SHEARMAN & STERLING

# Lessons Learned in Developing and Financing a Green Hydrogen Project

2021

# Key Contacts

# Publications and Events

- Panel Discussion: Hydrogen, the missing piece to a fully decarbonised economy?
  ***MENA Future Energy & Decarbonisation Summit***
  ***February 2021***
  **Dan Feldman, Partner**

- Africa and a green hydrogen economy
  ***February 2021***
  **Samuel Ogunlaja, Senior Associate**

- Hydrogen – is it the Answer to Clean Energy?
  ***October 2020***
  **Dan Feldman, Partner**

- Panel Discussion: Green Hydrogen - electrolysis, ammonia and other e-fuels
  ***IRENA Virtual Innovation Week***
  ***October 2020***
  **Dan Feldman, Partner**

# NEOM / ACWA / Air Products' Green Hydrogen Joint Venture

## Background to the Project

Announced **June 2020**

Scheduled to be onstream in **2025**

Involves **4 GW** of captive greenfield wind and solar generation

**2 GW** of electrolysis using Thyssenkrupp technology

Located in NEOM, a new **US$500 billion** city being developed in Northwest Saudi Arabia, bordering Jordan and the Red Sea

To produce **1.2 million tons** per year of green ammonia using Haldor Topsoe technology

NEOM, ACWA and Air Products each own **1/3rd** of the Project

Air Products to offtake **100%** of green ammonia for distribution around the world to produce green hydrogen for transportation market

# NEOM / ACWA / Air Products' Green Hydrogen Joint Venture

## Highlights of the Project

Currently, electrolyser facilities are smaller than 100MW, just 5% of the scale of NEOM's US$5 billion plant making it the **world's largest electrolyser facility**

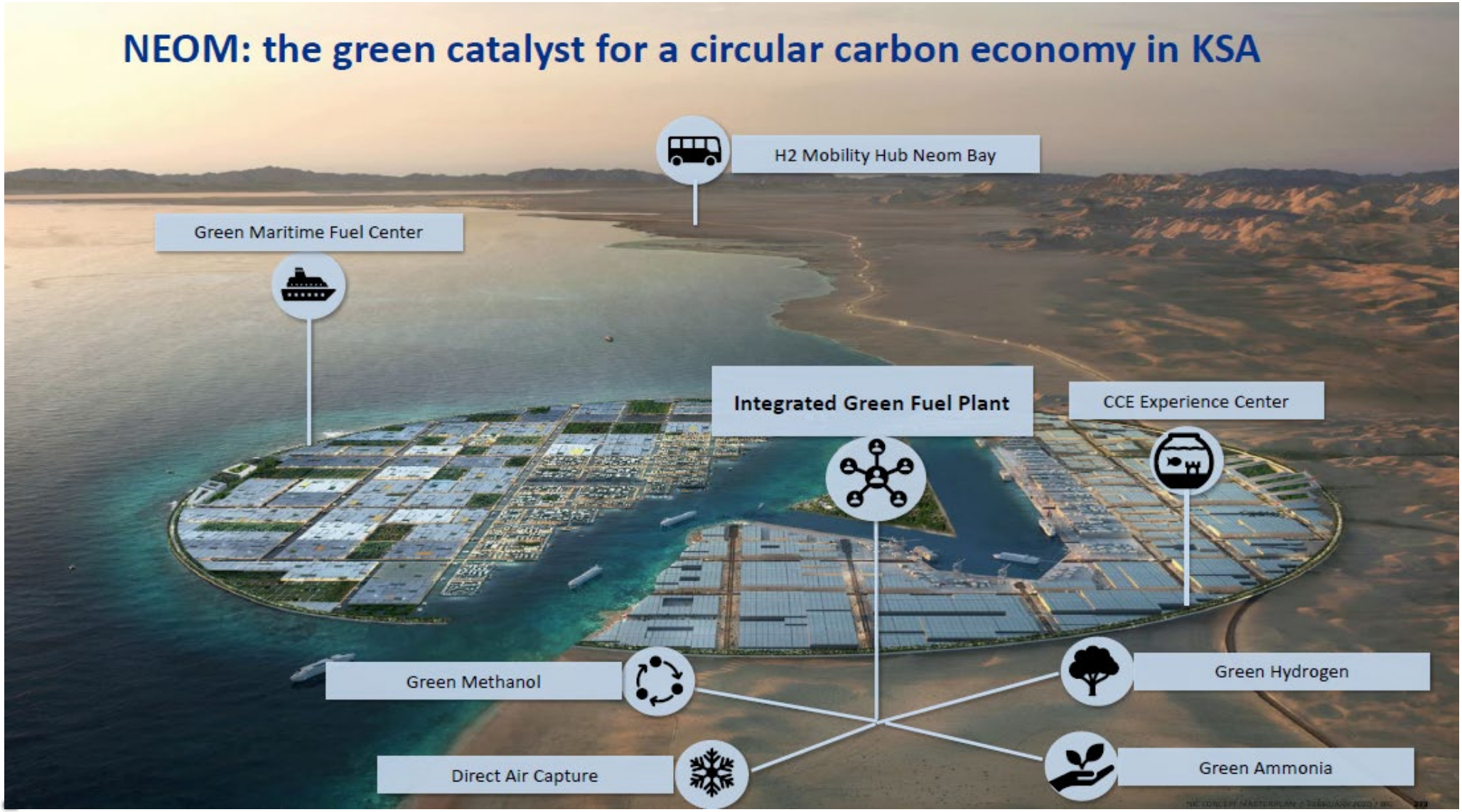
Joint venture with Air Products and ACWA Power brings together **hydrogen and renewables expertise.**

NEOM's future city will have zero net carbon emissions, powered entirely by renewable energy

The sites are **abundant with solar and wind potential** and the regulatory environment is facilitative of the Project

Green ammonia is expected to be transported by Air Products to **Germany, Japan, South Korea and the U.S.**

## Background to the Project



# NEOM / ACWA / Air Products' Green Hydrogen Joint Venture

## But what is 'green' hydrogen?

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

Hydrogen is the universe's **most common element.** It is lightweight yet energy-dense, and transportable in liquid form as ammonia and methanol

Hydrogen has **numerous applications**, including as fuel cells in the transport sector. Ships, cars and other vehicles are able to be powered by hydrogen fuel cells

Green ammonia is the first **scalable** medium, or energy carrier, for the export of one country's renewable power generated resources to another

EU hydrogen demand is forecast to be 16.9 million tons per year by 2030 and nearly **75% will need to be imported**

The German government has said that most of its hydrogen will need to be imported, and **only 'green' hydrogen is sustainable** in the long term

Japanese and South Korean governments have said all hydrogen imports must be **carbon-free by 2030**

OPEC now estimates **peak oil** within 20 years as the energy transition to zero-carbon based sources accelerates

# Key issues

## Construction and Interfacing

- **Highly integrated**: Large number of components 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)

## 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 is less well-proven, which may impact technical diligence during financing of PEM-based projects
- **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

## 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 (Europe may require single-purpose renewable projects for hydrogen)
- **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

## 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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