Opportunities and Challenges in The Energy Industry: Hydrogen

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The Abdullah Bin Hamad Al-Attiyah International Foundation for
Energy & Sustainable Development

INTRODUCTION

OPPORTUNITIES AND CHALLENGES IN THE ENERGY INDUSTRY: HYDROGEN

The Abdullah bin Hamad Al-Attiyah Foundation for Energy and Sustainable Development provides robust and practical knowledge and insights on global energy and sustainable development topics and communicates these for the benefit of the Foundation's members and community.

In 2020, the Foundation hosted a webinar series, in partnership with Refinitiv, to explore key trends and insights as the coronavirus pandemic continues to impact the energy industry and highlight the need to transition to renewable energy. The most recent webinar in the series explored the prospects for hydrogen to become a key component of the global energy mix.

Webinar Series

H.E. Abdullah Bin Hamad Al-Attiyah founded the Webinar Series as a platform for knowledge exchange and support for the global community in the quest towards a sustainable energy future. The quarterly events, which have been hosted in Qatar for three years, are a crucial networking and learning opportunity in the calendar of industry CEOs.

Worldwide, around 70 million tonnes of hydrogen are produced annually for various uses including ammonia and methanol production, power generation, transportation, and food processing. About 95% of this hydrogen is 'brown' hydrogen, made from methane via steam reforming, which produces carbon dioxide as a by-product.

Therefore, if hydrogen is to become a substitute fuel, we must switch to so-called 'green' hydrogen, which is made via electrolysis powered by renewable energy. Currently, green hydrogen is around three times more expensive than brown hydrogen; reducing these costs, and being able to manufacture hydrogen at an industrial scale, remain key challenges that must be overcome.

- At present, green hydrogen cannot compete price-wise with other forms of hydrogen or fossil fuels, so carbon taxes and subsidies are needed to support fledgling industry.
- Tumbling renewable electricity costs and renewables' growing share of the energy mix make hydrogen viable in the long term.
- Hydrogen is currently better suited to industrial applications than as a transport fuel.

Policymakers will play a pivotal role in our transition to a hydrogen economy by providing incentives and subsidies to create demand, and enable the environmentally friendly gas to compete with other energy sources.

"Hydrogen fits into every part of the energy system," said Prof. David Hart, a director at sustainable energy consultancy E4Tech and a visiting professor at Imperial College London's Centre for Environmental Policy.

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The professor stated, "We need to identify large-scale opportunities where we can bring costs down by putting in place significant industrial production and industrial end-use, and we need to identify small-scale opportunities, which start to put hydrogen technology into place in communities in areas where the economics work well. Those are often in remote communities, island communities where you may be paying [a lot] already for your energy."

Currently, in terms of policy, the European Union is proving to be a pioneer, incorporating hydrogen into The European Green Deal, which details how the EU will become climate neutral by 2050.

"There are ways of creating demand, which are partly about CO_2 emissions reduction, extra [carbon] credits, and air quality," said Prof. Hart. He continued by saying, "We're seeing zero-emissions zones being introduced into cities—if you're not allowed to drive a bus unless it's zero-emissions you only have a choice between

Filip Smeets, senior vice president of Nel Hydrogen's Nel Electrolyser division

batteries or hydrogen—you've already created a market even if the cost is a little bit higher in the near term."

The Covid-19 pandemic could accelerate the development of green hydrogen, which features in the economic recovery plans of many countries or regions. "It's important that policymakers really focus on why we're in this game—it's not to create an export for their own incumbent technology providers but to reduce emissions," stressed Filip Smeets, senior vice president of Nel Hydrogen's Nel Electrolyser division.

Over the past decade, wind and solar electricity production costs have tumbled to below that of gas and coal. Solar, in particular, fell from around $350 per megawatt-hour in 2009 to about $40 in 2019.

Yet, storing the excess electricity produced by intermittent renewables remains a problem, with batteries currently inadequate. Using this power to split water into hydrogen and oxygen through electrolysis is seen as a potential long-term solution, especially as renewables take a larger share of the energy mix. When burned, hydrogen produces only water, while it has a large energy content per unit mass.

In May, Spanish refiner Repsol announced a pilot green hydrogen plant. If expanded into a commercial-scale enterprise, it will produce 500,000 tonnes of hydrogen-based synthetic fuels annually. In terms of total costs for the Bilbao project, electrolysis materials will account for 18%, electricity 77%, and operation and maintenance 5%. Other green hydrogen projects report similar cost percentages.

"Policymakers will have to address that because 70-80% of your electricity bill is taxes and fees and that is killing the business case," Mr. Smeets highlighted, adding that "policymakers will have to grant full or partial waiving of those taxes [on electricity used to make] hydrogen; otherwise, it will be very difficult for business cases to emerge."

Yeo Yu Kin, senior vice president for Asia and the Middle East at Singapore's Argus Consulting Services.

The cost to make and transport green hydrogen through a seaborne market is around $6-8 per kilo, according to Argus Consulting Services estimates. That translates into $45-65 per MBtu, which is significantly pricier than natural gas production costs.

"In time, that may reduce but only if there's a rapidly developing market that allows [better] technologies and/or certain types of transportation routes to achieve economies of scale and therefore bring down the cost," asserted Yeo Yu Kin, senior vice president for Asia and the Middle East at Singapore's Argus Consulting Services.

Hydrogen is at a similar stage of development as liquefied natural gas was 50 years ago. Transportation remains technically challenging and prohibitively expensive, so in the near term, hydrogen will probably be made and consumed locally, said Mr. Yeo. Solar and wind technologies no longer require subsidies. Hydrogen will take time to reach the same point.

Mr. Yeo followed on by stating that "production and usage of hydrogen locally

can probably happen first and can probably cross the threshold earlier. Transportation [of hydrogen] will require longer."

Industrial applications offer "the biggest bang for your buck," Mr. Smeets emphasised, noting the large costs involved in building out the necessary infrastructure to make hydrogen vehicle fuel widely available.

"The cost of an electrolyser can be very low if you order enough of them," Prof. Hart further added. The professor went on to explain, "There's no intrinsic problem with cost, it's really just about making sure you have an agreement in place for industrial offtake. Then people will be very happy to build gigawatts of renewable hydrogen facilities."

The initial offtake agreements will likely be to manufacture ammonia, added Prof. Hart. "Putting it into ammonia gives you an immediate and relatively cost-effective way of transporting it," the professor elaborated.

Another option is to create a hydrogen and natural gas mix that is 95% gas and 5% hydrogen. This mix is burned as normal and transported via gas pipelines. "It doesn't have any negative impact on the pipeline and would use a lot of hydrogen, so gives you demand creation," said Prof. Hart, adding that "it's not a high-value use, but it is important."

While green hydrogen is made via renewables, 'blue' hydrogen uses electricity either generated by nuclear power stations or fossil fuel plants that employ carbon capture and storage. Brown hydrogen is made through steam reforming. There is some debate in the industry about whether to use cheaper-to-make blue and brown hydrogen to develop the hydrogen market faster or to solely focus on green hydrogen.

WEBINAR SPEAKERS:

Moderator:

Eithne Treanor, managing director of ETreanor Media.

Speaker:

David Hart, director at E4Tech and visiting professor at Imperial College London.

Speaker:

Filip Smeets, senior vice president of Nel Hydrogen's Nel Electrolyser division.

Speaker:

Yeo Yu Kin, senior vice president for Asia and the Middle East at Singapore's Argus Consulting Services.

"Anything that can reduce carbon is probably worth investing in the near term. In the long term, go green," advocated Prof. Hart.

The webinar audience was asked to contribute their views through polling and was divided over which aspects of the hydrogen economy governments should prioritise. An online poll found 28% advocated a focus on hydrogen production, 27% said transport, 25% touted industrial processes, and 20% argued for energy storage.

The webinar audience did, however, seem in broad agreement with Prof. Hart, as 54% said investments should be solely into green hydrogen in an online poll. Blue hydrogen attracted 18% of votes and brown hydrogen 6%, while 22% of participants said investing in all three types would be best.

The lower-for-longer oil era, which has made crude-based products more competitive, will not slow the switch to renewables, Mr. Smeets projected.

"We've started with wind, solar, and hydropower; now we need to convert and store green power with battery technologies and hydrogen so that we have a form of energy that we can use in large-scale industries and transportation," Mr. Smeets further said. Following on, Mr. Smeets said, "The driver will be to cut CO_2 emission reductions and [implement] CO_2 taxes. We're not there yet, but you can see policymakers converging to that same conclusion."

At present, Japan has been a leader in hydrogen for the past three decades, but other countries such as South Korea are catching up.

"The driver in Japan and South Korea is partly about industry building so [creating] competitiveness in fuel cells and hydrogen production. It's also partly about energy independence. They import an enormous amount of energy and they're looking to diversify their supply sources," explained Prof. Hart.

In July, Saudi Arabia announced it would build a $5 billion green hydrogen plant, which would be the world's largest. Other Gulf countries are also interested in using solar power to manufacture hydrogen for export as part of their post-oil economies.

Humanity is probably still at least a decade away from hydrogen becoming widely used in energy storage, while hydrogen-powered vehicles remain in their infancy. Yet hydrogen will eventually replace hydrocarbons—a transition we must accelerate towards in order to cut CO_2 emissions, which have more than doubled since 1970 and threaten the survival of life on earth.

"Renewable hydrogen technology is the bridge between renewable power and renewable fuel and renewable chemicals," ended Mr. Smeets, noting "there's no way around it; it will happen."

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Currently, the Foundation has over 15 corporate members from Qatar's energy, insurance, and banking industries as well as several partnership agreements with business and academia.

Our partners collaborate with us on various projects and research within the themes of energy and sustainable development.

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