Risk Management for Green Hydrogen Projects

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Financing Landscape for Green Hydrogen

- Hydrogen market potential to achieve climate neutrality by 2050
  - 170 million tons in 2030
  - 600 million tons in 2050

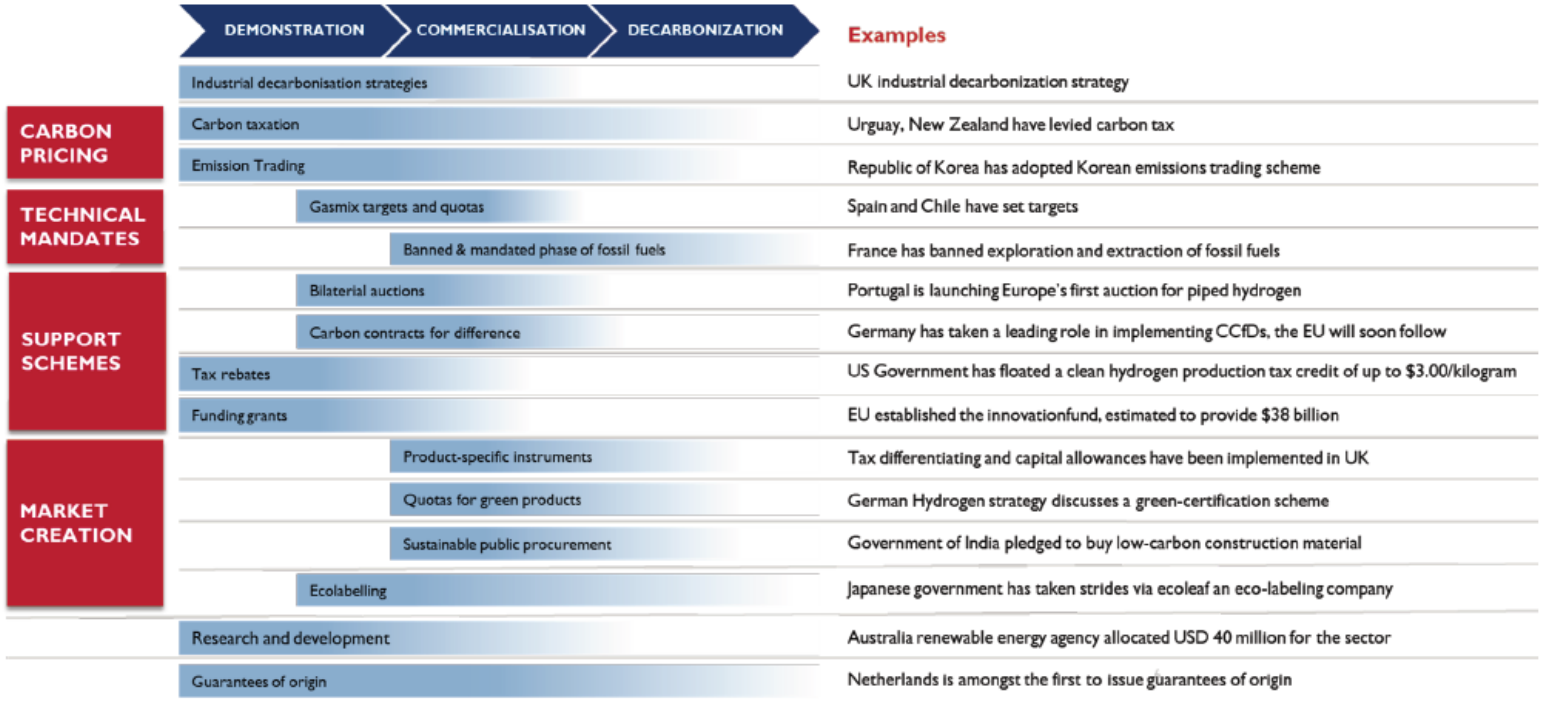
- Unprecedented challenge:
  - Creating a new major industry in less than three decades
  - Operating on a still-nascent value chain

- Cost of green hydrogen:
  - Conventional hydrogen does not sufficiently reflect its climate impact
  - Government support required until clean and green hydrogen becomes cost-competitive-leveraging economies of scale and tightening CO_2 pricing

Addressing Market Risks for Green Hydrogen

Existing projects depend on public support to break even, and demand creation. The first major government programs include:

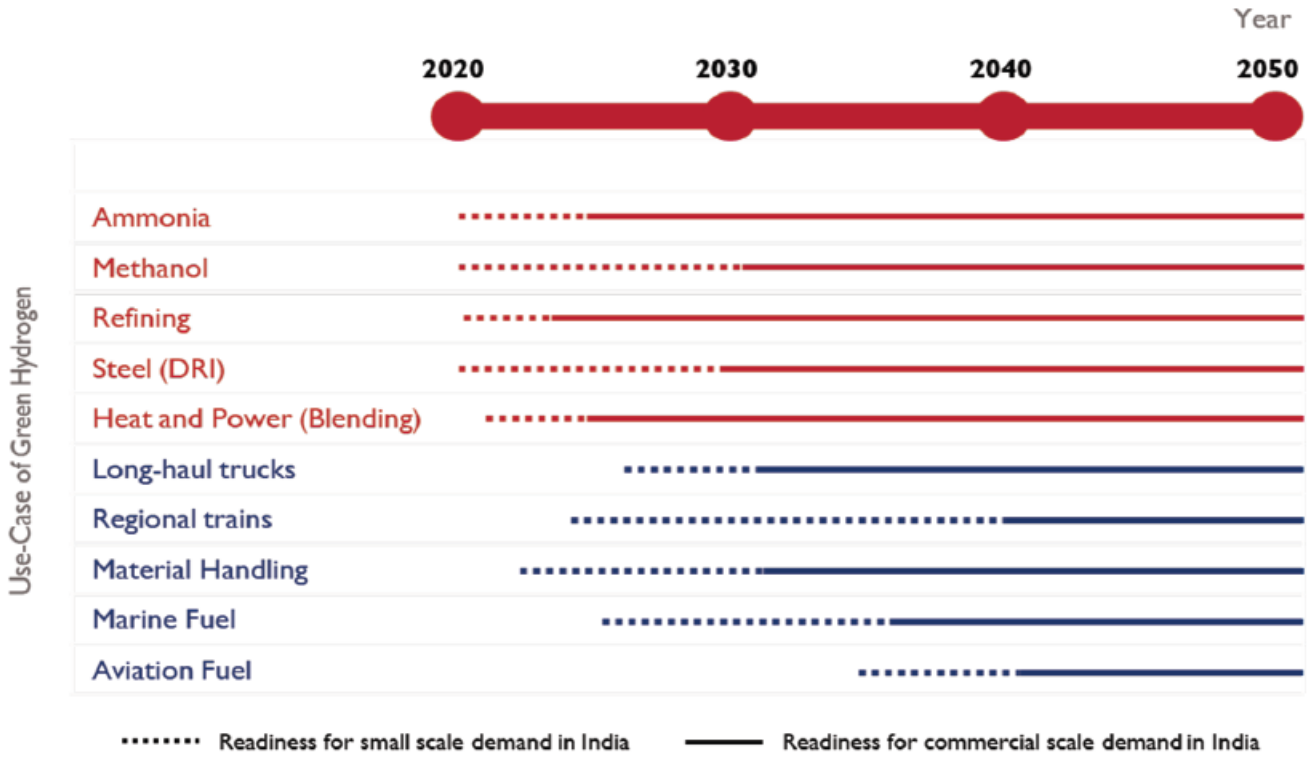
- the United States Inflation Reduction Act,
- the Australian Clean Energy Finance Corp.,
- the European Union Fit-for-55 package, and Important Projects of Common European Interest (IPCEI) funding program, and
- Japanese demand-side research and development (R&D) support programs.



Financing Landscape for Green Hydrogen

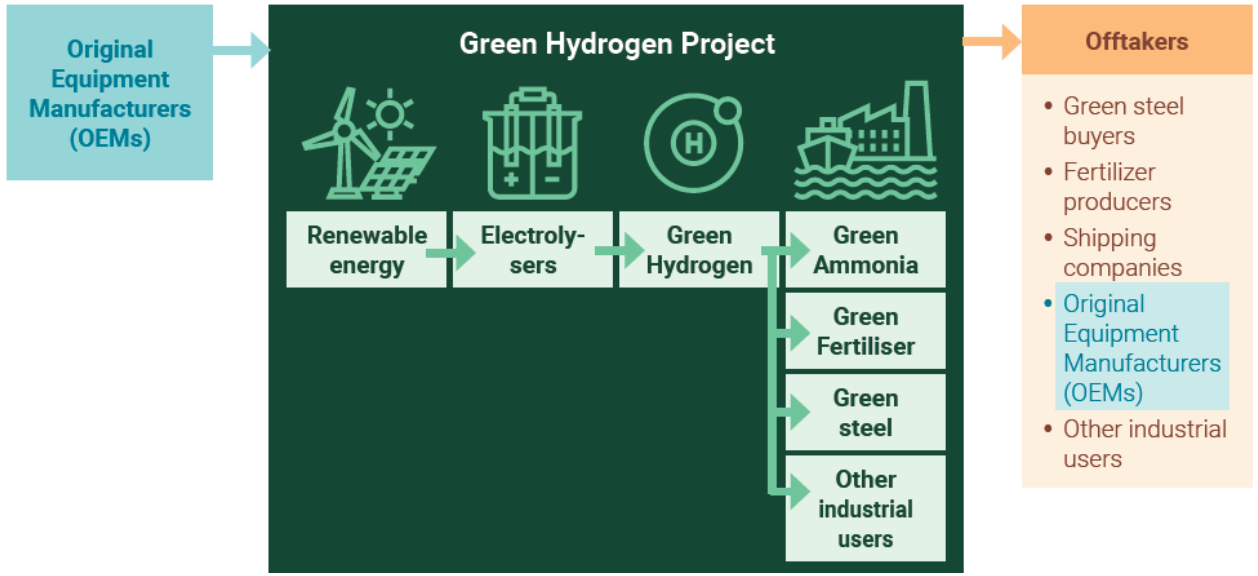
Bankability and cost-effectiveness will drive the market.

- Initial demand:
  - Decarbonization of existing industrial uses:
    - Fertilizer production
    - Refining
  - These industries have a bankable offtake.
- Subsequent sectors with predictable demand:
  - Public transport:
    - Buses and trains
    - Fixed schedule transport
  - Clean energy generation:
    - To manage variable renewable energy
- Other potential demand drivers:
  - Mandates and global demand for green products
  - Transport sectors:
    - Aviation
    - Shipping
    - Heavy road transport



Example: India Market Assessment for Green Hydrogen

Unique challenges to financing Green Hydrogen



The **financing** of the green hydrogen value chain is expected to include the

- manufacturing of upstream and downstream equipment,
- renewable energy generation (70% of cost)
- hydrogen production,
- storage,
- transportation,
- and infrastructure to deliver hydrogen (and, in some cases ammonia as a means of storage of hydrogen) to market / end-users.

Challenges:

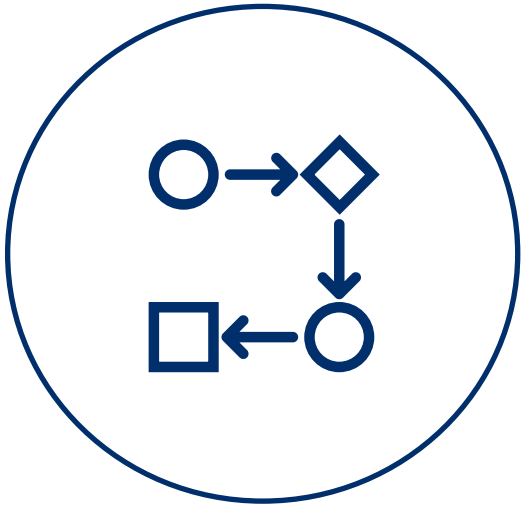
- Lack of visibility on demand
- Unclear regulation
- Supply chain constraints

Financial Considerations:

- Varying risk appetites across financial institutions
- Clean hydrogen projects often entail significant pre-construction and offtake risks, causing concern for private investors and financial institutions

Three major risks in emerging markets

Offtake (Price and Volume) Risk



Interface Risk

Certification Risk

Off-take 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

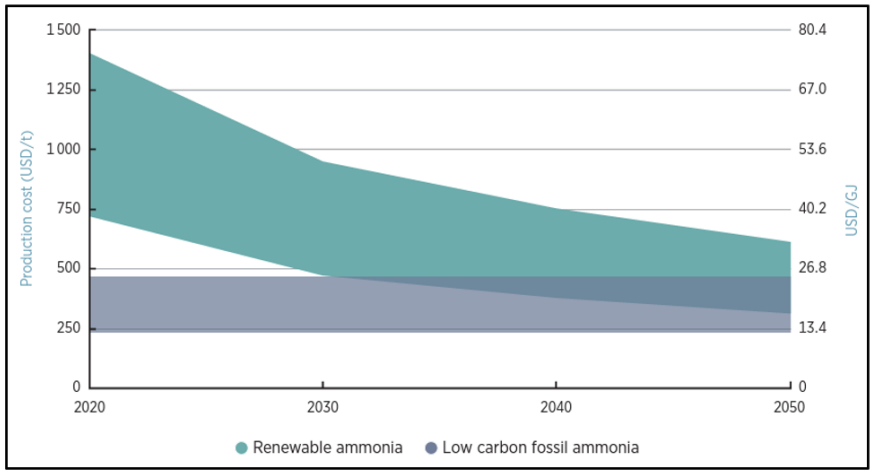
Offtake Price and Volume Risk

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

Interface Risk

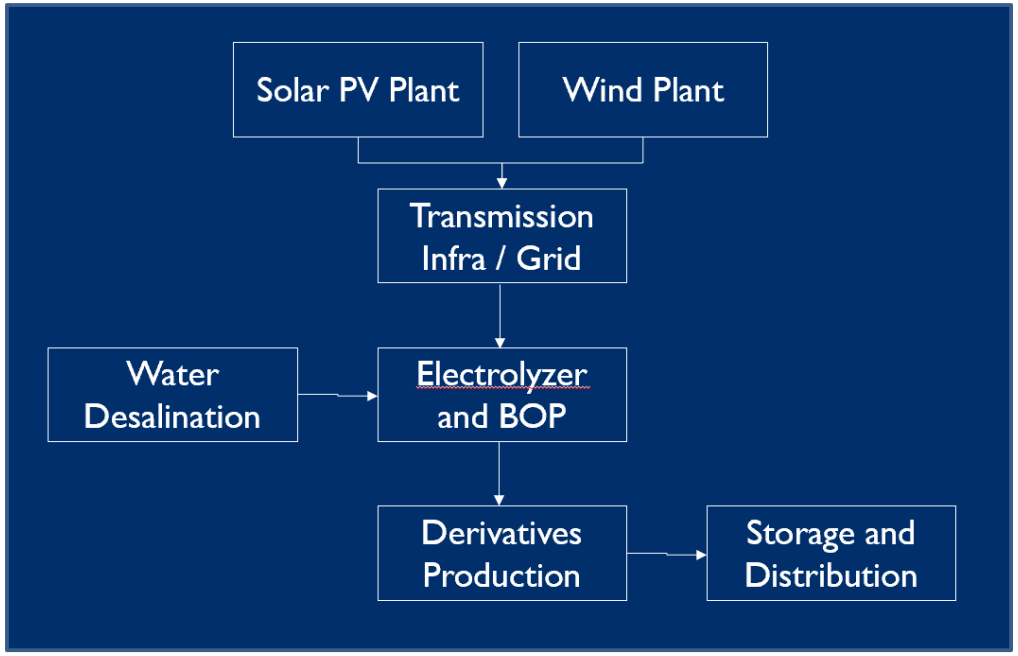
The co-dependence of multiple technologies in a single process plant creates high interface risk in Green H2/NH3 projects, leading to extensive technical due diligence requirements

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

Certification Risk

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

Project bankability remains a key concern for the sector to access financing

1 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**: 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 stakeholders are uncertain about production technologies, associated risks and standard solutions for project, they can be supported from the project development stages onwards, through Project Development Facilities or other development support mechanisms

These facilities can 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

GCF's Financing Tools:

- Readiness Support
- Project Preparation Facility

Possible Government interventions to drive investments

	Potential Challenges	Potential Mitigants
Price and Volume Risk 2	**Absence of Strong Domestic Consumption Market -** High green premium leading to reduced commercial viability **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	• **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)
Interface Risk 3	Green hydrogen projects involve integration of multiple technologies for a single project output, which could lead to delays / non-completion	• **Introduce a wrap guarantee** for overall plant operations • **Introduce oversized liquidated damages**
Uncertain Regulatory Framework 4	Grey and green hydrogen have the same physical characteristics and as such need the latter needs to be supported with clear green certification standards	• **Introduction of frameworks for regulation and green certification that are well-harmonized with global equivalents**

Details of GCF's FINANCING INSTRUMENTS

Readiness (RPSP), Project Preparation Facility (PPF), Simplified Approval Process (SAP)

	RPSP	PPF	SAP
Amount	up to 1m USD/year per country	up to 1.5m USD	up to 25m USD + co-financing
Product Type	grants	grants, repayable grants, equity	any GCF financial product
Conditions		• CN and NDA NOL ready • FPs developed with PPF resources to be submitted to Board within 2 years from PPF approval	• GCF funding up to 25m USD • minimal to no E&S impact
Scope	TA to support institutional capacity building, coordination, policy and planning, programming for investment, strategic frameworks	supports AEs in Funding Proposals (FPs) preparation and provides short-term TA	any project in line with GCF paradigm shift and investment criteria
Notes	• Funding is provided to NDAs, Focal Points (FPs) and Direct Entities • At least 50% goes to LDCs, SIDS and African States	• Simplified approval for requests <=300k USD • GCF handles procurement, AE handles implementation, oversight and reporting	• Simplified CN (optional) and FP • Simplified appraisal, M&R and post-approval procedures • Guided templates for fast tracking and scaling up

GREEN CLIMATE FUND

Thank you

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