Hydrogen: A Fuelture in the Making

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A stroll along the promenade of Iceland's capital Reykjavík belies the seismic changes occurring underfoot. A nation physically aloof yet sustainability extolled, Iceland is a part of a growing consortium of eager decarbonisers and financiers peaking over the wall on a global renewable hydrogen economy. Currently confined to conceptual net-zero pledges, the energy source is hailed to hold the potential of a silver buckshot for decarbonizing hard to abate polluting sectors such as steel production, transportation fuels, and renewable storage. Ultimately, hydrogen will only emerge as a key driver of decarbonization if international collaboration combines with private initiative across a diverse set of industries.

First, what is hydrogen? Though hydrogen is one of the simplest and most abundant elements on Earth; it is not naturally chemically isolated. Therefore, hydrogen must be produced through a multitude of techniques that range from low cost and polluting to financially prohibitive and sustainable. Currently, hydrogen can be produced through natural gas utilization due to its historical lower costs. As the main energy source utilizes fossil fuels, the end product is referred to as grey hydrogen. An alternative method, electrolysis, converts renewable energy and water into green hydrogen, which seeks to displace grey hydrogen in the near term future.

Second, why is hydrogen important? Unbeknownst to many, hydrogen production is already a critical component of modern society. In fact, almost 90 million metric tons were produced in 2020, churning an estimated $130 billion global market.[1] Proffered mainly as an industrial feedstock for the production of fertilizers and petroleum refining, one would be remiss to think that hydrogen does not already have a substantial market size. As hydrogen is also a fundamental building block of nature, there exists a host of other possible technology avenues ranging from building heating (replacing natural gas), industry applications (replacing coal in steel making), transportation (aviation, trucking, maritime fuels), and power generation (serving as a backup power source to renewables). Due to this blossoming potential, Iceland and many others see it as a fulcrum of decarbonization.

So how does Iceland, a country devoid of arable land and petroleum refining, seek to drive forward a future built around hydrogen? Hint: one of the biggest costs in hydrogen production is the energy used to make it. Therefore, the plan holistically is quite simple. Landsvirkjun, the National Power Company of Iceland and the Port of Rotterdam, seek to deliver low-cost green hydrogen powered by geothermal and hydro power to mainland Europe in a bid to appease an ever growing list of consumers.[2]

Once the fuel reaches Europe, the focus now shifts to the private and public sectors seeking to lower transportation and utilization costs in daily operations. For example, take the recent announcement of the world's first green steel produced in Sweden. With a working relationship forged in the blast furnaces and green hydrogen replacing fossil fuel, private steel maker SSAB joined arms with government owned mining and energy companies to deliver the first carbon neutral steel to the Volvo group.[3]

The collaboration is a critical step to reduce the global steel industry's seven percent of annual global greenhouse gas emissions[4] to zero, while signifying that cross-industry and country connections catalyze green hydrogen development. Aspiring hydrogen hubs will do well to emulate the public initiative Sweden has shown through funding industry research while cementing private relationships such as in this case of Volvo paying a premium for the world's first green steel. The question emerges then: how would imported green fuel move through an interlocked hydrogen economy once unloaded?

Due to the molecular size of hydrogen, physical infrastructure straddling international boundaries must be implemented in order to geographically flatten financial disparities. SNAM, the world's largest natural gas infrastructure operator, headquartered in Italy yet cross-national, seeks to chisel their role into a decarbonized future through providing hydrogen mobility. By 2050, SNAM expects to transport entirely decarbonised gas,[5] including both hydrogen and biomethane, across Europe. This would provide partners like Iceland immense financial benefits by lowering transport costs to the end consumer ultimately boosting demand and production. At this stage, climate hawks rightfully admonish the news of maintaining the largest natural gas operator in a decarbonized future. This precarious paradox of requiring some of the largest current polluters to be active in the shift towards a sustainable future echoes throughout the discussion on blue hydrogen, a possible competitor to green fuel.

Blue hydrogen serves as the middle ground between grey and green, where fossil fuels are used in the production of hydrogen with carbon capture utilization and sequestration (CCUS) to produce a compromise between current day production and moonshot efforts. Equinor, the flagship producer of oil and gas in Norway, seeks to launch a multi-billion dollar blue hydrogen push with proven technologies. This ardent support has led to a joint effort in the North of England which sets out to convert 3.7 million homes and 40,000 businesses to emission-free hydrogen (which could be produced locally or imported) by 2034.[6] This is a massive undertaking to financially remain an integral part of society, while stimulating possible green hydrogen imports from Iceland and abroad.

The implementation of green hydrogen at the prior mentioned scales are quickly being accepted at the highest levels with minimal daily life changes. Due to the fuel being a molecule and the world's already strong dependence on hydrocarbons, hydrogen is being envisioned as a replacement and not necessarily a fundamental change. Therefore, citizens of countries will still be able to drive private cars, take international trips, and heat their homes, yet the climate impact will be significantly reduced. In fact, an integrated European green hydrogen economy has the potential to generate 5.4 million new jobs across the value chain by 2050,[7] while utilizing previous fossil fuel workers to uphold the just transition. However, due to hydrogen following a similar supply chain to hydrocarbons, socio-political weaknesses such as foreign fuel dependence are still prevalent and necesitate steadfast international collaboration.

The quickening metamorphosis of at first glance disparate projects in Europe provides only a tantalizing appetizer of the future; yet, they all touch on critical aspects in the pursuit of an ingrained hydrogen future. Mainly, country collaboration must be rigorously upheld across private partnerships to accelerate the movement and consumption of hydrogen, as evident in the world's first green steel. Simultaneously, a critical debate must occur on the role that fossil fuel producers play in the transition period for hydrogen. It is detrimental to humanity and the world to not acknowledge the social and environmental justice issues surrounding current fossil fuel production and therefore possible continued aggravations. There is no doubt that the burgeoning fuel can ignite systematic sustainable change. However, a future of technological brilliance bubbling in the fumaroles of Iceland can only shine through a backdrop of political, private, and social certainty.

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[1] *"Global Hydrogen Review 2021 – Analysis - IEA Paris." https://www.iea.org/reports/global-hydrogen-review-2021.*

[2] *"Study on shipping green hydrogen from Iceland to Rotterdam " 14 Jun. 2021, https://www.landsvirkjun.com/news/study-shows-shipping-green-hydrogen-from-iceland-to.*

[3] *"Volvo Group launches world's first vehicle using fossil-free steel." 13 Oct. 2021, https://www.volvogroup.com/en/news-and-media/news/2021/oct/news-4088346.html.*

[4] *"Iron and Steel Technology Roadmap – Analysis - IEA." 21 Oct. 2020, https://www.iea.org/reports/iron-and-steel-technology-roadmap.*

[5] *"Snam and hydrogen." 9 Jul. 2021, https://www.snam.it/en/energy_transition/hydrogen/snam_and_hydrogen/.*

[6] *"Hydrogen - a key contributor to the energy transition - equinor.com." https://www.equinor.com/en/what-we-do/hydrogen.html.*

[7] *"Hydrogen Roadmap Europe." Hydrogen Roadmap Europe: A sustainable pathway for the European Energy Transition | www.fch.europa.eu.*