

06 September - 2023

# CEO Roundtable

Hydrogen  
Technology - From  
Strategy to Delivery



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# AGENDA



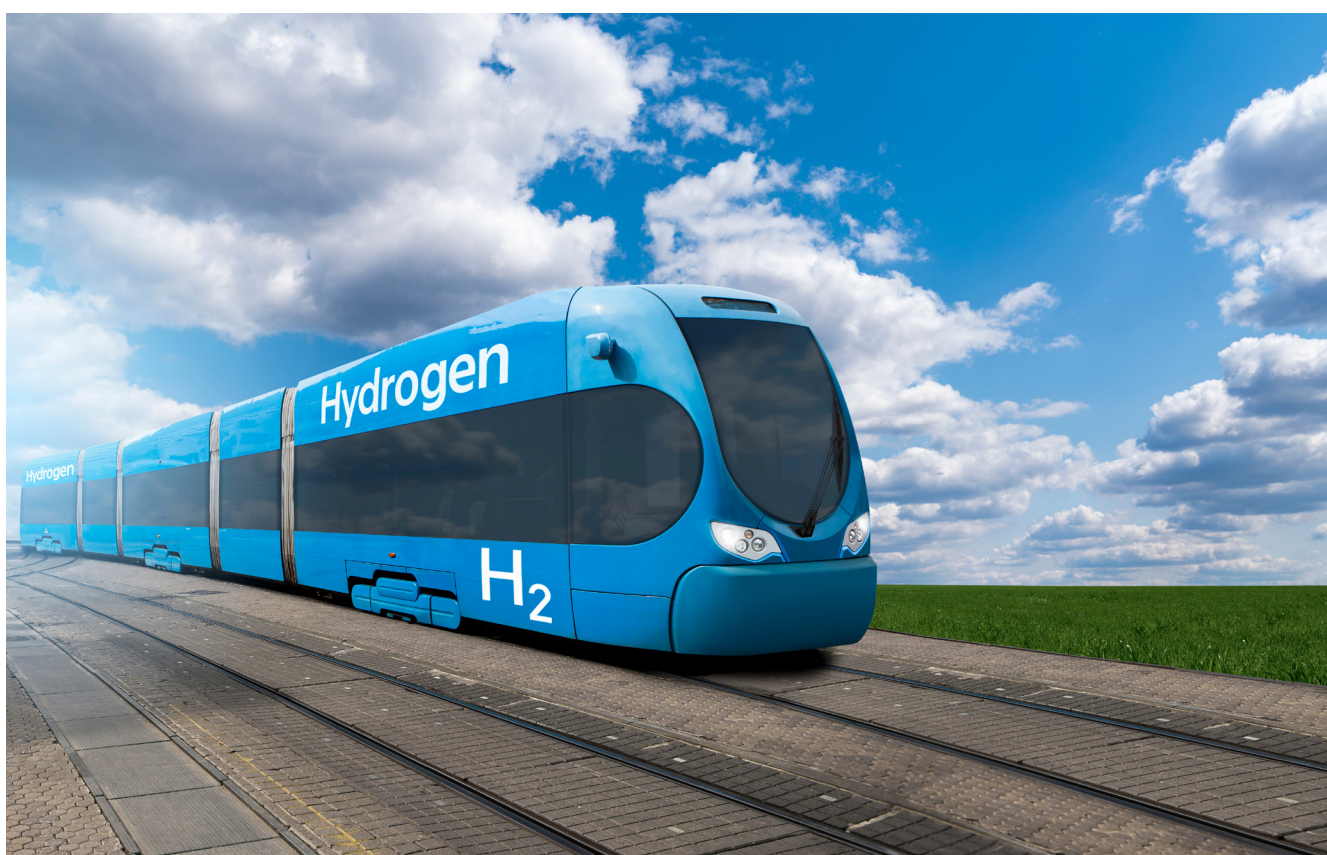
Wednesday, 6<sup>th</sup>  
September 2023

## CEO Roundtable Series

His Excellency Abdullah Bin Hamad Al-Attiyah, Chairman of the Al-Attiyah Foundation, launched the CEO Roundtable Series and Dialogues to provide a platform for knowledge exchange and support for the global community in the quest towards a sustainable energy future. All guests have the opportunity to share their opinions and insights in what is always a lively and thought-provoking discussion.

*\*The meeting takes place under the Chatham House Rule whereby participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.*

- 10:00 AM** Coffee and Networking
- 10:30 AM** Special Speakers
- 10:40 AM** Moderated Discussion
- 12:15 PM** Closing Comments
- 12:35 PM** Lunch





Hydrogen is the most abundant element in the universe and burns without emitting carbon dioxide. Due to these properties, many experts have claimed that it is the “wonder fuel” and could play a major role in the race to net-zero emission by mid-century. However, hydrogen production technologies are nascent, expensive to implement and require support from the public and private sectors for further implementation. At this CEO Roundtable, global experts, captains of industry and esteemed guests will examine the practical problems associated with using hydrogen as a fuel and the strategies that countries can adopt for the element to play its part in the transition to low fossil fuel, low emission economies.

The discussion will focus on hydrogen's “Energy Trilemma,” which is defined as the need to find balance between energy

reliability, affordability, and sustainability and its impact on everyday lives. The trilemma points are particularly pertinent as there are two distinct methods of producing hydrogen:

- 1). **By electrolysis of water** i.e., where water molecules are split into hydrogen and oxygen, capturing, and storing the hydrogen for use as fuel. This process was discovered by English chemist William Nicholson, (born 1753, London, England—died May 21, 1815). The problems of electrolysis are two-fold. The electricity must be “green” i.e., produced by a renewable source otherwise the use of hydrogen as a fuel is futile. The second problem is that hydrogen must be produced “at scale” to make an effective contribution to the energy transition. The vessel in which water is electrolysed is known as an electrolyser. Scaling-up electrolyzers is not easy or cheap. Production economies of scale may reduce the price of electrolyzers, but this is yet to be proven.

**2). By chemically separating a hydrocarbon**, usually methane, into its constituent parts namely hydrogen and carbon or a carbon containing compound using the steam-methane reforming process. In this process, high-temperature steam (700°C–1,000°C) is used to produce hydrogen from a methane source, such as natural gas. Methane reacts with steam under 3–25 bar pressure in the presence of a catalyst to produce hydrogen, carbon monoxide, and a relatively small amount of carbon dioxide. Steam reforming is endothermic - that is, heat must be supplied to the process for the reaction to proceed. Subsequently, in what is called the "water-gas shift reaction", the carbon monoxide and steam are reacted using a catalyst to produce carbon dioxide and more hydrogen. In a final process step called "pressure-swing adsorption", carbon dioxide and other impurities are removed from the gas stream, leaving essentially pure hydrogen. Steam reforming can also be used to produce hydrogen from other fuels, such as ethanol, propane, or even gasoline.

The problem for every molecule of hydrogen produced, one of carbon dioxide is also produced:

Steam-methane reforming reaction



Water-gas shift reaction



Consequently, to make the hydrogen "blue", Carbon Capture, Utilisation and Storage (CCUS) is required.

This extra stage of hydrogen production adds to production costs.

Hydrogen as a source of fuel has a few significant questions to answer, as per the "Energy Trilemma".

For sustainability then the questions of "blue" or "green" come to the fore. Battery technology may become important as a storage medium to use "off peak" electricity in the same way as pumped storage hydropower is used. Indeed, all energy storage developments may become a rival to hydrogen.



## EVENT OUTLINE

Due to global events over the past couple of years, energy security is a recent trilemma concern. Here hydrogen appears to have an advantage. Though it must be pointed out that cargoes of all types out of the Middle East have hardly been disrupted since the end of World War II.

Affordability is another key issue. Both routes to hydrogen are expensive when delivered to export customers. Of course, grey hydrogen is produced extensively for use in refineries worldwide, so a part of the affordability problem is already solved. The use of hydrogen boils down to affordable exports or by close production in hubs that utilise suitable (green/blue) electricity.

Another key question is where can hydrogen be used at scale and if so, how can a market price be established? If hydrogen is to be used at scale, then there are two markets that must be tackled, including:

- 1). Main markets for natural gas i.e., electricity generation and space heating. In these markets technological developments are looking at the possibility of blending hydrogen into existing natural gas usage. Here the market size is such that even relatively small blends would establish a market for hydrogen.
- 2). There are some hard to decarbonise industrial processes where coal is used to generate high temperatures. Examples are iron and steel making and the production of cement. These again are large markets and technology solutions are being researched.

## OVERALL OBJECTIVES

- To obtain expert views on the strategies that could be used to make hydrogen into a significant transition fuel.
- To discuss what will determine the price tracks of the two significant routes to produce hydrogen.
- To consider what may affect prices of hydrogen by either route to hydrogen.
- To discuss hydrogen in the context of the "fuel trilemma".
- To discuss the industrial uses of hydrogen particularly in hard to decarbonise industries.

Guests may also speculate on whether Qatar can become a significant exporter of hydrogen or its "blue" derivatives.



## DISCUSSION POINTS

- 1). Can hydrogen be considered a sustainable fuel in its "green form"? Will there be sufficient green electricity (from solar, wind, hydro and arguably nuclear power) available to produce it or will all the "green electricity" be used for other purposes?
- 2). Can hydrogen be considered a sustainable fuel in its "blue form"? Will there ever be sufficient CCUS available to produce "blue hydrogen"?
- 3). Is there currently a price disparity between grey (untreated) hydrogen and blue or green hydrogen in the global markets? Is such a difference bound to emerge as the hydrogen market continues to develop?
- 4). What will set a possible differential, the price of carbon or the price of offsets?
- 5). Can the cost of electrolyzers fall significantly so that "blue" hydrogen is not economically viable?
- 6). Alternatively, can the cost of CCUS fall significantly so that "green" hydrogen is not economically viable?
- 7). How much is the issue of security of supply driving the argument for "home grown" energy including hydrogen?
- 8). Can hydrogen be exported over significant distances in its own form or by using ammonia or methanol?
- 9). If hydrogen cannot be exported, where does that leave the economies of fossil fuel rich economies?

## MODERATOR & SPEAKERS

### Moderator:



Nawied Jabarkhyl,  
Broadcaster and Director  
– Head of International  
Media Relations at APCO  
Worldwide

### Speaker



David Hart,  
Partner, ERM:  
Environmental Resources  
Management

### Speaker



Martin O'Neill,  
Vice President, GE Vernova/  
GE Power

### Speaker



Joe Seifert,  
CEO, Vertex Hydrogen  
Limited

### Speaker



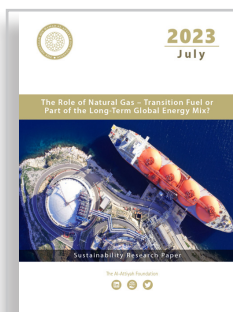
Mohammad T. Al-Suwaidan,  
Chief Middle East and  
Africa Analyst, ESAI Energy





## FURTHER BACKGROUND READING AND VIDEO MATERIALS

### SUSTAINABILITY RESEARCH PAPER



July – 2023

#### The Role of Natural Gas – Transition Fuel or Part of the Long-Term Global Energy Mix?

Natural gas has seen a rapid expansion since the 1970s as it has many attractive characteristics, including a low direct greenhouse gas emissions intensity. Many analysts have therefore seen it as a key "bridge fuel" to cushion the energy transition from coal and oil to renewables over the next decades.



(QRCO.DE)



May – 2023

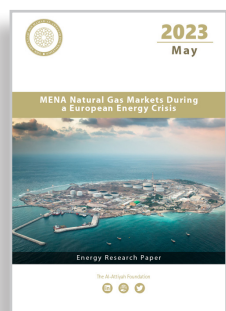
#### Green Hydrogen Opportunities for the Gulf Region

Green hydrogen can help decarbonise hard-to-abate sectors like refinery, steel and heavy duty transport and the chemical industry. The Gulf region is well positioned to establish itself as a hydrogen hub as it has cheap and abundant renewable energy resources and is located in the vicinity of major hydrogen consumption centres like Europe and Asia.



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### ENERGY RESEARCH PAPER



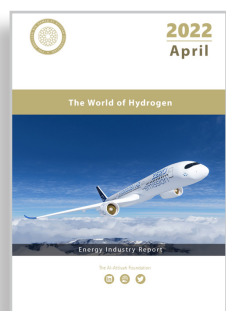
May – 2023

#### MENA Natural Gas Markets During a European Energy Crisis

The Middle East and North Africa (MENA) region has always been a strategic cornerstone of the European energy mix, but now it has gained newfound value for the continent as it adapts rapidly to a "Russia-less" energy world. In the shortterm, these MENA countries are set to be instrumental to European energy security.



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April – 2022

#### The World of Hydrogen

Hydrogen has emerged as an important fuel and energy carrier in the global race to tackle climate change and to reach net-zero emissions by mid-century. Global regulatory policies, technological developments, affordability, and scalability are converging to create an unprecedented drive for the expansion of the low carbon hydrogen economy.



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## ABOUT THE FOUNDATION

The Abdullah bin Hamad Al-Attiyah International Foundation for Energy and Sustainable Development is a non-profit think tank inaugurated by His Highness the Father Emir, Sheikh Hamad Bin Khalifa Al Thani, in 2015. The Foundation works closely with its members, academia, and a wide network of international experts, to provide independent insights, in-depth-research and informed debate on critical energy and sustainable development topics.

**Mission:** To provide robust and practical knowledge and insights on global energy and sustainable development topics and communicate these for the benefit of the Foundation's members and the community.

**Vision:** To be an internationally respected independent think tank that is a thought leader focused on global energy and sustainable development topics.

### Research Reports & Publications

- Daily News Flash
- Weekly Energy Market Review
- Monthly Energy Research Paper
- Monthly Sustainability Research Paper
- Monthly News Articles
- Special Industry Reports
- Webinar Whitepapers
- CEO Roundtable Whitepapers
- Annual Sustainable Development Book




### Podcasts, Webinars & Videos

- Bi-monthly Podcast Interviews
- Monthly Energy Educational Video
- Monthly Sustainability Educational Video
- Monthly Webinars
- Annual High-Profile Webinar

### Events & Activities

- The Al-Attiyah International Energy Awards
- Quarterly Energy Dialogues
- Qatar Sustainability Week
- The ICP Bosphorus Summit

### Connect With Us Online:

-  [www.abhafoundation.org](http://www.abhafoundation.org)
-  The Al-Attiyah Foundation
-  AIAAttiyahFndn



## OUR PARTNERS

The Al-Attiyah Foundation collaborates with its partners on various projects and research within the themes of energy and sustainable development.





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