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The Middle East Is Looking To Dominate The Hydrogen Race

By [Alan Mammoser](#) - Sep 29, 2021, 3:00 PM CDT

- ▶ Many hydrogen projects worldwide are now advancing toward initial financing, it is becoming apparent that the Gulf countries will need to move fast.
- ▶ The UAE could be among the lowest-cost producers of blue hydrogen in the world, while its significant advantages extend also to green hydrogen
- ▶ A struggle may ensue in coming years between countries that are betting big on green hydrogen and those that are making large investments in blue hydrogen



For those looking to invest in hydrogen's future, a key region to watch will be the Middle East, particularly the Gulf region where nations are highly dependent on hydrocarbon exports. There, where there is most to lose in an energy transition, attention is increasingly turning to alternative energy carriers with high potential in multiple sectors. Hydrogen has come into focus, based on a broadly shared view that the region's resources and legacy infrastructure leave it uniquely advantaged for it. Now, throughout the Gulf Cooperation Council (GCC) countries, interesting and ambitious projects are moving forward.

Three recent studies put focus on the significant but surmountable challenges facing hydrogen in the Gulf, while offering a full picture of what must occur to bring current initiatives to actual implementation. Moreover, they offer insight into an increasingly competitive environment in which numerous projects in diverse world regions will seek first mover status.

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Hydrogen Valleys

U.S. Gasoline Prices Hit Highest Level in Six Months



During the past year, both Saudi Aramco and the UAE's national oil company ADNOC have completed shipments of 'blue ammonia' to Japan. These shipments, seeking to prove the concept, were produced from hydrogen with carbon capture, combined with nitrogen to produce ammonia as a carrier fuel.

Meanwhile, major production projects in the GCC area are moving forward. Those in Oman and Saudi Arabia have been included on the 'Mission Innovation Hydrogen Valley Platform' (www.h2v.eu), which was commissioned by the European Union and developed by the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) partnership. The platform was launched in January.

This Hydrogen Valley list currently contains 36 future production centers, mostly in Europe and Australia, with two in the US. It is the result of surveys and data gathering undertaken by researchers at FCH JU and the Munich-based management consultancy Roland Berger. The project team updating the list as more data is obtained.

The list reflects a current understanding that low-carbon hydrogen will initially require industrial clusters or hubs in order to gain markets. It portrays regions composed of major projects and subprojects across a broad value chain that potentially supplies several sectors in the region. Such regions could encompass ports and even international transport corridors.

Most of the projects are very early stage with consortiums created to back feasibility studies. Some will no doubt fall away before reaching actual operations. However, two in the Middle East that have been listed, in Oman and Saudi Arabia, are in early development phases and acquiring some momentum.

Their success will be critical for the Middle East, where the wealthy Gulf nations, their economies dependent on hydrocarbons, will be looked at to lead the energy transition.

Finding Focus in the Gulf

A new report by Dubai-based Qamar Energy, entitled 'The UAE's Role In The Global Hydrogen Economy,' focuses on the United Arab Emirates. The report, co-authored by Dr. Julio Friedmann of Columbia University and Robin Mills, CEO of Qamar Energy, asserts that the UAE has a "combined competitive advantage" for the production of blue and green hydrogen, leaving it well-placed to take early-mover advantage in the global hydrogen business.

Their analysis shows that the UAE could be among the lowest cost producers of blue hydrogen in the world, while its significant advantages extend also to green hydrogen.

A First for Renewable LNG



Among world regions, the Gulf countries enjoy excellent natural conditions for blue and green hydrogen production. The UAE has good natural features for CO₂ storage while its high potential for solar power generation is the basis for an expanding solar power sector producing electricity at very low cost. Moreover, the country's excellent large-scale infrastructure to support refining, petrochemical production and shipping provide a strong basis for the production and export of hydrogen and hydrogen-derived products. Given the country's location, and the relatively high cost of hydrogen transport (as compared to LNG, for example), the authors write that the UAE could find an export destination in the countries of South Asia.

The authors write favorably of the country's "balanced strategy" to develop hydrogen, affirming that blue hydrogen will be easier to scale-up initially and is therefore important for creating a global market. Such an approach seeks to build scale in blue hydrogen while later introducing green hydrogen to achieve a steady supply, presumably sometime after 2030. They also discuss regulations and incentives required for the development of "hydrogen hubs."

The report thoroughly documents numerous cooperative agreements, including nine planned and operational blue and green hydrogen projects in Abu Dhabi, Dubai, and the other emirates. Indeed, the UAE has a good record for domestic and international partnerships in the energy and industrial sectors.

An important player will be ADNOC, which has joined with the national investment company Mubadala and holding company ADQ to form the Abu Dhabi Hydrogen Alliance. ADNOC, which has been mandated by the government to become a global 'hydrogen leader,' has a head start with a 1 Mtpa blue ammonia project already underway, while it continues to advance its technology to develop blue hydrogen hubs.

Qamar Energy's report may preview much of what will be in the UAE's forthcoming national hydrogen strategy. Important insights are also found in a new report from the Atlantic Council Global Energy Center.

In "The Energy Transition in the Arab Gulf: From Vision to Reality," by Dr. Jean-François Seznec and Samer Mosis, the authors describe a lack of unified vision for the energy transition in Saudi Arabia and the UAE. As energy exporters, the Gulf countries have considerable advantages in solar energy, access to capital and expertise. But they need to adjust their business models to organize coherent approaches to decarbonizing.

They assert that the UAE is more focused than Saudi Arabia, its federal structure notwithstanding. Still, they see diverging strategies among the largest emirates of Dubai and Abu Dhabi, due partly at least because of their need to reduce natural gas imports. This has led them to diversify into nuclear power and coal, rather than to unite on a shared strategy for renewables.

The researchers highlight Saudi Arabia's circular carbon economy (CCE) national program, announced last fall to guide the Kingdom's many planned projects for carbon capture and conversion. CCE was endorsed by the G20 when KSA held Presidency in 2020.

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The CCE program will help KSA to maintain its wealth in hydrocarbon energy while lowering the carbon emissions of that energy. They write that the country has definite potential to become a leader in carbon capture, utilization and storage (CCUS) and related technologies.

But they see that development being hampered by the apparent lack of close coordination among project leaders. These include the Saudi Ministry of Energy's Renewable Energy Project Development Office (REPDO), the ACWA Power and Projects Company, the country's Public

Investment Fund (PIF) that holds a controlling share in ACWA, and Saudi Aramco that must provide the expertise for carbon capture projects.

These will need to work in a more coordinated fashion and would benefit from a more centralized approach led by a strong guiding institution.

Desert Valley

Strong and persistent leadership will be required to advance on the PIF's megaproject NEOM, where the \$5bn Helios Green Fuels project could make it the first functioning 'hydrogen valley' for green hydrogen and ammonia production.

The joint venture with Acwa Power and US-based Air Products will develop a hydrogen-based ammonia plant, with Air Products the exclusive offtaker for export. The plant will produce 650 tonnes (t) of hydrogen daily, to produce 1.2 million tonnes (Mt) annually of green ammonia. Design and initial work is now underway.

All the pieces of a 'hydrogen valley' could be put into place, assuming strong leadership to advance on the project's ambitious schedule. Thyssenkrupp's electrolysis technology will combine with the production of nitrogen by air separation using Air Products technology, and the production of 1.2Mt annually of 'green' ammonia using Haldor Topsoe technology. Hyzon Motors will lead a venture to develop an assembly facility at NEOM with annual capacity of up to 10,000 vehicles in a hydrogen-powered fleet of heavy duty vehicles for GCC markets. The project will require local assembly and intends to create a 'hydrogen innovation center' to train workers.

Energy for the electrolyzers will derive from wind (1.5GW) and solar PV (2.5GW) capacity to be developed on-site, with a first phase utility-scale production operating in 2025. The Atlantic Council's report suggests that while local solar/wind projects can be deployed, they probably can't be built at large scale in time for completing the project's first phase. Therefore an initial energy source could be 'blue' hydrogen produced in a different part of the country where carbon capture can occur. Although this would likely be expensive, it could work while local renewables are developed.

"Considering the size of these assets, it is most unlikely that they will be ready for 2025," says Jean-Francois Seznec. "But (our suggestion) about blue hydrogen was more hyperbole than reality," he adds.

"Only Aramco could make that size of carbon capture, but this may be difficult considering that Aramco has to finance huge dividends and further huge amounts under the Crown Prince's new plan to get the company to invest 2 trillion riyals in possible PIF projects."

Thus it appears that conflicting priorities and lack of close coordination among project leaders may hinder hydrogen's momentum in KSA.

Special Roles

The challenges faced by the Gulf countries appear in global context in a new study in the journal *Energy Research & Social Science*. 'Industrial decarbonization via hydrogen: A critical and systematic review of developments, socio-technical systems and policy options,' by Dr. Steve Griffiths, et. al., looks at whole systems transformations and provides a 'sociotechnical' frame for comprehensive assessments taken from the current literature.

The paper provides a real compendium of knowledge on the topic, going way beyond sector coupling to see hydrogen as an energy vector in complex systems. So it begins to lay bare the real challenges ahead to get energy systems to change.

The research pertains specifically to the Gulf countries in its conclusions about potential regional specializations. Saudi Arabia is mentioned as a potential leader in the development of long-distance hydrogen supply chains. Such a development would somewhat alter its current role as a hydrocarbons exporter, as it would have to cost-effectively deliver its hydrogen and hydrogen-derived products for specific end uses.

Related to this, the paper also notes the potential importance of the circular carbon economy (CCE) framework, such as that now being planned in Saudi Arabia. Here again the Gulf countries could potentially find unique advantage, with their potential for circular carbon economy programs with hydrogen produced from fossil fuels with carbon capture.

"For countries that are major hydrocarbon producers and exporters, such as those across the GCC, the CCE offers an opportunity when carbon utilization and storage opportunities are available," says Griffiths, who is Senior Vice President for Research and Development at Khalifa University in Abu Dhabi. "I think KSA, the UAE, Oman and Qatar are all relevant."

Griffiths points to another area where the GCC countries can excel: embodied hydrogen exports.

“We argue that the clear sectors to benefit from low-carbon hydrogen are refining, chemicals (ammonia and methanol) and iron/steel,” he says.

“The GCC countries are major producers of these products and so stand to gain from local low-carbon hydrogen supply, making them well positioned for international trade as carbon border tariffs become relevant, particularly in the EU.”

Interestingly, the researchers write that a struggle may ensue in coming years between countries strongly oriented toward carbon-free green hydrogen (e.g., European countries) and those such as Saudi Arabia that would benefit from export of low-carbon blue hydrogen and derivatives. But they assert that, considering the ambitious goals for hydrogen set by international agencies, national governments, and industry groups, blue hydrogen (and other shades) in a CCE is an approach that must be taken seriously.

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