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Rise of Green Hydrogen in the GCC

As decarbonisation becomes increasingly urgent globally, GCC countries are looking to diversify their economies away from hydrocarbons while maintaining a central role in the global energy system. Given plentiful natural gas, the region is sure to be a prime location for blue hydrogen development with carbon capture and storage but it is the prospect of large-scale green hydrogen production that is firing up imaginations – and fuelling investment.

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Some of the largest green hydrogen projects to-date have been announced in the GCC and an important foundation for this is the region's existing and potential hydrogen demand. The GCC is currently the world's second largest consumer of hydrogen after China, with many of its end-users being regional industrials – including steel-makers, aluminium smelters and petrochemicals producers – which will need to ensure their products can remain competitive when their export markets inevitably introduce stricter "green-origin" policy requirements and carbon taxes.

Domestic transport provides another obvious application for green hydrogen and various initiatives already seek to install fuel cells in the buses, LCVs and HGVs that service urban and industrial areas. More widely on transport and logistics, the region is a global hub for international aviation and shipping, making it an obvious centre for the future development and rollout of e-kero and ammonia as alternative fuels.

Exciting export potential

However, it is as a potential export centre that the case for Middle East green hydrogen development becomes exciting in terms of global impact. The proposition is simple: advanced economies will need vast amounts of affordable sustainable hydrogen to help decarbonise sectors that cannot be readily electrified and powered directly by renewables. Many countries have already announced hydrogen strategies and plans to help meet Paris Agreement commitments – including EU member states, the UK, South Korea, Japan and China – and low carbon hydrogen is sure to see significant global demand growth.

For now, green hydrogen is significantly more expensive to produce than other shades. However, production costs are expected to drop significantly as electrolyser production is scaled up – though how far and how fast remains to be seen – and renewable energy generation capex costs continue to decline. The International Renewable Energy Agency estimates green hydrogen costs can be cut by 40% short term and up to 80% long term.

Even with lower production costs, transport of hydrogen will be difficult. Building pipelines from the Middle East would not be easy to achieve and shipping liquid hydrogen is expensive given its molecule size and boiling point, even compared with LNG. Shipping in vectors is one possible solution and ammonia is the focus for now: partly because it can be shipped in LPG tankers, though significant investment may be needed here if the green ammonia market is to grow significantly; partly because it does not involve any carbon, which could potentially undermine green credentials; and partly because it is less heavily regulated than alternatives. Notably, both the US$5bn ACWA/Air Products/NEOM project in Saudi Arabia and the US$2.5bn ACME Solar project in Oman plan to export green ammonia. Using any vector, though, involves efficiency losses in conversion and improvements are needed to the cracking process to convert ammonia back into hydrogen.

Government policy will be the other key force in establishing a market, both on the supply side (by providing support and establishing a favourable regulatory environment for projects) and the demand side (tariffs, taxes and outright prohibitions on carbon-based energy, which increase relative demand for sustainable alternatives). Much will depend on taxonomy: how will governments (and the wider industry) define sustainable hydrogen? This will be a key question on the first pathfinder projects.

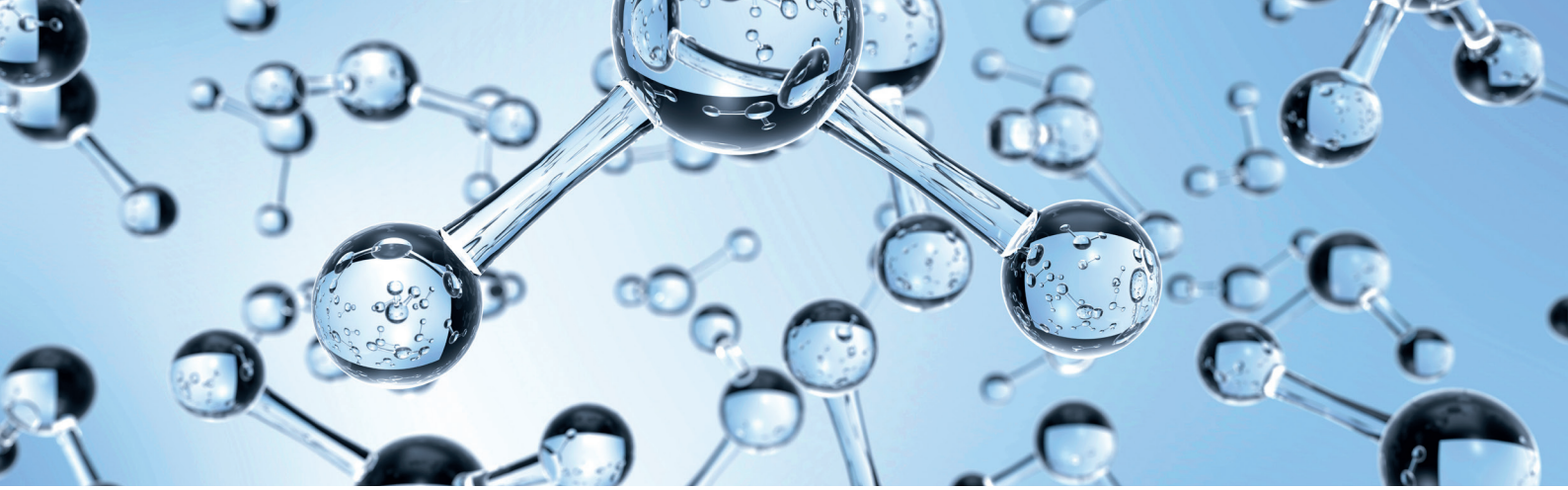
Assuming these hurdles can be overcome and a global market established, what makes the GCC region so well placed to produce green hydrogen?

A climate for renewables

Satellite imagery and climate data confirm the GCC is among the most favourable locations on the planet to place solar and wind assets. Though irradiation levels vary across the region, regional solar capacity has grown enormously as tariffs have dropped to some of the lowest globally – as low as US$0.0135 cents/kWh on Abu Dhabi's Al Dhafra PV IPP. Wind has been deployed too – most notably at Dumat Al Jandal in northwest Saudi Arabia – and features in many of the GCC countries' energy transformation plans. The combination of solar and wind power boosts electrolyser capacity and improves project economics significantly.

Other geographical advantages

The Middle East is also well located midway between the key import markets of Asia and Europe, and close to African and South Asian growth markets. Its significant coastline, and its history of desalination, should also provide a reliable water supply for electrolysis. Finally, the region's low population density makes it comparatively easy to grant large tracts of suitable land without impacting residents and existing land users.



A history of foreign investment

The GCC has a long history of attracting foreign investment and expertise into infrastructure and energy developments, often with project finance, which it will be able to harness for this new asset class.

There are two principal sides to the project finance energy market in the Middle East: the independent power or water project (I(W)PP) model and oil, gas, petrochemical and other industrial projects. While there are nuances across different countries and sectors, the I(W)PP model, with predictable cashflows typically based on strong government credit and availability based models and significant lender protections, has proven popular with equity investors and relatively easy to debt-finance. The region's refineries, LNG trains and petrochemical plants, often with more complex components and exposure to global commodity markets, tend to require a broader range of supporting factors to persuade lenders of bankability.

Classifying hydrogen investments

A key question for potential investors in the GCC's hydrogen projects will be where they sit in the investor risk stack. The MoUs and joint ventures that are already being formed for green hydrogen projects demonstrate (in addition to governmental entities) a combination of sponsors from these two different investor universes: the classic IPP developers and some of the O&G and industrial players, with the two bringing different perspectives and risk appetites to the table.

While the IPP players may seek a more traditional IPP structure and lower risk and return (the Independent Hydrogen Producer – or IHP – as one leading developer labelled itin our discussions), the industrials may favour structures that involve greater market risk.

The resulting structure will of course dependon who and what is driving the particular project. This difference in sponsor perspective is shared by many of the lenders and ECAs we are speaking to who are assessing whether to classify hydrogen alongside industrial, O&G and petrochemical exporting projects or whether they fit closer to power and renewables projects for credit scoring purposes.

Ultimately, project classification will depend on the structure used and it is probably fair to say that there will not be one structure in the region but many. This will reflect not only the many shades of hydrogen but also where and how hydrogen produced on a particular project will be used.

Bankability of a new sub-sector

Of course, hydrogen projects can range from simple structures involving an electolyser operating on a tolling basis through to fully integrated projects incorporating renewable energy generation and potentially desalination on the front end and the processing and marketing of derived products (including ammonia) on the back. With the tolling structure, there will naturally be a lot of focus on project-on-project risk; with a more integrated model, lenders will need to be comfortable with the multiple-asset risk. In either case, sponsors will need to demonstrate they have adequately addressed risks relating to construction, technology and offtake.

The construction question is essentially how close hydrogen projects will come to the usual IPP position of a lump-sum turnkey EPC package from a contractor with a strong track record and convincing balance sheet. On an integrated hydrogen project the initial difficulty may be in obtaining a wrap of the totality of the works with levels of liability in a way that reassures lenders. Whether and how the overall construction risk is addressed will partly be a function of who takes that overall delivery risk for the project, the extent and nature of the risk assumed by contractor parties and the level of sponsor support that equity investors may provide.

On the technology side, the potential issue is largely one of scale-up of electrolysers and arguably air separation units. From conversations we have had with technical advisers, however, this challenge does not appear insurmountable given the modular nature of most electrolysers and the performance history of ASUs on LNG projects.

Offtake will likely be addressed initially with tolling and fixed offtake structures to isolate the project from market risk. As a reliable market grows, we would expect to see different structures implemented on different projects, again driven by the intended use of the hydrogen produced. Here the questions will be the familiar ones: who is buying, what are they buying and for how long, and is there a firm take-or-pay commitment? Additionally, where the market is underpinned by policy initiatives, consideration will also need to be given to how change in law and policy risk is mitigated.

A bright future

We are expecting significant levels of activity in the green hydrogen market over the coming years. It will be fascinating to see how the first generation of hydrogen projects are structured and which models prove particularly attractive to the different market participants over time.