SHEARMAN & STERLING

Shearman H_2 and NH_3

Our Work On Hydrogen And Ammonia Export Megaprojects

August 2021

Our Global Hydrogen Industry Team

Publications and Events

- **CBAM and Revised EU ETS: Implications for the Aluminium Industry**, ***Published July 2021***
- **Green Hydrogen Use in Industry Promoted by Revised RED II**, ***Published July 2021***
- **Preliminary EU CBAM Proposal: Both Green and Blue Ammonia Incentivised**, ***Published July 2021***
- **IRS Issues Revenue Ruling Providing Guidance on Carbon Capture Equipment**, ***Published July 2021***
- **DOE Launches Energy Earthshot to Spur Low Cost, Clean Hydrogen**, ***Published June 2021***
- **Sponsors of European Hydrogen Conference 2021, Netherlands, June 2021**
- **IEA Roadmap Outlines Hydrogen's Role in Reaching Net Zero by 2050**, ***Published May 2021***
- **Africa and a Green Hydrogen Economy**
  Published in Project Finance International
  February 2021
- **Hydrogen – is it the Answer to Clean Energy?**
  Published in Project Finance International
  October 2020

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An Award-winning Global Team

NEOM Helios Project awarded 'Green Project of the Year' at the *Global Hydrogen Summit 2021*

Leading firm in Projects & Energy in each region of the world, including the U.S., Latin America, UK, Africa, Asia Pacific and Middle East, *Chambers Global 2021*

"Combining strong product expertise in relation to M&A, banking and capital markets, with underlying industry knowledge across the spectrum of renewable energy sources, Shearman & Sterling LLP is well-placed to serve a diverse roster of clients engaged in domestic and international transactions."

Chambers & Partners USA, Energy, 2021

Shearman Global Hydrogen Industry Team
Truly Unique Green Hydrogen Megaproject Experience

Shearman advises NEOM, which hosts and is a 1/3rd equity partner in the **US$ 5 billion Helios green hydrogen megaproject** in Saudi Arabia, under construction with Air Products and ACWA Power

Helios is powered entirely by **4 GW** of captive greenfield wind and solar generation (the largest single phase renewables project in history)

At Helios' heart is **2 GW** of electrolyser capacity using thyssenkrupp technology. The electrolyser is **100 times larger** than any plant in commercial operation.

Helios will produce 250,000 **tonnes of hydrogen per year** of hydrogen and take nitrogen from the air to produce **1.2 million tons of ammonia** per year.

From 2025 Air Products will offtake **100%** of Helios' green ammonia for distribution around the world and dissociate the nitrogen to produce green hydrogen for the transportation market.

Shearman has advised on all aspects:

- Initial MOU
- JV structuring
- EPC, including electrolyser and ammonia loop procurement
- IP licensing
- Marketing and regulatory matters (including interaction with European regulation such as RED II as well as regulation in the US and key Asian countries)
- Offtake
- Utilities supply
- Land arrangements
- Export arrangements
- Ensuring bankability of documents for project financing
- Project financing process
- O&M arrangements

This means Shearman has a multi-year head start on all other law firms in understanding how to structure complex green hydrogen projects globally.

We are influencing policy and creating the project development model, not just following the news.

With 30 partners in every region of the world, Shearman's Global Hydrogen Industry Team is ready to support on hydrogen projects across the value chain, wherever your opportunities are located.

We are experienced in all aspects of the hydrogen value chain, globally

Advisers on the world's first green hydrogen / ammonia export megaproject, involving 4GW of solar and wind and a 2GW electrolyser in Saudi Arabia with Air Products (USA) and ACWA Power (KSA) . Capex is US$5 billion, plus $4 billion of downstream capex.

Advisers on the world's first blue ammonia megaproject, a joint venture with OCI in Abu Dhabi, UAE, combining grey hydrogen production with carbon capture and sequestration.

Drafting the world's first end-to-end, production-to-use hydrogen legislation, on behalf of a government related entity.

Advisers on the two largest green hydrogen projects (one electrolysis, the other pyrolysis) in the USA.

Advisers to LyondellBasell in connection with a joint venture to develop a syngas (hydrogen and CO_2) facility in Texas.

Advisers to Hydrogen Energy International on various hydrogen energy projects, including a project in California to produce 400MW of electricity together with carbon sequestration.

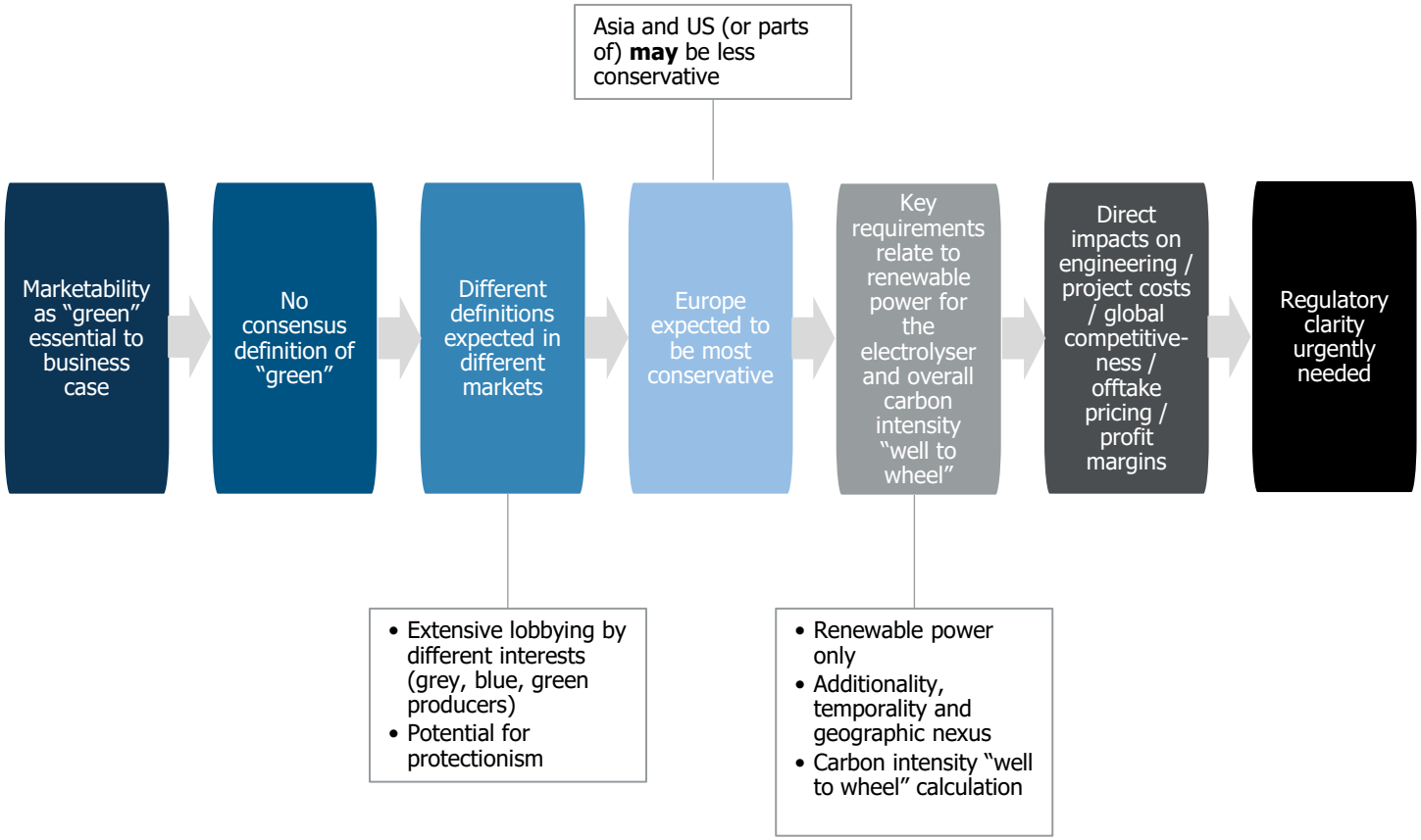
Advisers to numerous energy companies on hydrogen pipelines in Texas associated with the separation of hydrogen and CO2.

Advised Anglo Platinum Marketing on a JV with Shell Oil, Toyota and Honda to develop hydrogen refueling stations in California.

Advisers to APVentures, which was spun out of Anglo American, on investments in platinum-based hydrogen fuel cell technologies.

Advisers to Syntroleum in connection with several projects to produce synthetic fuels by the Fischer-Tropsch process (converting hydrogen and CO2 into liquid hydrocarbons) using natural gas, coal, or biomass as feedstocks.

Importance of Regulatory Certainty on Structuring



Offtake: The Driver For Green Hydrogen Mega-Project Structuring Today

H_2 produced entirely from zero carbon renewable energy. It is also zero-carbon at point of use.

But what is 'green' hydrogen, really?

What markets will exist?
Which are you targeting?
How do they define "green"?

Do you have 100% captive renewable power?
If so, how do you deal with intermittency?

How do you certify origin, additionality, and temporal and geographical conditions?

How do you calculate carbon intensity? Hydrogen only? Or ammonia / energy carriers as well?

Who takes the risk on "greenness", producers or offtakers?

What if you get it wrong, and you have too much carbon?

What if you get it wrong, and you have been too conservative?

Offtake Models: A Potential Roadmap

	Current state of the market (2020s)	Future state of the market (2030s)
Nature of Offtake	**Higher-risk / higher-reward**	**Commodity-style risk profile**
Downstream market profile	**Downstream market risky / speculative** • Small pool of large scale consumers • Regulatory uncertainty	**Established demand centres** • Clear destination markets and consumers • Some markets "greener" than others
Trading of product	**Limited spot market / trading** • Small pool of export projects • No established supply chains • No agreed standards on specification **Zero / limited opportunities for redirection / arbitrage**	**Merchant market** • Portfolios of export projects • Established shipping, trucking pipeline supply chains **Opportunities for sophisticated marketing / trading operations**
Nature of offtake arrangements	**Long-term take or pay offtakes** - debt will struggle to take market risk	**LNG-style offtake strategies** - debt may take some market risk
Offtaker involvement in equity	**Typical -** Risk management for both offtakers and other sponsors	**Less typical** - Fewer offtakers involved in equity as offtake terms more offtaker-friendly
Features of pricing	• Price needs to cover **project costs, repay debt** and provide **acceptable IRR** • Pricing must **balance the following** (all of which overlap): - No track record on market pricing - Forecast on grey / brown ammonia demand and pricing - Competitive profile of green hydrogen project costs over life of the investment - Future natural gas and gray, blue and green hydrogen demand - Carbon pricing and other taxes - Supply chain costs - Labour costs	• Market pricing track record • Financial tools available to manage volatility
Tenor of offtake	**Longer** to cover tenor of debt	**Mix** of term and spot
Who has the bargaining power?	**Suppliers**, as there is a limited pool (both upstream and midstream)	**Buyers**

Key Issues In Green Hydrogen Project Development

Regulatory

- **Marketability:** International regulations setting criteria for 'green' hydrogen do not yet exist. We expect all aspects of the supply chain will be taken into account in determining the carbon content. First mover developers have to be extremely conservative to ensure so as to not inadvertently exclude themselves from a particular market
- **Power and water supply:** Power and water supply is often highly regulated. Renewable electricity taken from a grid will need to be recognised as green in the end markets
- **Jurisdiction:** Investors and lenders may seek change in law or stabilisation protection, unless the jurisdiction has a strong track record for the development and financing of large scale industrial and renewables projects

Power and Water Supply

- **Clean sources:** Electricity used for production needs to come from renewable sources, with zero (or extremely little) "grey" power being used in the production process
- **Reliability:** Renewable energy is naturally intermittent. Most projects will require power from multiple sources to ensure plant utilisation rates can satisfy IRR hurdle rates. Ammonia requires a constant supply of electricity and requires access to stored power or grid connection
- **Access to water:** A large volume of fresh water is required for electrolysis. Projects without access to proximate fresh water supply will require desalination plants. Carbon emitted during desalination process will be attributed to the hydrogen

Technology

- **Due diligence:** Electrolysis application at utility scale is novel. Of the two competing technologies (alkaline and polymer electrolyte membrane (PEM)), PEM is considered by some to be most attractive but it uses expensive rare metals and is less well-proven, which may impact technical diligence during financing of PEM-based projects
- **IP protection:** Essential for technology licensors. But investors want to understand it
- **Access:** There are a limited number of licensors for equipment at scale
- **Financing**: Licensing agreements for electrolysis and ammonia production technology must be bankable. Due to the uncertainty of the energy sector over the long term, developers and lenders will focus on potential 'stranded asset' risk

Key Issues In Green Hydrogen Project Development

Construction and Interfacing

- **Highly integrated**: Large number of components (power, water, transmission, battery, storage, electrolyser, ammonia loop) creates potential interface risk during both construction and operations phase
- **Scale:** No green hydrogen projects have been built to scale. Pilot projects aimed at identifying areas for optimisation are running in parallel
- **First-mover advantage**: Developers need to move quickly to secure market share and ensure equipment supply
- **Risk allocation:** Need to target single-point construction and appropriately allocate risk away from the project company and across the supply chain
- **Financing strategy**: Developers may separate elements of supply chain into separate financings (i.e. utilities and electrolysis plant)

Offtake

- **Market risk:** There is currently no merchant market for green hydrogen and developers and lenders may not accept the associated exposure. To be considered bankable, green hydrogen projects will require long-term, fixed price offtake contracts with creditworthy offtakers, structured on a take-or-pay basis
- **Limited offtaker pool:** There is a limited pool of creditworthy offtakers with the risk appetite and downstream distribution network to offtake green hydrogen at utility scale
- **Production uncertainty:** It is difficult for producers to commit to steady and predictable production profiles because of the reliance on renewable power sources, making volume commitment arrangements complex

Land

- **Availability:** Greenfield green hydrogen projects involve a combination of elements and therefore significant vacant land mass. This can impact due diligence if multiple land acquisitions are involved
- **Location:** The quality and reliability of the renewable energy sources will be a key determinant in the cost and therefore overall IRR. Extensive meteorological forecasting will be required to ensure the requisite renewable energy levels and therefore projections can be met
- **Commerciality:** The best renewable energy sites may not be conveniently located near other essential project infrastructure such as transmission infrastructure, roads and ports. Maximising renewable energy potential may need to be weighed against other logistical and commercial considerations

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