Capacity Building Workshop for

Financing Institutions on Green Hydrogen

July 07, 2023

9:00 am - 5:30 pm IST

Session:.....

Topic: Key insights, Risks and Mitigation options for financing: Project structuring, Contractual Framework and Risk Management

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Speakers

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Agenda

1. Green Hydrogen in India
2. Key Project Risks and Mitigants
3. Green Hydrogen Financing

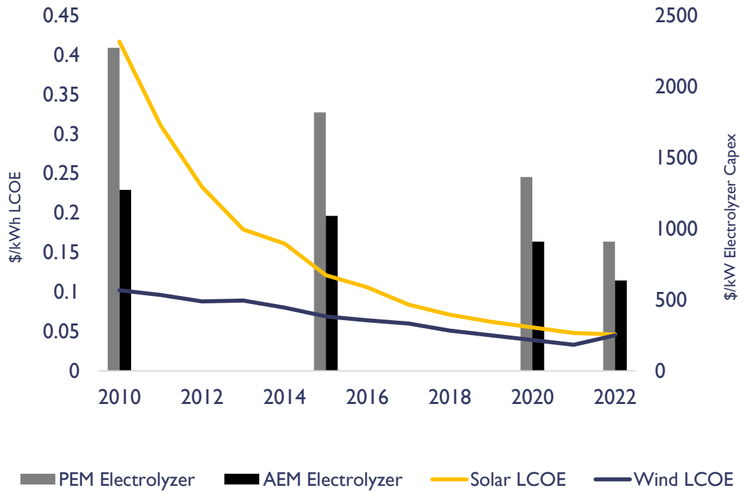
Electrolysis-based H2/NH3 is finally becoming commercially viable, even though the technology has been around since the 19th century

400+ The number of operational alkaline electrolyzers in the year 1900, before Steam Methane Reforming took over as a low-cost alternative for large scale hydrogen production[1]

8-12 kg CO_2 produced per kg of hydrogen from Steam Methane Reforming[2]

5.5-6 $/kg Cost of Green H2 production today, with aggressive estimates of ~$1/kg post 2030

0.7-1.6 $/kg Estimated cost of Grey H2 before natural gas price volatility due to geopolitical instability[5]

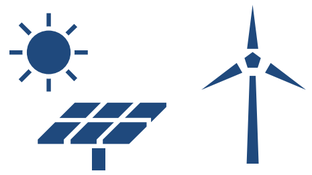


Large-scale Green H2/NH3 production is still nascent with a significant price differential over long-term average Grey H2 prices.

The lack of a precedents leaves uncertainty over ideal project structures that optimize production costs and project risks.

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

- 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.**

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Development of Green H2/NH3 projects is structurally unique and complex, but can draw learnings from complex utility and petrochemical precedents

Feature	Green H2/ NH3	Complex Utility (e.g. Offshore Wind)	Petro-chemical (e.g. LNG)
Capital Intensive	✓	✓	✓
Multi-Component	✓	✓	✓
Ease of Export	✓	✗	✓
Commodity-price exposure	✗	✗	✓
Existence of forward price market	✗	✗	✓
Emerging Technology	✓	✓	✗
Economies of learning	✓	✓	✗
Requirement of government support	✓	✓	✗

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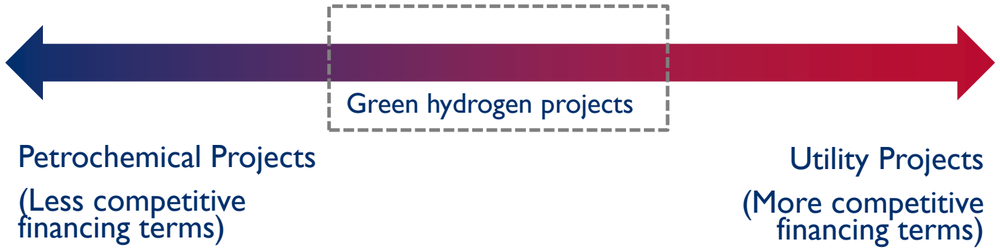
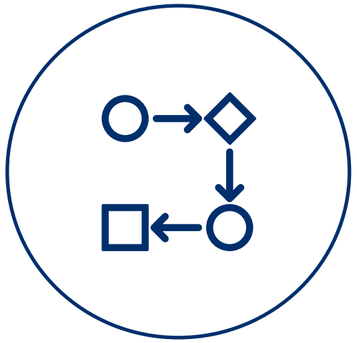
- Currently, Grey H2 and NH3 are traded as commodities, with prices correlated to natural gas prices
- Production of Green H2/NH3 is capital-intensive, with no correlation between production costs and commodity prices
- For viable project economics through affordable financing, Green H2/NH3 producers would ideally require long term price and volume visibility – similar to utility projects, even though the current grey market is geared towards commodity-like structures

Green Hydrogen Project Structures



However, project development in India is inhibited by unique risks such as offtake risk, interface risk and certification risk

Offtake (Price and Volume) Risk



Interface Risk

Certification Risk

There are significant price and volume risks in Green H2/NH3 projects which lead to strong offtake being the cornerstone of a sound project structure

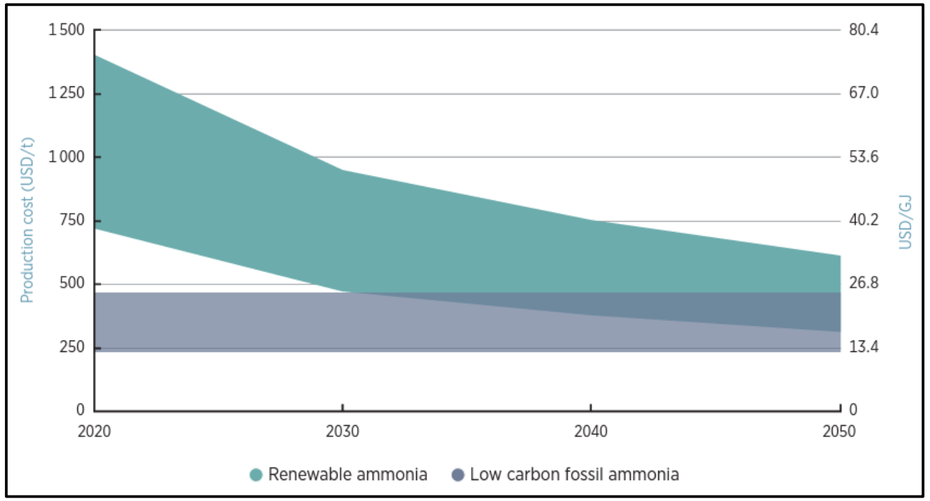
Offtake Price and Volume Risk

Risk that the buyer does not purchase product at the expected quantity or price. This can be because there isn't sufficient market demand or the market price does not align with the predicted prices at FC

Causes of Risk in Green H2/NH3 Projects

- Offtakers may not be willing to enter long term contracts with purely fixed prices due to uncertain market outlook for Green H2/NH3, thereby limiting the project's ability to raise long term financing
- If market prices fall significantly below contracted fixed prices, offtakers may be disincentivized to fulfil purchase obligations

Green H2/NH3 prices are expected to be higher than average Grey H2/NH3 in the long run



IRENA and AEA (2022): Innovation Outlook Renewable Ammonia

Potential Risk Mitigation Options

Equity participation from offtakers to enable watertight offtake contract with fixed price, volume and termination protections via adequate Liquidated Damages

Contracts for Difference (CFDs) from government / third parties to bridge gap between grey and green H2/NH3 prices, thus allowing variable pricing for offtakers

Short-term financing against a shorter offtake for the project, with the aim to refinance when it demonstrates operational viability and the product market has matured

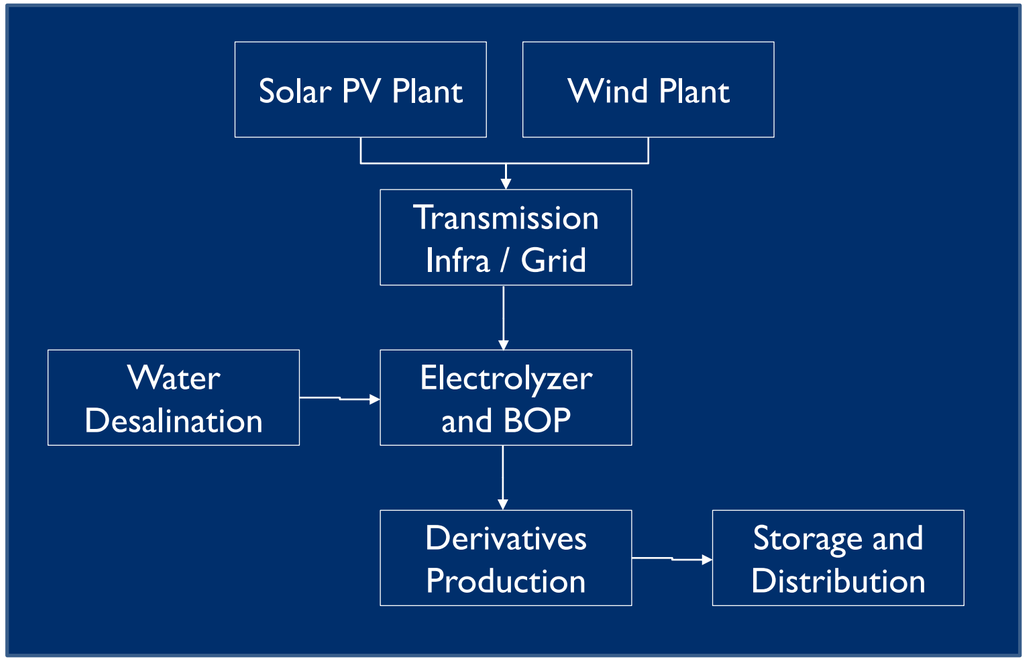
The co-dependence of multiple technologies in a single process plant creates high interface risk in Green H2/NH3 projects, leading to extensive technical due diligence requirements

Interface Risk

The risk of delays or non-performance of one project component leading to adverse impact on overall project output and cash flows is interface risk

Causes of Risk in Green H2/NH3 Projects

- The project requires multiple technologies and interface points in a single process plant. These may be developed, constructed and operated by different parties
- It can be challenging to structure liquidated damages for delay or non-performance of a single low-cost component when it impacts overall performance



Potential Risk Mitigation Options

Reduction in number of EPC and O&M providers through lumpsum contracts for consolidated plant

Introduce a wrap guarantee for overall plant operations, to be provided by project sponsors or third parties

Introduce oversized liquidated damages that compensate for lost cashflows of the overall project output

There are no physical differences between Grey and Green H2/NH3. Compliance with currently evolving green certification standards leads to additional certification risk

Certification Risk

- The risk that the project company is unable to provide the certification required under the offtake to demonstrate that the H2/NH3 is 'green' and qualifies for government support and the associated price premium
- It is also applicable for continued compliance during operations phase

Causes of Risk in Green H2/NH3 Projects

There are no attributes that can clearly differentiate green from grey/other forms of H2/NH3

Risk Considerations

- Sponsors should consider differences in compliance standards required by the offtaker, production and consumption destination governments while formulating plant's operational philosophy

Key Green Standard Developments across the Globe

Public Regulatory Schemes

India	Yet to announce
Europe	EU RED II
Australia	Zero Carbon Certification Scheme
China	China Hydrogen Standard
Japan	Japan Certification Scheme
South Korea	Hydrogen Act
UK	UK Low Carbon Hydrogen Standard
US	US Low Carbon Hydrogen Standard

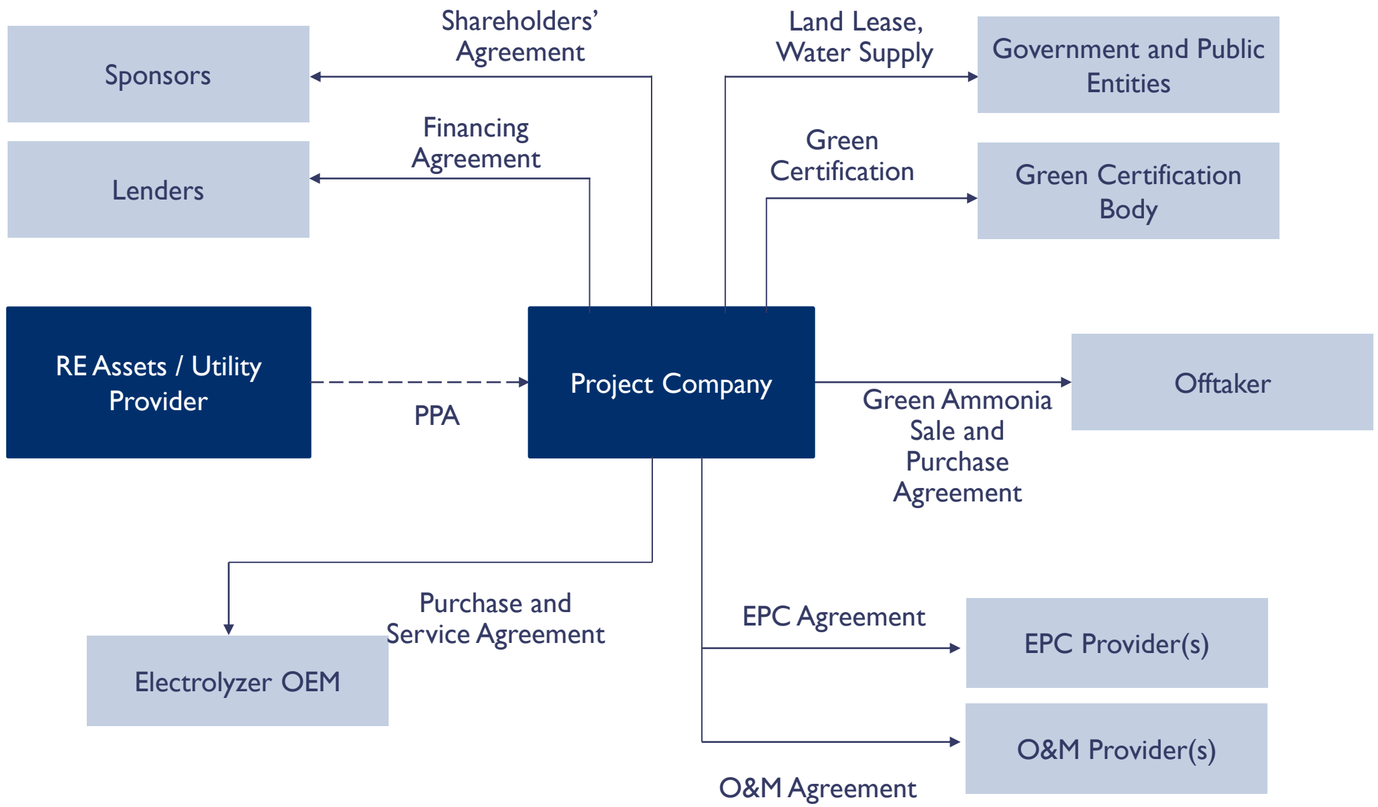
Private Voluntary Standards

- Certify
- TUV Rheinland Standard H2.21
- AEA Low Carbon Certification Scheme
- Green Hydrogen Standard
- ISCC Plus

A strong, watertight contractual framework is required to mitigate other major risks and raise competitive project finance

General Project Risks in Green H2 / NH3 Projects

- Regulatory Approvals and Compliance
- Project Site and Environmental Impact Assessment
- Construction Risk – Cost and Time Overruns
- Foreign Exchange Rate Fluctuations
- Floating Interest Rates
- Generation Yield
- Supply of Support Utilities
- Political Force Majeure
- Natural Force Majeure



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There exists significant appetite and interest for large scale project finance deployment in India's Green H2/NH3 sector

Types of Lenders	Description and Expected Terms	Potential Investors in India
Development Finance Institutions	• Most of the global DFIs are active in India with significant investments in country's green sectors • DFIs usually have a capacity to individually finance upto USD 100-200M subject to relevant country and project caps • Can offer concessional financing for Green H2 sector • Can offer upto 20-year loan duration based on offtake tenor • Smaller DFIs usually prefer participation from larger DFIs for leading due diligence process, which can be extensive for DFIs	IFC, DFC U.S. International Development Finance Corporation, PROPARCO GROUPE AFD, AIIB Asian Infrastructure Investment Bank, BIO Investing in a Sustainable Future, finnfund, FMO, KFW, Green Climate Fund, Norfund, ADB, British International Investment
Commercial Lenders	• International and domestic commercial lenders act as a key source of large-scale project finance in India • Can offer multi-BN financing capacity in consortiums • Usually have more flexible terms and less strict due diligence process than DFIs	SMBC, Societe Generale, Barclays, SBI, Standard Chartered, MUFG, ING, ICICI Bank, BNP Paribas, IREDA, Mizuho, IDBI Bank
Export Credit Agencies	• ECAs participate against equipment procurement or equity participation from their home countries • While China currently dominates the electrolyzer market, procurement from nations like Germany, Norway, UK, Japan, others can unlock cheaper credit from respective ECAs • ECAs offer multi-BN financing capacity through direct lending, or unlock investments by commercial lenders through insurance covers	Euler Hermes, UK Export Finance, Korea Eximbank, Eksfin Export Finance Norway, bpifrance, NEXI, JBIC
Green Bond Market	• While still nascent, the bond market can emerge as a key source of finance for Green H2 projects in the future	

The credit approval process is generally similar to standard project finance transactions, but with more extensive due diligence due to a lack of precedents

Lenders' Due Diligence Process

Lenders usually require third-party support for detailed financial and technical due diligence, in the form of various project documents –

- **Resource Report** – for solar, wind, water (as necessary)
- **Technical Report** – for all engineering and operational aspects
- **Legal Report** – for legal review of project agreements
- **Environmental Impact Assessment Report** – for compliance with Equator Principals or lenders' own requirements
- **Market Report** – for assessment of offtaker's end market
- **Insurance Report** – for project's insurance adequacy
- **Tax Report** – for validation on tax assumptions
- **Model Audit Report** – for validation of financial model accuracy

Outputs from these reports highlight compliance with lenders' investment philosophy and define base case financial model assumptions.

Negotiations on Financing Terms

Based on due diligence performed, lenders will form an opinion on various investment parameters to be negotiated with the sponsors –

- Acceptable **risk allocation**
- Additional **risk mitigants** required
- Project's **maximum debt capacity** and **cash waterfall**
- Debt **margin and fees**
- **Repayment schedule**
- Debt **covenants**
- **Conditions Precedent** to Financial Close (CPs)

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Once lenders and sponsors are aligned on financing terms, a Binding Offer is made, and the sponsors are requested to complete CPs in order to achieve Financial Close and withdraw debt.

While there have been large scale announcements for Green H2/NH3 globally, only a few projects have reached post-development stage

As of October 2022, over 480 GW electrolyzer capacity was under different stages of development, including 4.6 GW under construction. Less than 0.5 GW was operational.[1]

Largest Projects Under Construction	Country	Electrolyzer Capacity (MW)	Sponsor(s)
Neom Green H2	KSA	2200	ACWA Power, Air Products, NEOM
H2 Green Steel	Sweden	800	Large consortium
HYBRIT	Sweden	500	SSAB, LKAB and Vattenfall
Ben Tre project	Vietnam	301	TGS Green Hydrogen
Kuqa, Xinjiang	China	260	Sinopec
New York STAMP	USA	120	Plug Power
Recycle Carbone Varennes biofuels plant	Canada	88	Shell Canada, Enerkem, Suncor and Proman

1 IEA (2022): Hydrogen Projects Database

Case Study: NEOM, KSA

The NEOM Green Hydrogen Project is the world's largest utility scale Green Hydrogen project with secured financing and under construction. It is a joint venture between ACWA Power, Air Products and NEOM.

Expected Comission Date: 2026
Output: 650 MTPD Green H2 / 1.2 MTPA Green NH3
Installed Capacity: 2.2 GW electrolyzer, 3.9 GW Renewables
Off-taker: Air Products
Financiers: Saudi Industrial Development Fund (SIDF), international and regional banks

- Air Products, project's offtaker, primary EPC provider, and distributer holds 33.33% shareholding in SPV
- Strong government support with participation from ACWA Power and NEOM's clean energy agenda

Thank You

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