Introduction

Why Green Hydrogen

Carbon free Hydrogen is critical to achieve net zero emission target by 2050

Enables large scale renewable energy storage

Support to remote generation and distributed energy generation

Considerations for Bankability:

- Technological Aspects concerned with energy storage, electrolyzers and the required expertise
- Regulatory Aspects including certification and categorization
- Offtake Structuring
- Considerations of EPC and O&M contract structuring
- Lender requirements
- Sponsor
- Debt cover requirements
- Land Availability and associated risks
Green Hydrogen Supply Chain
Production and Storage, Distribution and Uses

**PRODUCTION AND STORAGE**

- Transmission and Grid Balancing
- Electrical Energy (Renewable Sources)
- Electrolyser (H₂ Production)
- Ammonia Loop (Synthesis Reactor)
- Water Desalination Plant
- H₂ Storage

**DISTRIBUTION**

- Port Infrastructure (Import Points)
- Port Infrastructure (Export Points)
- Shipping and Insurance
- H₂ Distribution At Use Center

**USES**

- Energy Production (Power Plants in Japan/ Korea)
- Feedstock (Fertilizers & Other Industries)
- Transport Fuel (Fuel Cell Vehicles)
# Bankability Considerations

## Technological

| Electrolyzers | • Limited precedents for utility scale electrolyzers  
|               | • Interfacing risk between renewable generation and electrolyzers/ammonia synthesizers  
| **Mitigation:** | • Availability of data on electrolyzer performance through pilot projects  

| Interface Risks | • Limited sponsors/contractors with expertise across the entire green H2/green ammonia process  
|                | • Interface risk between renewable generation component and electrolyzers/ammonia synthesizers  
| **Mitigation:** | • EPC contract structuring and coordination agreement  

| Risks from variable generation | • Reduction in electrolyzer life/faster than anticipated replacement  
|                               | • Process disruptions in case of production of Green Ammonia through the Haber–Bosch process  
| **Mitigation:** | • Inclusion of baseload renewable power sources (hydropower, geothermal) in the mix or using complementary RE sources (wind + solar) along with limited energy storage  
|                               | • Low-load factor Haber-Bosch synthesis loop coupled with hydrogen storage;  

Bankability Considerations

Regulatory

A. Green Hydrogen Certification

The green hydrogen certifications provide formal verifications that the resources used in production of Hydrogen are renewable in nature. They help in meeting regulatory requirements, making the project eligible for subsidies, tax benefits, and other financial incentives. These certificates act as proof which facilitates access to financing contributing to the project’s bankability.

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<td>• US Low carbon fuel standard</td>
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B. Requirements for Green Hydrogen Certification

**GEOGRAPHICAL CORRELATION**
Green hydrogen production systems should require some degree of physical link to ensure that electrolysis powered with renewables is involved in the process of producing hydrogen that is claimed to be green.

**ADDITIONALITY**
Green hydrogen development should contribute to additional power capacity. Given that the green hydrogen market is relatively young, a transitional period may be permitted during which the electrolyzer could consume power from current renewable plants.

**TEMPORAL CORRELATION**
To ensure that electricity used for electrolysis is renewable, green hydrogen production systems should operate on a time interval that will both meet the demand and support the establishment of future power purchase agreements, as well as include available production forecasts.

**TECHNOLOGICAL SPECIFICATIONS**
It is essential that specifications provide full transparency and information on the resource used to produce electricity and ensure its renewable nature.
Project Bankability

A. OFFTAKE STRUCTURING

Bankability Perspective

- Fixed price (vs benchmarked to spot prices of natural gas/oil in the case of traditional grey hydrogen contracts)
- Long term (longer than tenor of debt) to recover high Capex – major component of project cost
- Termination protection for SPV and off-takers to be mutually decided – important consideration for bankability
- Take-or-pay structure

Offtaker Perspective

- Input price based (vs offtake price dependent on natural gas/oil price)
- Short term or lower fixed tariffs

Challenges in Pricing

- SPV's cash flow forecasting becomes challenging with input price-based contracts
- Unavailability of historical green ammonia price trends
- Green ammonia prices expected to go down with enhancement of large-scale electrolyzer technology (higher efficiency & lower prices)
Project Bankability

B. EPC and O&M Contractors

Key Issues

- Due to the novelty nature of green hydrogen projects, there are few EPC or O&M contractors with the capability and expertise to construct or operate & maintain the end-to-end production chain (from desalination of water, generation of electricity, electrolyser operation and ammonia conversion).
- Whilst being the easiest in terms of management for the project company, an EPC wrap and/or O&M wrap is usually expensive.

C. Generic Lender Requirement

Key Issues

- Green Ammonia long-term contract party is likely to be a private company and unable to provide a revenue guarantee.
- DSCR with adequate buffer, DSRA accounts, restrictions on dividends in case of DSCRs falling beyond certain thresholds.
Project Bankability

D. Sponsor Experience

Split SPV or Integrated SPV Structure

- Ring-fencing the relevant business units would create inter-project risk and inter-project liability which could affect bankability of Project at unit level.
- Ownership and operation by a number of SPVs will necessitate understanding and dealing with the interfaces between each SPV.

Lender’s Perspective

- Sponsors’ international experience and local experience in project country
- Nature of equity investors whether private company or government owned
- Sponsors’ balance sheet size and history of operations and relationship with bank

E. Debt Cover Requirement

Key Issues

- To cover technology risk for this new type of project, international commercial lenders would likely require MDBs / ECA (or credible private insurance) commercial covers for SPV’s debt obligations and for political risks
- Lenders expected to benefit from ECA cover in case the project terminates due to commercial/political risks
F. Land Availability

Key Requirements

- Large enough land at low cost for large-scale renewable energy installations
- Adjacent to sea and port for desalination facilities and efficient ammonia export
- Sufficient electricity demand and grid facilities in the vicinity for efficient operation through the grid network
- Land parcel should have good solar irradiation and/or wind speed for efficient renewable generation
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