BUSINESS COUNCIL REPORT

POLICY REPORTS

Road to COP28:

Hydrogen Takes Center Stage

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U.S.-U.A.E. Business Council

Authors

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Introduction

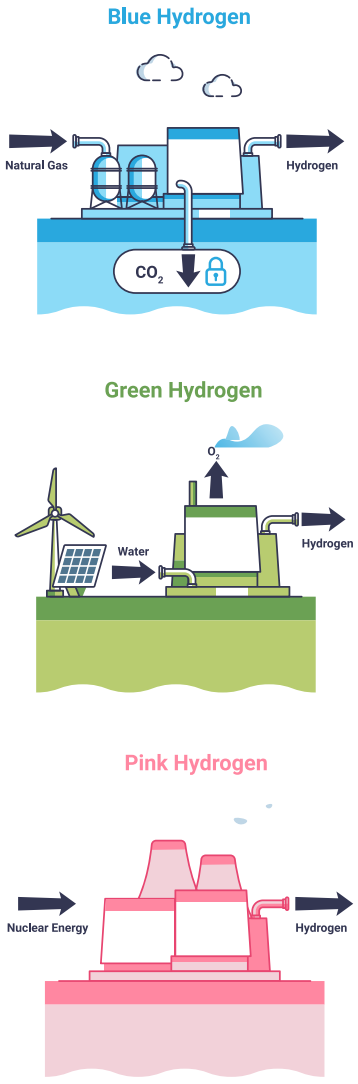
The emergence of hydrogen as a zero-carbon or low-carbon alternative fuel has led to widespread international business interest. As the U.A.E. gears up to host COP28 this fall, hydrogen will have its moment in the spotlight as a key pillar of COP28 and in light of the country's newly released National Hydrogen Strategy. At COP28, negotiators are set to announce a plan to double global hydrogen production to 180 million tons per year by 2030. The U.A.E. government, as part of its Hydrogen Strategy, plans to embark on local hydrogen projects aimed to position the country as a leader in this field. U.S. businesses are already investing in large-scale hydrogen projects and bring the requisite experience and best practices to new hydrogen projects. U.S. companies are therefore well positioned to plug in the gaps in the U.A.E. hydrogen sector and collaborate with the U.A.E. to develop new technologies in this field.

Hydrogen In-Focus

Hydrogen is the world's most abundant chemical element, estimated to constitute 75% of the mass of earth. Various forms of hydrogen fuel are the by-product of different sources of energy production. Some forms, such as gray or black hydrogen, are produced through fossil fuels and release large amounts of carbon dioxide into the atmosphere. Other forms, such as blue and green hydrogen, produced from natural gas and renewable sources respectively, are considered cleaner but remain difficult and expensive to operationalize. Pink hydrogen is generated through electrolysis powered by nuclear energy.

Business investment and interest is largely focused on two forms of hydrogen: green and blue. Blue hydrogen is produced through burning natural gas, with companies using carbon capture technology and storage to reduce emissions. On the other hand, green hydrogen is produced through renewable energy sources. At COP28, blue and green hydrogen will be the main focus areas of discussion, negotiations, and programming when it comes to hydrogen fuel technologies. The U.A.E. envisions both blue and green hydrogen as key pillars of its sustainability and renewable energy agenda. The U.A.E. National Hydrogen Strategy calls for the production of 15 million tons of green hydrogen by 2050 and to position the U.A.E. as a global market leader. The U.A.E. has a competitive advantage on green hydrogen production, the most sustainable of the hydrogen fuels, due to four key factors:

- Existing solar infrastructure that will allow the U.A.E. to scale up green hydrogen production more rapidly (more solar plants are planned in the next decade).
- The U.A.E.'s vast energy infrastructure, including ports, tankers, and storage facilities, allow for a seamless storage and transport process.
- U.A.E. government intervention in the form of financial investment will help jump-start hydrogen projects and ease investor concerns.
- An existing technology and industrial ecosystem that will help meet the challenge of catalyzing end-use demand for green and blue hydrogen locally and regionally.



Despite these advantages, the development and viability of an indigenous hydrogen capability faces significant hurdles. Hydrogen production is still in its early stages of commercial viability and there is no established legal and regulatory framework outside of the development and use of hydrogen vehicles. On the supply side, in the near-term, government support is needed to off-set the high cost of producing, storing, and transporting hydrogen. On the demand side, technological advancements globally towards end use applications for various forms of hydrogen fuel remain in early stages. One of the key hurdles to successful production is the low density of hydrogen, rendering storage technically challenging. Other challenges to commercialization include the water-intensive nature of the production process (in the case of green hydrogen) and ramping up industrial demand for its use.

Hydrogen hubs and off-take agreements will be key to the commercialization of hydrogen. A hydrogen hub is a cluster of local hydrogen production, storage, and demand. Countries including the United States and the U.A.E. are developing hydrogen hubs or clusters designed to ramp up production and storage, and foster demand to capture a significant share of global hydrogen fuel revenue. Demand-led off-take agreements for the sale and use of hydrogen fuel will be crucial for financially viable hydrogen production operations. Due to uncertain consumer demand, securing long-term off-take agreements remain a crucial element for producers to make investments in the necessary resource-intensive infrastructure. While the U.A.E. is well positioned in the supply side of hydrogen, demand driven by the development of new end-use applications remains a global challenge.

The U.A.E.'s Hydrogen Strategy

The U.A.E.'s National Hydrogen Strategy is part of the country's overall energy diversification efforts. The bedrock policy is U.A.E. Energy Strategy 2050 which includes a pledge to be carbon neutral by 2050. Ahead of COP28, the U.A.E. amended the overall strategy to include several new goals such as raising the percentage of clean energy in the total energy mix to 30% by 2031. The U.A.E. also plans to triple renewable energy capacity to 14 gigawatts (GW) by 2030.

In order to help meet its renewable energy benchmarks, the U.A.E. government adopted its National Hydrogen Strategy with the broad goal of strengthening the U.A.E.'s position as a leading producer and supplier of low-emission hydrogen by 2031. The U.A.E. believes that hydrogen, particularly green hydrogen, is a "fuel of the future." Emirati officials also believe that hydrogen can play a role in promoting sustainability across many sectors given its broad applications. In the near term, hydrogen fuel can best be used in the transportation and petrochemical industries, while advanced manufacturing is a potential end-use over the medium to long term. Ultimately, the U.A.E.'s goal is to link the hydrogen sector to the local, regional, and global technology and industrial ecosystem.

There are several key planks, incentives, and goals in the U.A.E.'s National Hydrogen Strategy. These are designed to incentivize private sector activity, establish the regulatory environment, and catalyze the linkages between production and demand. The key points of the strategy are:

- Develop a regulatory framework and policies that support hydrogen as a sustainable fuel for the future.
- Bolster investments in research and development to improve the cost effectiveness of hydrogen production, transport, and utilization.
- Provide land and associated infrastructure resources to support UAE production and develop the domestic ecosystem.
- Establish two oases (hubs) by 2031 -- in Ruwais and the Khalifa Industrial Zone Abu Dhabi (KIZAD), and a hydrogen center for research and development to be set up by 2031.
- Develop supply chains in support of the hydrogen market.

The U.A.E.'s Hydrogen Projects

The U.A.E. is seeking to develop an indigenous hydrogen market with plants, hubs, and carbon capture, utilization, and storage (CCUS) projects. The domestic hydrogen market will focus on ramping up green and blue hydrogen projects in the next decade. Green hydrogen production will be linked with the solar energy industry, while blue hydrogen projects will include CCUS technology and plants. Masdar is taking the lead on green hydrogen projects with the aim to produce up to 1 million tons of green hydrogen per annum by 2030. ADNOC is taking the lead on developing blue hydrogen, blue ammonia, and direct air capture (DAC) projects. Below are key select projects and their stages of operation:

U.A.E. Green Hydrogen Projects:

Source: wam.ae

- The U.A.E. has established the region's first green hydrogen plant at Mohammed bin Rashid Al Maktoum (MBR) Solar Park. The green hydrogen project covers an area of 10,000 square meters at the outdoor testing facility of the DEWA Research and Development Center, a part of MBR Solar Park. Masdar recently signed a $1.5bn agreement to develop 1.8 GW sixth phase of MBR Solar Park. (Operational)
- In partnership with Siemens Energy, TotalEnergies, Marubeni Corporation, Department of Energy in Abu Dhabi, Etihad Airways, Lufthansa Group and Khalifa University, Masdar is leading the development of a demonstration project to produce green hydrogen and sustainable aviation fuels (SAF). (Development stage)
- Masdar and ENGIE formed a US$5 billion strategic alliance to help drive the U.A.E.'s green hydrogen economy which includes development of a 200 MW green hydrogen plant in the U.A.E. with Masdar, Engie, and Fertiglobe. (Development stage)
- Masdar and Boeing signed a strategic parternship agreement in October 2023 to develop the green-hydrogen derived SAF industry in the U.A.E. and globally. The companies will also explore advancing SAF accounting principles, which could enable the SAF industry to overcome geographic barriers as it scales. (Development stage)

U.A.E. Blue Hydrogen and CCUS Projects

Source: adnoc.ae

- ADNOC produces over 300 kilotons (kt) per year of hydrogen in its downstream facilities, which is largely used for industrial purposes. It has existing plans to increase hydrogen production to 500 kt per annum. The downstream facilities include:
  - Ruwais Industrial Complex (operational)
  - TA'ZIZ Industrial Chemicals Zone (operational)
  - Umm Shaif field (operational)
- ADNOC plans to build a blue ammonia production facility in Ruwais, Abu Dhabi. The facility's capacity will be 1,000 kilotons per annum and start-up is targeted for 2025. (Development stage)
- Al Reyadah Plant is the first commercial-scale CCUS facility in the region and the first fully commercial CO2 facility for the iron and steel industry worldwide. It captures up to 800,000 tons of CO2 from the emirates steel industries and started operations in 2016. (Operational)
- Habshan CO2 recovery project: In September 2023, ADNOC approved Habshan project which aims to capture and sequester 1.5 million tons of carbon dioxide per year at a facility in Al Gharbia. The project is expected to be completed in 2026. (Development stage)

The Role of the Private Sector

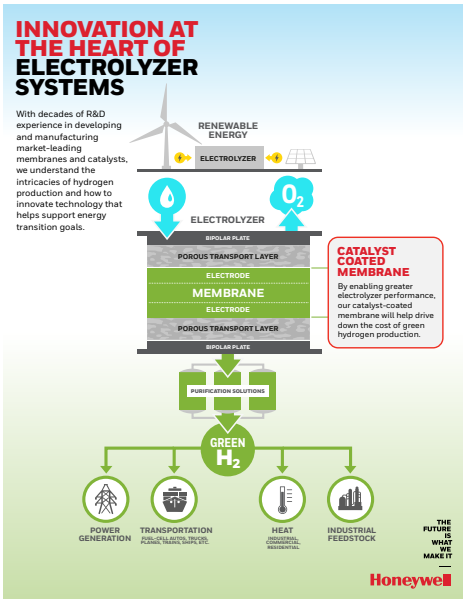
U.S. companies see the value of hydrogen production and have launched several large projects in the last few years. The U.A.E.'s National Hydrogen Strategy and its commitment to developing a mature hydrogen supply chain offers opportunities for U.S. companies to provide best-in-class knowledge and plug in gaps in the U.A.E. hydrogen ecosystem. Additionally, bilateral mechanisms such as the U.S.-UAE Partnership for Accelerating Clean Energy (PACE) and AIM for Climate offer public financing and incentives to catalyze investments in the clean energy sector, including hydrogen.

PACE, a key pillar of bilateral cooperation in clean energy, is designed to catalyze $100 billion in financing, investment, and other support and to deploy globally 100 gigawatts of clean energy by 2035. To that end, Occidental and ADNOC recently signed a new agreement to explore jointly developing CCUS hubs across the U.A.E. and the United States. Under their new partnership, ADNOC

and Occidental are also in talks to develop DAC projects in the U.A.E., including the first megaton DAC unit to be constructed outside the United States. Through PACE and in line with the U.A.E.'s strategy to ramp CCUS technology, Occidental is filling a need in the U.A.E. hydrogen ecosystem. Through partnerships such as this, U.S. companies are investing in a promising marketplace and fostering international hydrogen partnerships—one of the 10 enablers identified by the U.A.E. government in its new hydrogen strategy.

U.S. companies can also plug in gaps and help the U.A.E. meet its goals under the National Hydrogen Strategy. The U.A.E. is well-equipped to produce competitive green hydrogen given its advanced solar energy infrastructure. U.S. companies are well positioned to invest in the development of new technologies to support demand for hydrogen through new end-use applications.

On the supply and production technology, Honeywell is developing a product that will make the green hydrogen production process more efficient. Last year, Honeywell announced that it had developed catalyst-coated membrane (CCM) technology for green hydrogen production that will ultimately drive down costs. Similarly, Emerson offers technological solutions such as efficient hydrogen modular units, electrolyzers, and fueling stations. Collaboration on projects like these potentially fall within the U.A.E. National Hydrogen Strategy's goal of "incubating and accelerating next generation hydrogen technology."



Source: honeywell.com

On the demand side, the U.A.E. seeks to "link production with demand" under the 10 enablers. Some of the end-use applications of green hydrogen include transportation, pharmaceutical manufacturing, semiconductor manufacturing, and the chemical industry. The prospect of incorporating hydrogen into the pharmaceutical manufacturing sector is noteworthy given strong collaboration between U.S. companies and the U.A.E. in the healthcare vertical. Cross-border investment will indirectly support the hydrogen marketplace by building out the supply chain.

Looking Ahead to COP28

On the road to COP28, the U.A.E.'s adoption of its National Hydrogen Strategy signals its intention to be a leader in hydrogen technology and become a future hydrogen hub. At COP28 itself, the plan is to announce a doubling of global hydrogen production to 180 million tons a year by 2030. This plan is considered a "key area of focus" and demonstrates the degree to which hydrogen has rapidly become one of the solutions to decarbonization. Additionally, the COP28 platform calls for expanding hydrogen availability as key to maximizing its impact.

In addition to announcing the above policy aims, there will be programming that is designed to raise hydrogen awareness amongst global stakeholders. The buildup of hydrogen awareness will be key for the U.A.E. so that hydrogen can gain acceptance as an alternative fuel in a crowded renewables market. Progress also needs to be made on some of the core challenges of the hydrogen marketplace: building demand, scaling up production, bringing down costs, and developing new technologies. To that end, the Hydrogen Transition Summit will be convened to highlight the challenges facing hydrogen projects and the global hydrogen economy. The U.A.E. government also plans to release a white paper around COP28 that is based on the hydrogen dialogue session at the U.A.E. Climate Tech Forum.

At COP28, U.S. businesses can play a role through exploring the value of hydrogen and networking with key hydrogen stakeholders. The convergence of a COP that raises the profile of hydrogen and the U.A.E. National Hydrogen Strategy is an opportunity to jumpstart activity in this emerging sector. While production and end use for hydrogen remains technically challenging and currently expensive, the U.A.E. is well-poised to take advantage of its abundant natural resources and existing energy infrastructure to become a global hydrogen hub.

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