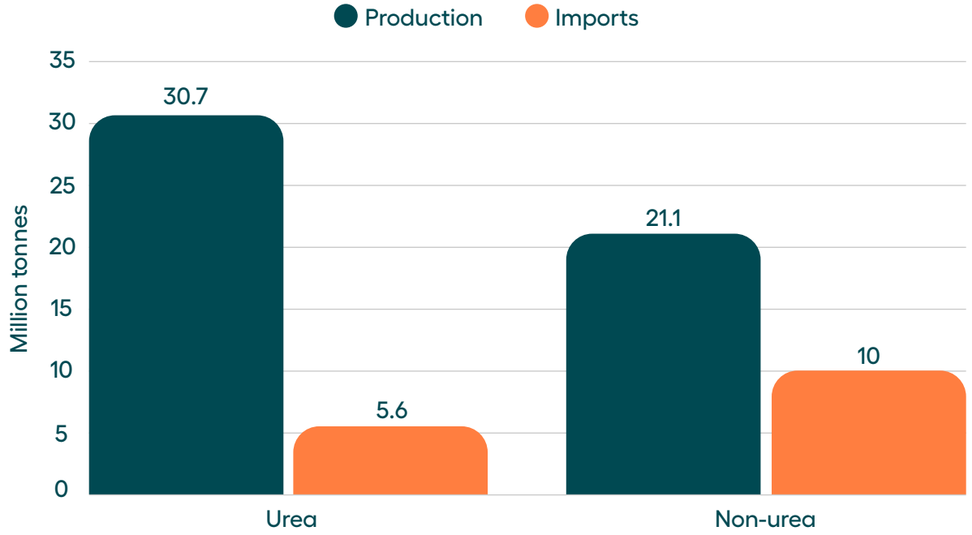


Ammonia serves as the primary foundational building block for nearly all synthetic nitrogen-based fertilisers. Combining ammonia and carbon dioxide produces urea fertiliser.

India's fertiliser sector is among the largest globally and remains one of the country's most strategically important yet politically sensitive industries. The sector plays a critical role in ensuring agricultural productivity and food security, while also being heavily shaped by subsidy structures, import dependence, and government intervention. These structural characteristics significantly influence the adoption pathway for green ammonia.

India is also the world's second-largest fertiliser consumer, with agriculture contributing 18.3 per cent to gross value added in FY 2022-23 and employing around 54 per cent of the workforce.[13,14] Total fertiliser consumption reached ~70.7 MMT of products in 2024-25.[15] India's self-reliance across the fertiliser value chain remains low and is highly dependent on other countries for feedstock as well as the final fertiliser product.

Figure 2: Production and imports of urea and non-urea for 2024-2516 (non-urea imports include NPK (3.3 MT), DAP (4.5 MT), and MOP (2.2 MT)



Source: ICRIER

Urea dominates both fertiliser use and the nitrogen mix, representing 80–85 per cent of India's ammonia consumption and accounting for 38.7 MMT in 2024-25.[17] The sector is structurally dependent on the global supply chain due to its import-dependent nature.

Domestic ammonia production is entirely fossil-based in India. All domestic urea plants are natural gas based, with each tonne of ammonia requiring roughly 178 kg of hydrogen produced via steam methane reforming (SMR).[18] This means ~19 MTPA of ammonia consumption is currently entirely grey (fossil-based), emitting 2.0-2.5 tonnes of CO_2 per tonne of ammonia.[19] Shifting to green hydrogen could reduce emissions by ~38-48 $MtCO_2$/yr. Additionally, the fertiliser market is highly regulated and subsidised, creating a massive fiscal impact on the economy, thereby blocking adoption of green alternatives.

The central government spent ~INR 2 lakh crore (~USD 20 billion) on fertiliser subsidies in 2025-26, making it one of the largest subsidy expenditures in the country.[20] The subsidised urea price encourages:

- Overuse of nitrogen (urea)
- Under-application of phosphorus and potash (DAP, NPK)
- Diversion of subsidised urea to non-agricultural uses (industries, ethanol production)
- Distorted consumption patterns, making balanced fertilisation economically irrational for farmers

Fertiliser prices in India are a politically sensitive issue as any change in the pricing mechanism or the level of subsidy will have a direct impact on the majority of India's population who are dependent on agriculture for their livelihood. Any move to increase their prices or reduce subsidies will have significant political ramifications.

Thus, unless the government is willing to increase subsidies, transition to green ammonia-based fertiliser will be difficult as it would lead to increases in food prices and reductions in farm incomes. In other words, a switch to green ammonia-based fertiliser may not be economically feasible unless additional subsidies are provided. Consequently, while recent SECI auctions witnessed record low tariffs, indicating that green ammonia is close to being economically competitive to grey-imported ammonia, its acceptance is limited by political and fiscal challenges, not technological ones.

Methodology: Capturing stakeholder's view on India's green ammonia ecosystem

This report draws on insights from two parallel stakeholder engagements, each capturing a distinct vantage point on India's emerging green ammonia ecosystem: CSO perspective and industry perspective. A combination of surveys and interviews have been used to gather these views.

Sample description - CSO and industry value chain covered

The civil society sample comprises 26 organisations, including 21 CSOs and 5 funders working across climate policy, energy transition, and agriculture in India. Their views are informed by their work at the intersection of communities, environment, and policy, and their responses have been included to represent a diverse set of views on India's green hydrogen and ammonia space.

Figure 3: Composition of the civil society and Industry

CSO

26 stakeholders

- **20** CSOs and think tanks — Policy research, advocacy
- **6** Funders — Climate and energy philanthropy

INDUSTRY

31 stakeholders

- **21** Upstream — RE developers, electrolyser OEMs, GA developers, GH2 producers
- **5** Midstream — Storage, transport, shipping, ports
- **5** Downstream — Fertiliser (urea and non-urea), refineries

The industry sample comprises 31 respondents across the full green ammonia value chain. Upstream respondents (21) include green ammonia and green hydrogen developers, electrolyser OEMs, and technology providers. Midstream respondents (5) represent storage, transport, shipping, and logistics players. Downstream respondents (5) represent fertiliser manufacturers across urea and non-urea segments.

Survey methodology

An online survey questionnaire was circulated between March to May 2026 among civil society organisations working at the intersection of climate policy, industrial decarbonisation, and India's energy sector. The survey comprised questions pertaining to organisational capacity, thematic priorities, perceptions towards barriers and opportunities, views on policy interventions, end-use prioritisation, and the role of civil society in supporting green ammonia deployment. Question formats included single and multiple-select questions, likert-scale ratings, rank-order prioritisation exercises, top-response selections, and open-ended qualitative responses.

Interview methodology

Subsequently, one-to-one, semi-structured interviews were conducted with the organisations for 45-90 minutes each. These conversations were around organisational positioning on green ammonia, priorities for end-use sequencing, views on the SECI tenders and SIGHT scheme, thoughts around just transition, livelihoods, and environmental concerns, and reflections on where India's green hydrogen mission should focus over the next five years. Survey findings were then triangulated with insights from interviews to derive quantitative and qualitative insights on India's green ammonia ecosystem.

Industry survey and interview methodology

The industry perspective was developed by FTI Consulting in partnership with Climate Catalyst. FTI Consulting manages the secretariat and acts as the planning and execution arm for the India Hydrogen Alliance (IH2A). FTI Consulting conducted surveys and interviews with 31 industry players across the value chain (shown in the table 1 above) through structured surveys and one-on-one interviews covering commercial viability, technology readiness, infrastructure gaps, and policy priorities for scaling green ammonia. Climate Catalyst developed the initial survey and interview questionnaires, which were subsequently refined with FTI's input to reflect the current industry situation and sector priorities. All industry perspectives presented in this report are drawn from this combined survey and interview insights.



Stakeholder map – The green ammonia ecosystem

India's green ammonia ecosystem comprises a diverse and evolving set of actors spanning government, industry, civil society, and finance. Understanding the roles, mandates, and interests of these actors is essential for identifying where collaborations are feasible, where tensions are structural, and where gaps in capacity or coordination currently exist. The figure 4 below provides an overview of the entire green ammonia ecosystem.

Government and regulatory bodies

Government players include the central decision-making body along with central ministries and PSUs. Green Ammonia comes under the National Green Hydrogen Mission headed by MNRE.

Industry: Upstream, midstream, and downstream

The upstream side includes renewable energy developers, electrolyser manufacturers, EPC and technology players, and industrial gas producers and transport players. Mid-stream includes storage, transport, shipping, and logistics stakeholders. Downstream players include fertiliser manufacturers across urea and non-urea segments, refineries, chemical companies, traders and offtakers including those using it for co-firing, shipping, or hydrogen carrier.

Research, think tanks and civil society organisation

The civil society ecosystem engaged in this study includes think tanks, policy research organisations, funders, and groups working at the intersection of climate, energy, agriculture, and industrial policy.

Industry associations

Industry associations are private or public sector organisations actively engaged in hydrogen, ammonia, or fertiliser related activities.

Figure 4: Overview of India's green ammonia ecosystem

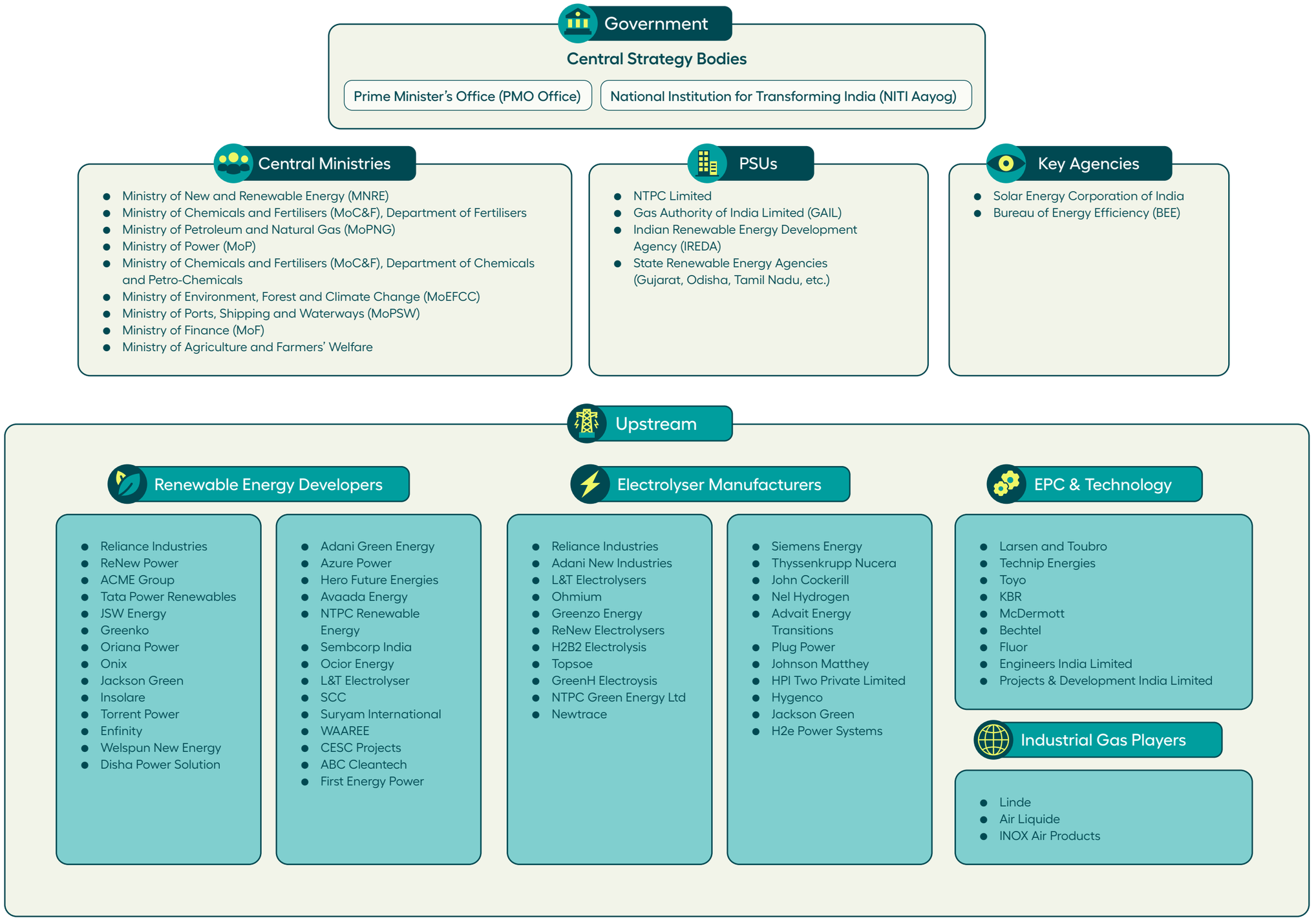


Figure 4: Overview of India's green ammonia ecosystem

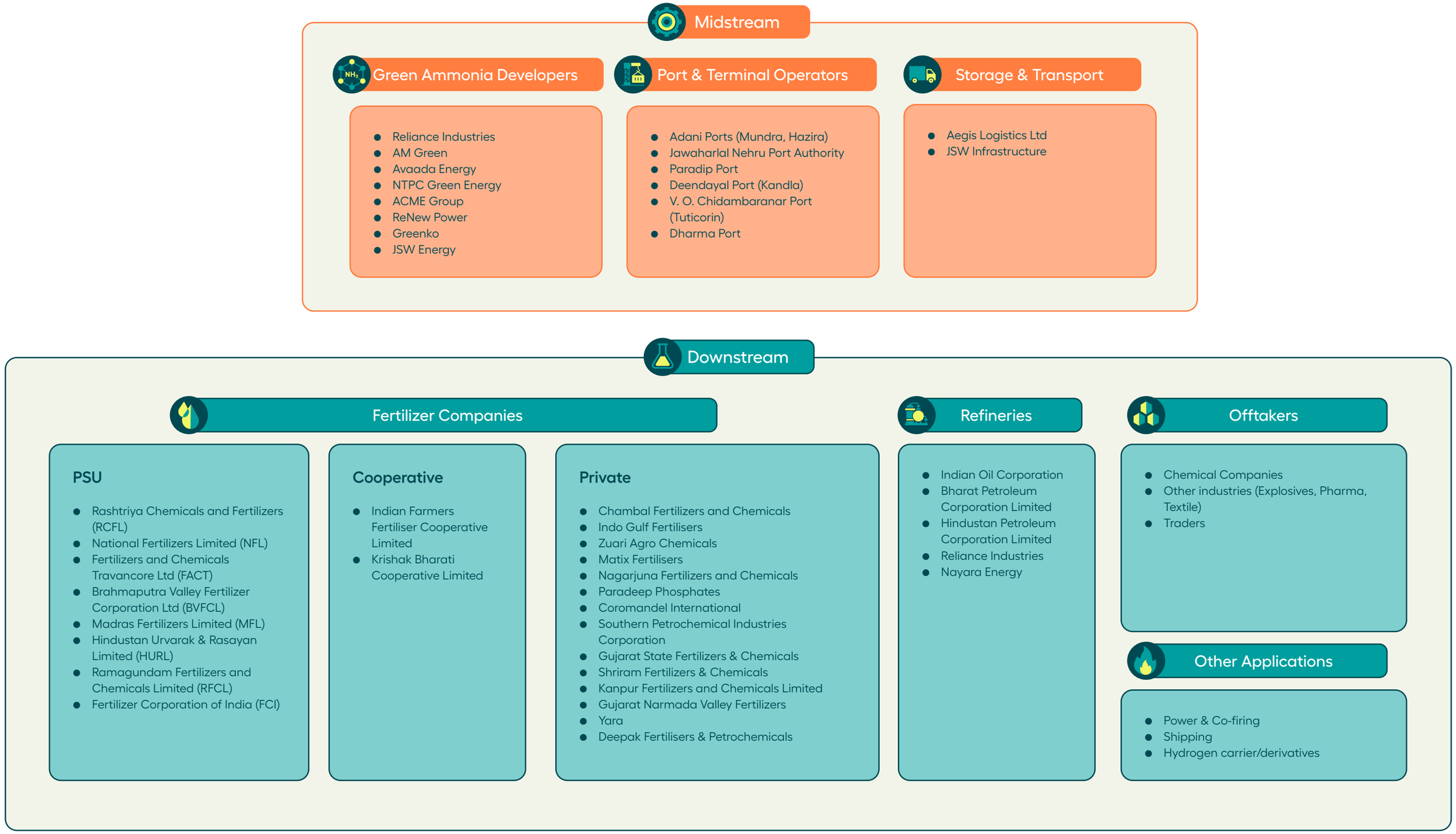


Figure 4: Overview of India's green ammonia ecosystem

Research, Think Tanks, & Civil Society

Indian Think Tanks

- Council on Energy, Environment and Water
- The Energy and Resources Institute
- Centre for Science and Environment
- World Resources Institute India
- International Institute for Sustainable Development
- Integrated Research and Action for Development
- Climate Catalyst
- Rocky Mountain Institute India
- Vasudha Foundation
- Indian Council for Research on International Economic Relations

- Observer Research Foundation
- Climate Policy Initiative
- Sustainable Futures Collaborative
- Prayas Energy Group
- Climate and Sustainability Initiative
- Center for Environment and Energy Development
- Center for Study of Science, Technology and Policy
- International Forum for Environment, Sustainability & Technology
- Mission Possible Partnership

International Organisations

- Climate Analytics
- Agora Energiewende
- Energy Transitions Commission
- Clean Air Task Force
- SystemIQ
- Institute for Energy Economics and Financial Analysis
- Climate Analytics
- NewClimate Institute
- E3G
- Environmental Defense Fund
- International Fertilizer Development Center
- International Food Policy Research Institute
- Regulatory Assistance Project
- World Economic Forum
- Deutsche Gesellschaft für Internationale Zusammenarbeit
- Center for International Environmental Law

Academic & Research

- Indian Institute of Technology Bombay
- Indian Institute of Technology Madras
- Indian Institute of Technology Delhi
- Indian Institute of Science Bangalore
- Indian Institute of Petroleum Dehradun
- National Chemical Laboratory
- Bhabha Atomic Research Centre
- Council of Scientific and Industrial Research Laboratories

Funders

- Global Industry Hub
- Bloomberg Philanthropies
- Children's Investment Fund Foundation
- ClimateWorks Foundation
- Shakti Sustainable Energy Foundation
- Sustainability, Equity and Diversity Fund
- Oak Foundation
- Hewlett Foundation

Industry Associations

- Fertilizer Association of India
- Indian Hydrogen Alliance
- Hydrogen Association of India
- Confederation of Indian Industry
- Associated Chambers of Commerce and Industry of India
- International Fertilizer Association
- Federation of Indian Chambers of Commerce and Industry
- PHD Chambers of Commerce

CSO landscape working on green ammonia: Stakeholder views on organisational capacity, barriers, opportunities and policy priorities

Green ammonia is an emerging focus area for CSO and philanthropic ecosystems. This section covers the CSO landscape in four dimensions: current scale of dedicated capacity identified as full-time equivalent (FTEs), types of activities organisations are undertaking, level of focus on green ammonia, and where the attention lies along the value chain. Together these four aspects reveal momentum building in this space and the significant gaps in coverage, depth, and coordination that the ecosystem must address.

Dedicated capacity working on green ammonia

Across the CSO sample, the dominant response on current full-time equivalents allocation was 1-5, mentioned by 10 organisations. In some cases, the organisations have recently begun engaging with the topic.

Figure 5: Dedicated FTE capacity on green ammonia across the CSO sample



Note: FTE means Full Time Equivalent

Types of activities and barriers faced by CSOs

The top activities undertaken by CSOs are policy research, technical assistance, followed by public narrative and communication, philanthropy, and industry engagement. These activities enable CSOs to provide evidence-based policy inputs, strengthen implementation capacity, and foster informed public and stakeholder engagement on green ammonia and the broader energy transition.

CSOs highlighted several structural barriers to engage with the green ammonia ecosystem. Political sensitivity around fertiliser was identified as the most significant barrier, followed by limited in-house technical expertise. Three factors were tied for the third-highest barrier which include limited entry points into policy processes, insufficient funding, and limited access to industry players. Together, these constraints limit CSOs' ability to build technical capacity, conduct research, and sustain long-term engagement.

Figure 6: Types of CSO activity on green ammonia



Organisational focus on green ammonia

The CSO survey revealed that only two organisations have green ammonia as a core focus area, reflecting the nascency of the topic. For most organisations, the entry point has been green hydrogen or industrial decarbonisation. Green ammonia sits at the intersection of all three but is not yet driving a dedicated program of their own for the majority of organisations.

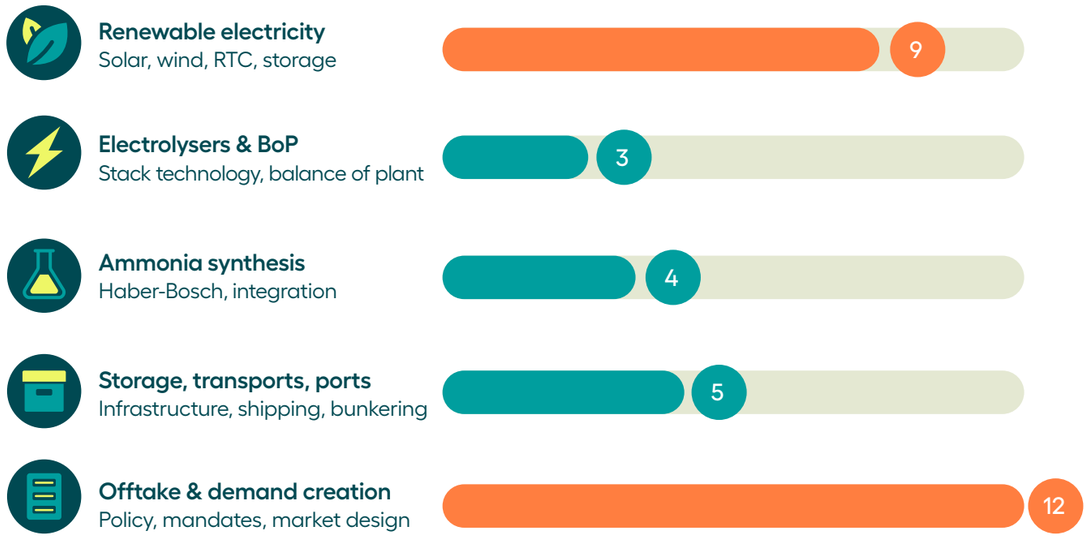
Figure 7: Level of organisational focus on green ammonia



Value chain focus

Our CSO landscape mapping highlighted the areas within the green ammonia value chain that received attention and those which are overlooked. The survey indicated that CSOs are focusing on renewable energy on the supply side of the value chain and offtake/demand creation on the policy side. Significant gaps on the midstream and downstream side of the value chain (electrolysers, ammonia synthesis, logistics and infrastructure) appear to be less prioritised.

Figure 8: CSO attention by value-chain segment





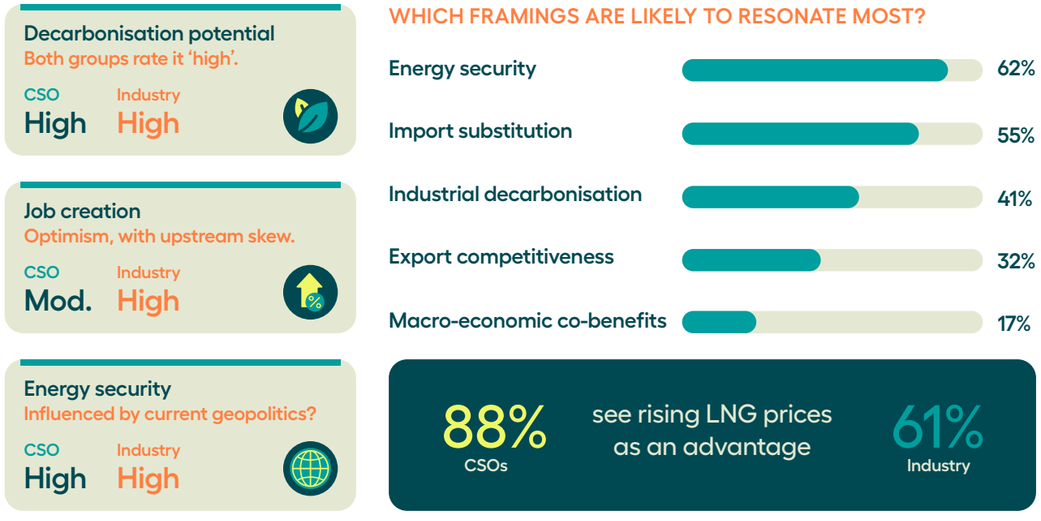
Green ammonia landscape: Insights from surveys and interviews on potential for green ammonia, barriers, and project execution

The macroeconomic story:

Both CSO and industry stakeholders are aligned on the potential of green ammonia to decarbonise the sector, with more than half the respondents in both groups rating the potential as ‘high’. Industry respondents were generally much more optimistic about job creation potential. CSOs noted that green ammonia projects could create jobs, particularly during the construction and project development phase. However, they expect most jobs will likely emerge in renewable energy deployment and upstream infrastructure rather than in midstream and downstream activities.

We also probed the stakeholders’ expectations on the global price trajectory of natural gas as this has important implications for green ammonia’s competitiveness against grey ammonia. A strong majority expects natural gas prices to go up over the next five years. A caveat here is that the roll-out of the survey coincided with the West-Asia war which may have influenced the respondents’ views on these questions. We asked CSOs on the framing of green ammonia that will resonate with the majority of stakeholders. Stakeholders most frequently selected energy security over import substitution and decarbonisation.

Figure 9: Stakeholder views on green ammonia’s decarbonisation potential, job creation, energy security, green ammonia competitiveness, and the preferred policy framing.



Barriers in the current ecosystem:

We examined the two stakeholder groups on the current impediments to green ammonia adoption in the ecosystem - this included issues categorised as per the PESTLE framework. Based on inputs from experts, we also added infrastructure as a category. While policy is normally included under the ‘Political’ category, we included it as a separate category. These changes were made to reflect conditions specific to the fertiliser and chemicals sector in India. Both stakeholder groups largely pointed to barriers in the economic, policy, political, and technological domains.

Table 2: Barriers identified by CSOs and industry, mapped using the PESTLE framework.

CSO view	Industry view
Policy uncertainty • Lack of clarity on long-term incentives and subsidy design • Certification and standards for green ammonia are still evolving • Market-creation mechanisms are not yet fully established	**Long-term offtake is missing** • There is no mature demand-side market for green ammonia today • Long-term buyers and bankable offtake agreements are limited • Consumption mandates are still unclear or insufficient
Political sensitivity around fertilisers • Fertiliser reform is politically sensitive because it affects farmers directly • Any increase in fertiliser cost can raise concerns around food prices • The existing subsidy burden makes reform fiscally difficult	**Technology unproven at scale** • Large electrolysers above 100 MW remain unproven in Indian conditions • Performance under intermittent renewable power is still uncertain • Execution and bankability risks for large projects
Technological concerns • Electrolyser costs remain high and affect green ammonia economics • Access to low-cost round-the-clock renewable power is still limited • Existing urea plants face transition and retrofit challenges • Technology choices should avoid creating long-term lock-in risks	**Infrastructure: grid, land and water** • Grid connectivity and transmission access remain major bottlenecks • Land acquisition for large projects is often slow and difficult • Water availability is a serious issue for green hydrogen/ammonia projects • Delays in these enablers can hold back project execution timelines
Demand creation • Green ammonia demand will not emerge automatically without policy support • Blending mandates can help create early market demand • Public procurement signals can improve confidence for producers • Incentives are needed to support early adoption and scale-up	**Long-term policy visibility** • Current policy support for 3 years is not long enough for large capital-intensive projects. • Investors need policy certainty over 10 years or more • Without visibility, financing and FID become harder

Barriers in the value chain:

Beyond the ecosystem-level challenges, we asked stakeholders about the specific challenges that exist along the green ammonia value chain. Both groups highlighted the same three stages in the value chain that face bottlenecks - offtake, renewable energy supply, and electrolysers and balance of plant. There is unanimity that demand creation is one of the first areas to be addressed and that while the SECI tender is a great starting point, it is not sufficient to unlock the demand at scale required for a meaningful transition.

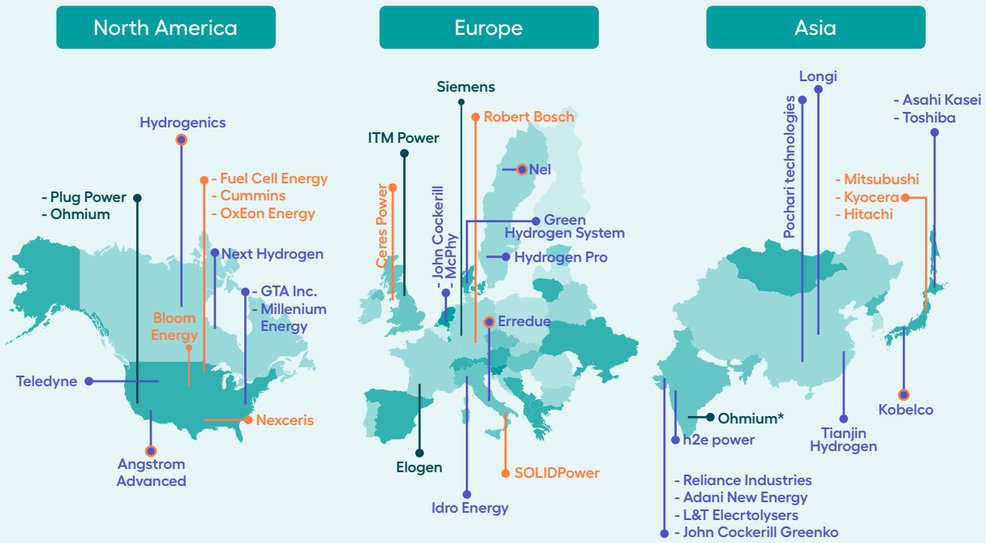
Table 3: Value-chain bottlenecks identified by CSOs and industry.

Theme	CSOs concerns	Industry concerns
Offtake/ demand creation	Strong push for phased domestic blending mandates. Demand creation remains the primary challenge. While the SECI tender represents a significant milestone towards bankability, it is not sufficient on its own to unlock demand at the scale required for a meaningful transition.	The industry describes the absence of confirmed long-term offtake as the single most significant barrier for project development today. Multiple respondents characterised the situation as a classic chicken-and-egg problem: developers are unwilling to commit capital without guaranteed demand, while buyers remain hesitant to commit without competitive long-term pricing and policy certainty.
Renewable energy supply and availability	Several respondents highlighted the need for round-the-clock renewable energy combined with transmission connectivity and grid integration. RTC renewable supply at the required price point remains extremely difficult, and that delay in transmission access or grid connectivity can stall the entire value chain upstream before projects even begin moving toward production.	Industry sees RE as over 65 per cent of hydrogen/ammonia cost and therefore the biggest determinant of project viability. Main issues are round-the-clock power availability, electrolyser load factors, lack of grid connectivity, and transmission infrastructure.
Electrolyser and BoP (balance of plant)	CSOs raised concerns about the broader technology pathway and its implications, rather than focusing on any single equipment supplier. India should avoid building a green ammonia strategy that depends too much on imported supply chains, short-term subsidies, or a single technology route. There is also concern that very low bid prices may not reflect the true long-term cost if equipment reliability, maintenance needs, and material quality are weaker than assumed.	Stakeholders highlighted limited domestic electrolyser manufacturing, dependence on imported components, and worries about equipment performance including stack degradation, corrosion, and purity issues within the first year of operation. They also flagged risks around compressors, storage, water/desalination systems, transmission links, and integrating electrolysers with variable renewable power.

Box 1: Electrolyser localisation

Currently, electrolyser manufacturing is concentrated in China, Europe, and the United States, with Indian domestic manufacturing capacity at an early stage. Several domestic electrolyser OEMs and manufacturers have emerged recently in the Indian market, including Ohmium, Newtrace, and others.

Figure 10: Electrolyser manufacturing is concentrated in China, Europe, and United States[21]



Source: CEEW

Industry respondents from the developer side were cautiously supportive of localisation as a long-term objective. Under the SIGHT scheme, use of domestic components is a mandatory requirement ensuring that incentives actively promote indigenous capabilities.22 Still, several expressed concern that mandatory domestic content in SECI tenders or SIGHT applications could add unwarranted costs if domestic electrolyser quality and reliability are not yet at parity with international alternatives. The trade-off between supporting domestic manufacturing development and ensuring that initial green ammonia projects are commercially viable is a difficult but important policy decision to manage.

Another concern raised by respondents is the technology and intellectual property aspect of electrolyser manufacturing. The dominant electrolyser technologies, which are alkaline and PEM (Proton Exchange Membrane), involve significant proprietary know-how and materials specifications that are not easily transferred through simple domestic content requirements. Some respondents noted that the most effective route to genuine technology transfer and domestic manufacturing capability is through joint ventures, licensing agreements, and long-term partnership arrangements between international OEMs (Original Equipment Manufacturers) and Indian manufacturing partners, rather than through mandated domestic content that may simply result in assembly of imported components rather than actual manufacturing capability.

Across the consultations, stakeholders identified three priority measures for advancing electrolyser localisation. First, sustained and predictable long-term SIGHT support for domestic manufacturing investment, with eligibility criteria that incentivise genuine manufacturing capability with significant domestic value addition rather than final assembly. Secondly, adopting a phased approach to domestic content requirements, with progressively increasing thresholds that allow time for domestic manufacturing capabilities to develop, would be more effective in nurturing local capabilities without undermining the overall economics of green ammonia production. Thirdly, facilitating technology partnerships (through the NGHM's international cooperation window, or otherwise), and leveraging India's international clean energy partnerships, would be critical in building long-term technology transfer and indigenisation roadmaps with key electrolyser OEMs.

Cost levers to reduce Levelised Cost of Green Ammonia:

Renewable energy cost and electrolyser CAPEX were the two top levers that emerged as key areas by stakeholders. However, there was a slight difference in the perception between CSO and industry. While CSOs were of the view that electrolyser cost is more critical, the industry representative responded that renewable energy accounts for over 65 per cent of the costs of production today. Renewable energy impacts the costs of green ammonia in two ways. First is the impact of intermittency on capacity utilisation and its life, which implies higher costs compared to estimates used in the current SECI

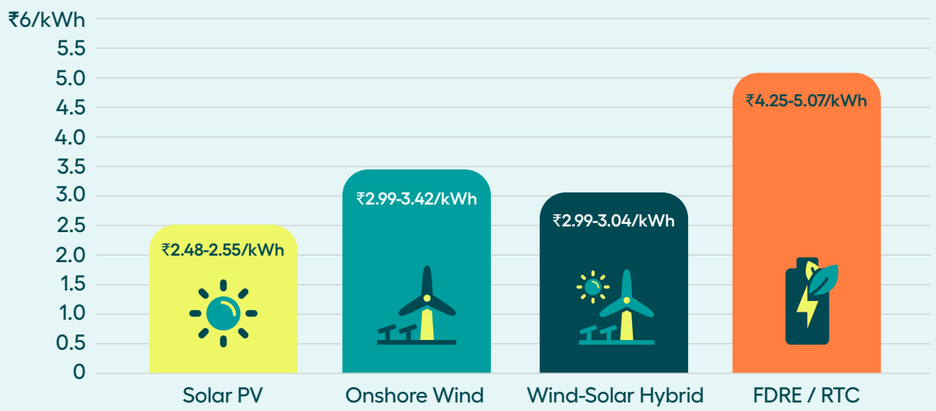
tender as per industry stakeholders. The second is the renewable energy cost itself which determines green ammonia's competitiveness with grey ammonia.

Manufacturing incentives, production-linked incentive schemes, and localisation policies are areas where respondents expect government intervention lowering costs over time. Industry respondents also highlighted that the issue is not merely on achieving low renewable energy tariffs. Having a solar-only generation profile was in itself a limiting factor due to the lower electrolyser utilisation that would negatively impact the economics of the project. Achieving higher utilisation and 24/7 power supply would require co-locating solar, wind and storage capacity. This would however, increase the project capex and complexity of the system.

Box 2: Renewable energy and intermittency

Renewable electricity cost is the single most important parameter which drives the economics of green ammonia. India has achieved some of the lowest utility scale tariffs for renewables at close to INR 2.5-5/kWh, which has been widely quoted in the media as the basis for projecting costs of green ammonia. However, in practice, as indicated by the industry respondents, the tariff applicable for procurement by green ammonia producers is different and much higher due to several factors.

Figure 11: Cost comparison of renewable energy sources in India[23]



FDRE/RTC tariffs reflect a guaranteed 80% Plant Load Factor (PLF), ensuring round-the-clock firm renewable power supply

Source: Opten Power

These components include transmission and wheeling charges (Inter-State Transmission System (ISTS) charges, state transmission charges, and wheeling charges can add INR 0.5–1.5/kWh to the delivered cost even after ISTS waivers); land and development costs for renewable energy projects specifically dedicated to green ammonia production; grid connection and substation costs; the cost of round-the-clock (RTC) power supply configurations that blend solar, wind, and storage to provide a consistent power profile; and the cost of battery or pumped hydro storage required to smooth intermittency. When these components are included, the delivered cost of renewable electricity to an electrolyser is materially higher than the auction tariff alone would suggest.

Barriers to export: RFNBO compliance, certifications:

Both CSO and industry respondents acknowledged that RFNBO compliance and international certification will be critical for market access in Europe, and that India's current certification ecosystem is not yet ready to reliably verify compliance at scale. Both CSOs and industry respondents rated RFNBO compliance as challenging. The RFNBO certification requirements around temporal correlation, geographic correlation, and additionality are particularly complex for developers to satisfy. Additionally, it requires renewable energy to be sourced from newly installed renewable capacity. Temporal correlation requires hourly matching between renewable generation, hydrogen production. Geographic correlation requires both renewable energy sources and the production facility to be within the same bidding zone.

Several respondents highlighted that temporal correlation would be difficult to meet in India given the dominance of solar PV in the country's renewable energy mix. Temporal correlation would require the addition of wind power or storage to the project configuration, which adds to costs and complexity. On the other hand, India's own green ammonia standard utilises a fundamentally different methodology as it allows using a 12-month average emissions intensity of greenhouse gases as compared to the hourly emissions required by the EU. The compliance costs would impact the competitiveness of green ammonia exported from India.

Box 3: Infrastructure and export readiness

Across the industry interviews, infrastructure emerged as a foundational constraint on green ammonia deployment that receives less policy attention than the demand and financing questions but may prove just as limiting. The gap between India's current infrastructure for storing, transporting, handling, and exporting ammonia and the infrastructure required for the SECI tender's committed volumes, let alone the broader ambitions articulated in the NGHM, is substantial. Understanding this gap is essential for realistic deployment planning and investment prioritisation. Ammonia is a hazardous chemical that requires specialised storage infrastructure: refrigerated or pressurised tanks, safety systems, trained personnel, and regulatory compliance frameworks. Industry respondents noted that several SECI tender awardees are in the early stages of planning storage infrastructure, and that lead times for refrigerated ammonia storage tanks often manufactured in Korea, Japan, or Europe are long (24 to 36 months) and represent a critical path item for project delivery timelines.

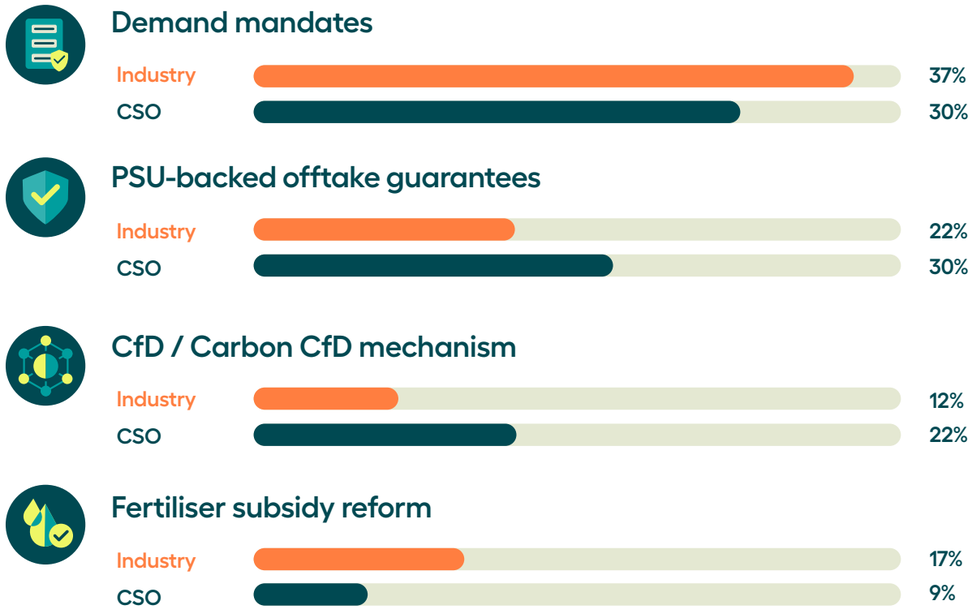
India's ambitions for green ammonia export depend on the development of port infrastructure. The current port infrastructure for ammonia is limited: Kandla, Paradip, Tuticorin, and a handful of other ports have some ammonia handling capacity, but not at the scale required for meaningful export volumes. Several respondents pointed to the long development timelines for dedicated export terminals (often five to seven years from planning to commissioning) as a reason for concern about whether India can develop the necessary export infrastructure in time to capture the near-term demand window in European and East Asian markets.

Several respondents noted that ISTS waiver provisions, which reduce the cost of interstate renewable energy transmission for green hydrogen and ammonia projects, have been an important enabling policy. However, the physical transmission infrastructure and the timelines for building it remain a constraint. In several cases, project timelines are constrained by the lead time required to develop transmission lines, substation capacity and connection infrastructure, rather than by transmission costs. Connecting this capacity to production facilities requires transmission infrastructure, grid network access (GNA) permissions, and in many cases ISTS connectivity for renewable energy sourced from Rajasthan or Gujarat solar zones to production facilities on the coast.

Towards scaling green ammonia – Policy, targets, market creation:

Opportunities and challenges aside, we wanted stakeholders' views on the way forward including on the policy interventions required, the end-uses to be prioritised, and the scale of utilisation to be targeted. Across the survey and interviews, CSOs and industry respondents were unanimous in their support for demand mandates and PSU-backed offtake guarantees. The recommended direction is to create demand at scale through mandates and government-backed offtakes.

Figure 12: Stakeholder support for demand mandates and PSU-backed offtake.



If demand mandates are the way to go, what green ammonia blending percentages should be targeted? For non-urea applications, CSOs opted for six to 10 per cent as the target whereas industry respondents chose a more ambitious target of above 10 per cent. For urea on the other hand, both groups chose six to 10 per cent as the target. However, this choice is interesting since both groups flagged the technical challenges with green ammonia blending in urea in particular during interviews. The general sentiment during these consultations was less optimistic regarding blending and concerns were highlighted about the feasibility that needs to be explored through research.

Box 4: The Blending Question – Urea and Non-Urea pathways

Blending mandate requirements for fertiliser producers to incorporate a minimum percentage of green ammonia, are the most frequently cited policy instrument for creating domestic demand at scale.

The technical case is clear. Non-urea production processes use ammonia as a direct input. Green ammonia can therefore substitute for grey ammonia in non-urea production without requiring fundamental process redesign. Non-urea fertilisers are governed by the Nutrient-Based Subsidy (NBS) regime rather than the fixed retail price applicable to urea. Under NBS, the subsidy per nutrient unit is fixed by the government, but manufacturers have flexibility on product pricing. This means that green premiums can, in principle, be accommodated within the NBS framework.

Urea blending presents a fundamentally different and more complex challenge. Urea is synthesised by reacting ammonia with CO_2 at high pressure, a process that requires a concentrated CO_2 stream as an input. In conventional grey ammonia production via Steam Methane Reforming (SMR), this CO_2 stream is readily available as a by-product of the reforming process. In a green ammonia pathway, where there is no reforming and therefore no CO_2 by-product, the CO_2 required for urea synthesis must come from an alternative source captured from industrial or atmospheric sources, or generated through a fundamentally different production configuration. This creates a technical challenge that both industry and CSO respondents consistently flagged with several respondents explicitly arguing that credible targets cannot be set without dedicated technical research on CO_2 sourcing, integration costs, and the operational implications for existing plant configurations.

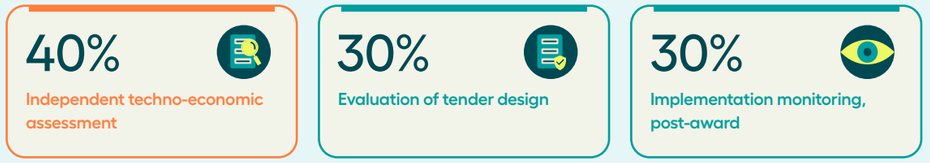
The political economy adds a further layer of complexity. Urea prices are fixed by the government at a level well below production cost, with the difference covered by subsidy. Any change to urea pricing or production economics that flows through to either retail price or subsidy cost is politically challenging.

Since the fertiliser sector is one of the many sectors where ammonia is utilised today, we asked stakeholders about applications to prioritise in the near term. Green shipping and export of green hydrogen and its derivatives were the other two areas chosen most frequently by both stakeholder groups.

Box 5: SECI as catalyst for the green ammonia market

CSO respondents broadly welcomed the tender as a necessary first step while emphasising the need to track progress on implementation. Around 40 per cent identified independent techno-economic assessment of SECI tender economics as their most valuable contribution evaluating whether bid prices reflect all-in production costs. A further 30 per cent prioritised evaluation of the tender structure itself, as SECI and SIGHT primarily focus on lowest bid prices rather than tender design and implementation. The remaining 30 per cent stressed post-award implementation monitoring as the most critical gap in the current ecosystem. CSOs did raise concern on the limited number of projects advancing to FID stage and expressed concerns about whether announced and awarded projects will materialise.

Figure 13: CSOs see independent assessment and monitoring as areas where they can contribute to support the SECI tender



CSO View

- SECI and SIGHT primarily focuses on lowest bid prices rather than tender design and implementation
- Limited number of projects advancing to FID stage
- CSOs expressed concerns about whether announced and awarded projects will materialise

Industry View

- Most positive on the price signal
- GAPA is praised as the key bridge mechanism
- 3-year construction deadline is the single biggest operational worry

> Awards announced in April 2026 target mid-2029 delivery. An ammonia plant requires 30 months of construction plus 6 months of stabilisation – and that 36-month clock only starts after FID is taken, land is secured, and supporting infrastructure is in place.

Industry respondents viewed it positively but consistently flagged the 10-year green ammonia GAPA duration. Several called for GAPA extension to 15–20 years, recalibration of SIGHT levels based on actual project economics, and standardised project finance structures before the next procurement round. The major operational worry for the industry is that the 3-year construction deadline is too short.

Additional insights from interviews: Imports vs exports, prioritisation, and sequencing of green ammonia

Table 4: CSO and industry views on domestic versus export prioritisation.

Parameters	CSO Views	Industry Views
Exports emerging as the primary demand pathway	**Current project pipeline is overwhelmingly export-oriented (Europe, East Asia):** Domestic demand relies almost entirely on SECI tenders which is restricted to the non-urea market demand. No scalable domestic demand mechanism exists.	**Survey results posit exports as the most immediate end-use:** Export of hydrogen and its derivatives emerged as the highest-ranked end-use supported by most of the respondents.
Prioritising green ammonia demand	**A priority ladder or sequence is needed to unlock various markets:** We need to move from SECI tenders to voluntary demand coalition platforms and consumption mandates. A similar stakeholder view was that India needs a clear end-use hierarchy that sequences fertilisers (urea/non-urea as the anchor demand with lowest substitution cost), shipping (maritime bunkering with IMO regulations providing external demand pull), chemicals (industrial feedstock applications), and explicitly rules out or deprioritises power-sector co-firing.	**No consensus on the sequencing of markets:** Consultations revealed an active debate within the industry regarding the sequencing of domestic and export markets. While several stakeholders argued that early exports can help build scale, reduce costs, attract investment, and accelerate ecosystem development, most cautioned against exporting subsidised green ammonia while continuing to import conventional grey ammonia.
Domestic willingness vs imports	**Mismatch between willingness to pay and volumes:** Fertiliser companies (the bulk consumers) cannot pass the green premium through the regulated subsidy system, and will not voluntarily switch. Premium-paying markets (shipping, niche chemicals like nitric acid, pharmaceuticals) exist but have small volumes. This creates a structural mismatch between bulk demand and premium-paying demand.	**Import substitution should be the focus:** While recent international offtake agreements demonstrate growing global demand for green ammonia and confidence in India as a future supplier, a set of industry views centred around prioritising replacement of imported grey ammonia used in domestic fertiliser production. Stakeholders emphasised green ammonia's wider strategic relevance to fertiliser security, energy security, industrial competitiveness and import substitution, alongside its role in decarbonisation.
Balance near-term export opportunities with longer-term domestic demand	**Balance export and domestic focus:** Early green ammonia offtake from export markets (Japan, South Korea, EU) is a legitimate and necessary intermediate step. The highest priority is ensuring that early projects both SECI and those meant for export markets (AP and Gujarat) are commissioned successfully and on schedule. A credible first wave of delivered projects is the prerequisite for all subsequent scaling.	**Export markets are lucrative:** A set of stakeholders also highlighted significant export opportunities across Europe and Asia. Europe's RFNBO market is expected to remain an important demand centre for green hydrogen derivatives, while Japan, South Korea, and Singapore are actively exploring green ammonia for power generation, industrial decarbonisation, and energy security. Shipping fuel remains a longer-term opportunity.

Domestic vs export focus:

A key area of tension across interviews within both stakeholder groups has been around prioritisation of domestic and export markets in the short-term. The views are quite divided with some advocating that both pathways will have to be pursued simultaneously, whereas others are clear that the domestic market is the bigger opportunity. While industry survey responses highlighted export as the immediate opportunity, the interviews revealed that given execution challenges to date, industry is less optimistic about exports. We capture some of these contradictions in the table below:

Box 6: Reducing fertiliser consumption matters

India's fertiliser consumption, particularly of nitrogenous fertilisers, is characterised by significant overuse relative to agronomically optimal levels. Studies link the under-pricing of urea to over-application which has driven nitrogen use that far exceeds what crops can absorb efficiently. The consequences are well-documented: groundwater nitrate contamination affecting drinking water quality across major agricultural states, nitrogen-cycle disruption contributing to greenhouse gas emissions (N_2O is a potent GHG), soil acidification and health degradation including risk of cancer from toxicity, reducing long-term agricultural productivity, and air quality impacts from ammonia volatilisation.24,25 The nitrogen problem in Indian agriculture extends beyond input costs, with significant implications for the environment and public health.

The specific interventions respondents called for include progressive reform of urea subsidy structures to reduce the price distortion that drives overuse; support for precision agriculture technologies that enable farmers to match fertiliser application to actual crop needs; investment in soil health assessment and micronutrient management to reduce nitrogen use without sacrificing yields; and promotion of integrated nutrient management approaches that partially substitute chemical nitrogen with biological nitrogen fixation and organic inputs.

Insights from a convening of CSOs hosted by Climate Catalyst: Practical pathways for scaling India's green ammonia sector

Climate Catalyst hosted a two-day strategy workshop to gather a diverse range of perspectives on how India can scale its emerging green ammonia sector. The workshop was hosted at Nandi Hills, Bengaluru, on 21 and 22 July 2026 under the Chatham House Rule and brought together 29 organisations from civil society, think tanks, philanthropy and industry. It builds on Climate Catalyst's six-month mapping exercise.

The details of the discussion can be accessed via this link.

The Road ahead

Green ammonia's salience for India's economy is multifold - energy and food security, decarbonisation, and value addition through exports. Policymakers have taken decisive steps towards scaling green ammonia adoption starting with application in non-urea. Announced project pipelines exceed 25 MTPA, though only a handful have reached final investment decision and moved to construction. Green ammonia is also an emerging area of work for the majority of CSOs that were consulted as part of this study and they are currently engaged in policy research, technical assistance, and communications support for this sector.

While the CSO and industry stakeholders demonstrate a positive outlook for green ammonia, they have flagged several ecosystem and value-chain specific challenges that could put the current projects and overall transition at risk. Bankable offtake guarantees for tenures of 15 years or longer, long term policy certainty, RE-RTC availability and cost, infrastructure (grid, ports, land, and water) access and availability, and technology indigenisation and demonstration were among the major issues highlighted.

Headwinds for the sector include the lack of consensus among stakeholders on the sequencing and prioritisation of initial market development - domestic vs exports. The transition to green ammonia must also contend with fertiliser overconsumption and its environmental and health impacts. The latter challenge is politically sensitive and will require structural reforms to the current fertiliser sector and the subsidy regime. CSOs will have to navigate the 'greening' objective without losing sight of the toxicity and environmental degradation associated with ammonia. The road ahead will require

a stronger focus on sub-national level policy interventions to ensure the success of existing domestic and export focused projects. Unlocking further demand for green ammonia will require more clarity on a green ammonia roadmap that details domestic end-uses, sets targets for exports, and interventions to indigenise technology and build the supporting infrastructure. CSOs have a critical enabling role to play on all fronts to ensure that India cements its position as a global leader on green ammonia transition.



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