9th September 2020

BRIEFING FOR POLICYMAKERS: GREEN HYDROGEN AS FISCAL STIMULUS

Brian O'Callaghan and David Tritsch | Produced by the Oxford University Economic Recovery Project, Smith School of Enterprise and the Environment

1. Summary

COVID-19 economic recovery spending has brought an unprecedented acceleration in support for green hydrogen. Asymmetric investment will allow early movers to shape the future competitive dynamics of global hydrogen technologies and trade. Nations with strong natural resource endowments who fail to invest now risk losing a degree of potential long-term global market power, and with it, future jobs, and growth.

Green hydrogen is a burnable gas produced using two major inputs: water and renewable electricity. As a store for renewable energy, green hydrogen could enable the decarbonisation of energy supply, as well as several hard to abate sectors (e.g. aviation, shipping), possibly through ammonia and/or synthetic electro-fuels.

Without a path to affordable green hydrogen there is currently no viable way of decarbonising a large portion of the global economy. Fortunately, cheaper renewables and lower electrolysis CAPEX have substantially decreased green hydrogen production costs. These trends are likely to continue, with the rate of cost fall directly influenced by global investment spending.

2. What are the potential markets for green hydrogen?

Hydrogen is an established feedstock used in the production of organic and inorganic chemicals such as ammonia and methanol. Currently, 90% of global hydrogen is used in feedstock applications. More recently, energy-based hydrogen applications have received increasing attention from economies aiming to decarbonise (Figure 1).

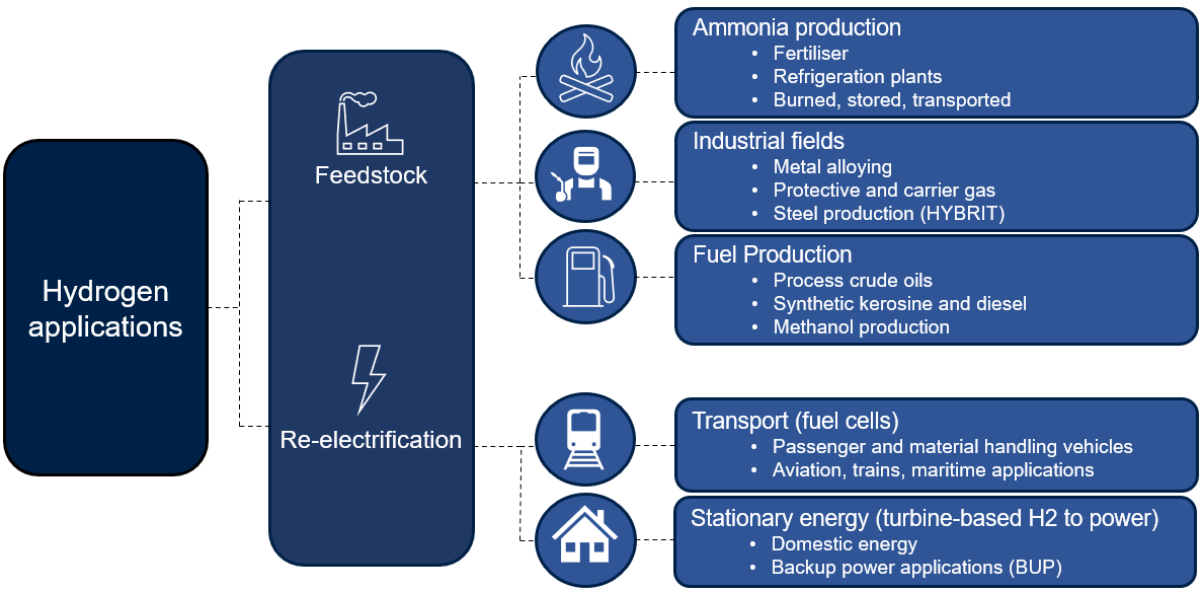

Figure 1. Potential applications of green hydrogen.

Beyond direct energy applications, green hydrogen is considered a leading approach for carbon abatement in hard to electrify industries, such as high-temperature industrial processes and heavy transport. Furthermore, efficient green hydrogen production could unlock economic production of comparatively higher-density ammonia, which in many contexts shows even greater promise as a tool for decarbonising hard to abate sectors.

3. What has changed in green hydrogen in 2020?

In the wake of COVID-19, nations are using recovery stimulus spending to reinvigorate their economies. For governments targeting long-term prosperity, green hydrogen investment has been a central component of fiscal spending. So far, Germany has committed USD10.7bn (by 2030), France USD2.4bn (by 2022), and Korea USD0.5bn (by 2021). The EU has finalised a hydrogen strategy that expects investments of between USD3bn to USD18bn.

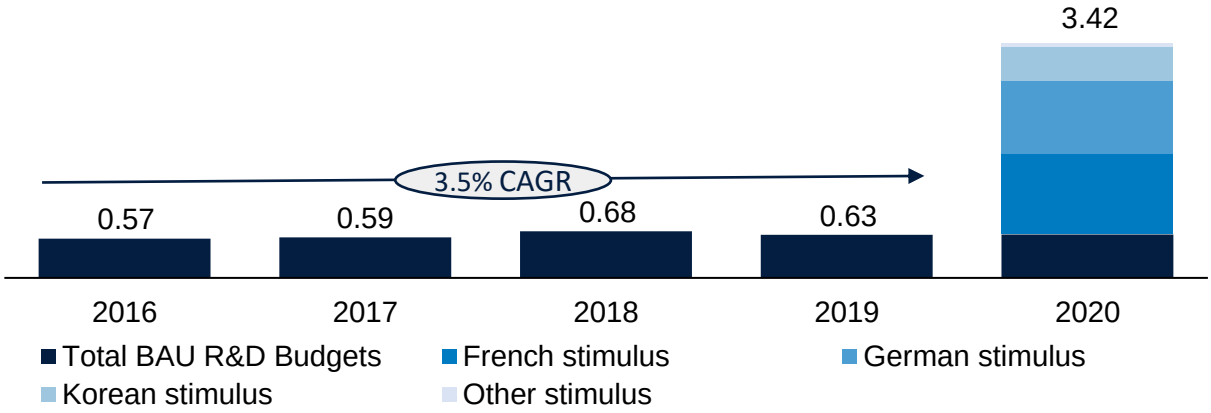

Figure 2: Global public hydrogen R&D spending (USD, billions). Source: IEA, original tracking.

An uptick in public R&D spending has been accompanied by a considerable acceleration in private sector interest. For instance:

- In July, an USD5bn integrated green hydrogen-ammonia plant was announced for Neom, Saudi Arabia (60 times the capacity of the next largest biomass-based plant in operation, and 20,000 times the capacity of the next largest green ammonia plant).
- In August, a USD35m German government cash injection was announced alongside USD69m in private sector investment for a 700MW electrolyser (35 times larger than any in operation today). According to the IEA, 2050 hydrogen demand will require over 3500 electrolysers of this size – one every 3 days.
- Spanish renewable energy player Iberdrola and fertiliser major Fertiberia will spend USD176m to build a solar PV plant, a lithium-ion battery storage system and a 20MW electrolyser to produce green hydrogen (operation beginning in 2021).
- The Australian Renewable Energy Agency's most recent April funding round attracted hydrogen grant requests of over USD730m, fourteen times the available USD51m.

4. What has made green hydrogen attractive for public and private investment?

Three trends have together precipitated a sudden uptick in hydrogen interest:

i. A drastic fall in hydrogen production costs. The cost of green hydrogen production is projected to fall ~60% over the coming decade. This cost reduction is likely to be driven by a) falling costs of electrolysis and b) falling costs of renewable energy generation.

Firstly, on hydrogen production costs, over the 15-year period 2003-2018, power to gas electrolysis costs dropped approximately 40% for alkaline water electrolysis (AEL) and 50% for proton-exchange membrane fuel cells (PEM). Following in the path of solar PV, hydrogen production costs are expected to continue dropping rapidly over the coming decade, driven mostly by scale effects and incremental technological developments.

On renewable energy generation, solar and on-shore wind costs have dropped 80% and 40% since 2010. In many parts of the world, newly installed renewable energy capacity is already cheaper than all fossil fuel alternatives. Cheaper renewables enable economically rational scaling of electrolyser manufacturing and act as a stimulant for the development of lower-cost hydrogen storage facilities.

According to the IEA, global operational electrolysis capacity in 2025 is likely to be over 55x that of 2015. In 2020 alone, capacity additions are up 500% compared to 2019 and 1000% compared to 2018.

ii. Hydrogen considered as an enabler. Driven by falling costs, policymakers have begun considering green hydrogen production as an enabling technology to a raft of new decarbonisation initiatives. In this way, green hydrogen is no longer considered a single-application technology, but rather a broad enabler. Green hydrogen is seen as a contender in applications as diverse as fertiliser production, aviation, road transport, and shipping (see Section 2). It is unclear in which of these industries green hydrogen will come out on top, however given the number of potential large-market applications, it seems certain that it will have a future. Under this revised interpretation, the risk-return profile of government green hydrogen investment is significantly enhanced.

iii. Economies requiring strong stimulus. In the wake of COVID-19, nations are investing heavily in recovery stimulus packages – more than USD3tn globally (out of USD9tn total government spending) – to reinvigorate their economies. This investment is necessary and comes in the wake of the most severe global economic downturn in living memory.

Green hydrogen investment, whether in the form of infrastructure capital or R&D support, presents significantly positive economic recovery characteristics (see Section 5). If appropriately marketed to private investors, these investments also crowd-in significant private capital. In the long-term, the economic returns of this spending could be transformational. Competitive green hydrogen production and application systems require substantial initial capital investment to scale.[1] Green hydrogen R&D is similarly in need of substantial capital to drive down the cost-curve. In this way, higher public stimulus spending on green hydrogen topics today will likely boost the future competitiveness of future green hydrogen industries.

5. Does hydrogen stimulus make sense?

Green hydrogen fiscal investment can bring both strong positive economic impacts and strong positive climate impacts. The degree of impact depends, in large part, on the form of investment – R&D, infrastructure stimulus, or short-term provision of liquidity to existing green hydrogen corporations (Figure 3). Each of these investments also vary in their speed of

[1] It is estimated that a USD70bn investment is required by 2030 to scale up existing hydrogen technologies and deliver competitive alternatives to conventional fuels in hard to abate sectors like intensive transport, freight logistics, and industrial heating.

capturing economic benefit (comparatively fast for liquidity support, slow for R&D), however this is not to state that one type should be pursued at the exclusion of another. A well-formed economic recovery package should ensure a continuous multi-year economic growth profile, and in this way feature a mixture of slow-impact, and rapid-impact policies.

A 2019 University College London Report found that the long-run economic supermultipliers of non-military R&D spending (which accounts for both multiplier and accelerator effects) can be over 3.6 times those garnered through government investment spending, and 6.9 times those achieved in consumption spending. In recessionary periods we may expect the deviance between multipliers to shrink, but according to the World Resources Institute, even in recession green R&D spending can deliver some of the highest long-run job creation benefits. A 2010 European Commission report supported this finding, stating that of all available climate policy options, front-loaded green R&D subsidies have the greatest potential for stimulating future economic growth following a short-term fall in GDP.

Green hydrogen growth, made possible by government investment, could also catalyse the economic competitiveness of other technologies. Plans for net zero carbon targets are unlikely to succeed unless countries reconfigure their energy systems. Hydrogen enables "sector coupling" between the electricity system and relevant industries. By facilitating energy storage and transport, hydrogen has the technical potential to shift large amounts of renewable power to sectors which would otherwise struggle to decarbonise.

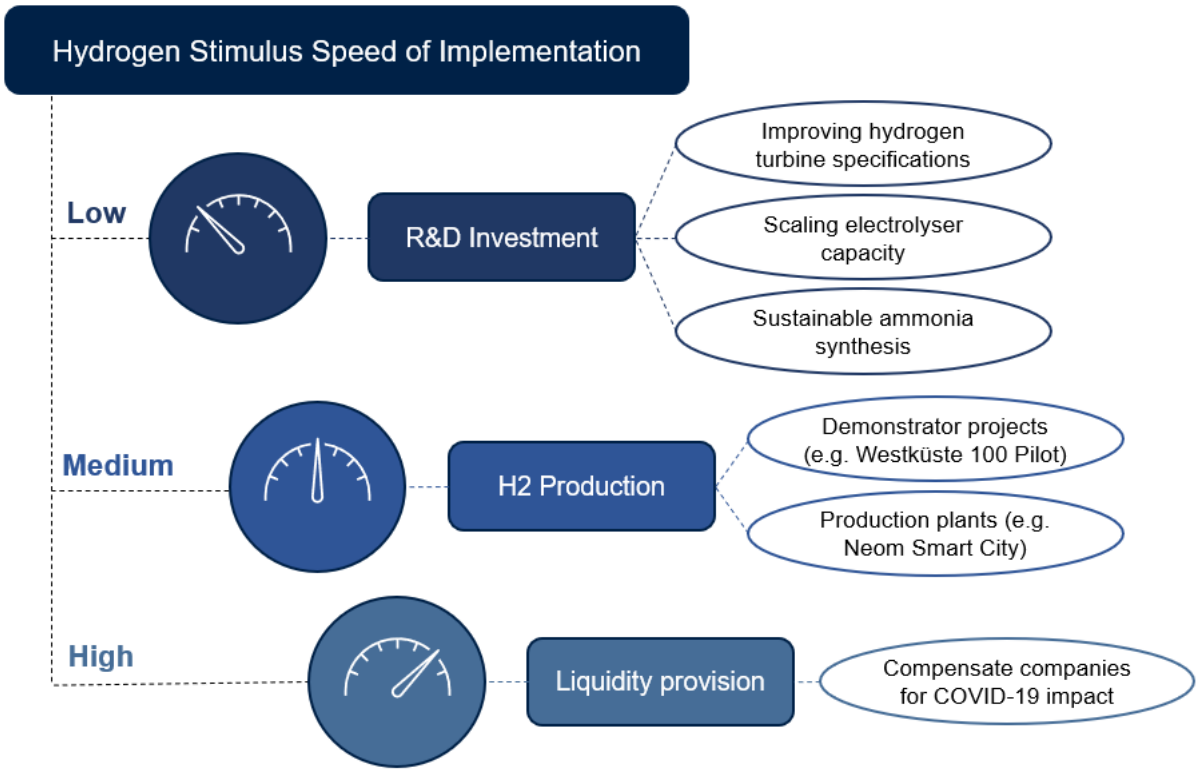

Figure 3. Hydrogen stimulus opportunities grouped by speed of implementation.

SUGGESTED CITATION

O'Callaghan, B. and Tritsch, D. 2020. Briefing for Policymakers: Green Hydrogen as Fiscal Stimulus. Smith School Briefing Paper 20-03.

ABOUT THE OXFORD UNIVERSITY ECONOMIC RECOVERY PROJECT

OUERP is the world's hub for developing and communicating long-term economic perspectives on recessionary fiscal spending. The project develops leading original research, as well as core advisory services to governments and multilaterals, businesses, and non-profit institutions. Core initiatives include tracking of global COVID-19 government recovery spending, assessment of spending effectiveness, and development of core perspectives on how to incorporate long-term economic, social, and environmental objectives into immediate stimulus action.

The project is generously supported by the Children's Investment Fund Foundation, ClimateWorks Foundation, Green Fiscal Policy Network, the International Monetary Fund, and University of Oxford Social Sciences Division.

ABOUT THE AUTHORS

Brian O'Callaghan is Lead Researcher and Project Manager of the Oxford University Economic Recovery Project. He is an Australian Rhodes Scholar and Consultant at the Robertson Foundation, covering topics in Energy and the Environment. He is also a consultant to government and business groups on issues relating to the energy and climate transitions.

Brian is on a leave of absence from Boston Consulting Group (BCG). Before BCG Brian was a Junior Fellow for the Australian Centre for Innovation and International Competitiveness. Brian holds degrees in Engineering (First Class Honours with the University Medal) and Commerce (Finance and International Business) from the University of Sydney. Contact: brian.ocallaghan@smithschool.ox.ac.uk

David Tritsch is a Research Assistant for the Smith School of Enterprise and the Environment. David's research interests are growth models and the economic impact of climate change. David is also a journalist and news editor for Cherwell, Oxford's independent student newspaper.