Decarbonised Gas Alliance: the role of hydrogen in powering industry:
Submission to the Hydrogen APPG inquiry, April 2021

1. The role of hydrogen in helping UK industry sectors reach net-zero

The hard-to-decarbonise sectors, including industry, can make extensive use of hydrogen to help reach net zero:

Industry – 76.5m tonnes of CO2 equivalent (17% of UK total emissions):[1]

- Hydrogen is needed to provide high-temperature heat for industrial processes and is vital where the process requires a flame to come into contact with the product being made, e.g. glass and ceramics. There is existing industrial hydrogen demand, although the hydrogen is not low-carbon.
- The first trial of hydrogen in the steelmaking process has just been completed in Sweden,[2] and a UK trial has been funded to evaluate the use of hydrogen in glass manufacture.[3]
- All of the UK's main industrial clusters, located in less affluent areas of the country, have ambitious decarbonisation plans that include hydrogen production and it's subsequent use in industries such as steel production.[4]

Hydrogen can help accommodate the growth of renewable **electricity**, with stranded wind and solar power being used to produce hydrogen, and then the hydrogen being used in a power station to produce electricity when wind and solar generation are low. Natural gas reforming could also play an important role in providing the hydrogen for reliable back-up power capacity.[5]

2. Hydrogen and associated infrastructure development can be a significant job creator

Hydrogen and associated infrastructure, including CCS and domestic conversion, can be a significant job creator:

- A recent report by the Offshore Wind Innovation Hub found that the transition to **green hydrogen** (100% H2 gas network) will result in an estimated investment level of between £4bn and £12bn per year over an extended period (up to 50 years) between 2040 and 2090.[6]
- The H21 North of England report showed that a widespread **domestic conversion of homes to hydrogen** would require over 3,000 gas engineers for a number of years, with additional management staff.[7]
- **Hydrogen and CCS development** for broad-based decarbonisation could create 43,000 jobs for industrial decarbonisation alone, 195,000 jobs if hydrogen plays a full role in economy-wide decarbonisation, 221,000 jobs if the UK also becomes a major hydrogen exporter.[8] A recent Summit Power report also found that developing a network of CCUS projects (needed for blue hydrogen) along the East Coast of the UK, capturing 75m tonnes of CO_2 per year, would provide £163bn of economic benefits and 225,000 jobs, cumulatively, through to 2060.[9]
- A recent report by the Hydrogen Taskforce found that, by 2035, **upstream hydrogen production** could deliver 28,500 jobs and £4.2bn of GVA, **midstream hydrogen transport** could deliver 15,500 jobs and £5.3bn of GVA, and **downstream hydrogen use** could deliver 30,500 jobs and £8.7bn of GVA.[10]

3. Hydrogen production, transmission, distribution and storage issues

All forms of low carbon hydrogen production are needed if we are to reach net zero. The Committee on Climate Change has suggested a need for up to 270 TWh of hydrogen in 2050[11] - by 2035, the FES scenarios[12] envisage 29-79 TWh of hydrogen supply:

- To produce this solely via **blue hydrogen** would require 4-11 GW of Auto Thermal Reforming (ATR) capacity (assuming a load factor of 85% to allow time for maintenance). It would also require 36-99 TWh of natural gas feedstock, assuming ATR efficiency of 80%, and 7-18mtonnes per annum of CO_2 capture and storage (given natural gas feedstock emissions of around 185 g/CO_2 per kWh and 95% CO_2 capture rates).[13]
- To produce this solely via **green hydrogen** would require 7-18 GW of electrolysers, if fed by dedicated offshore wind with a load factor of around 50%. The offshore wind capacity to feed the electrolysers would need to be 8-23 GW, assuming electrolyser efficiency of 80%.

Since the UK currently uses around 880 TWh of natural gas per annum,[14] the hydrogen production numbers shown above represent 3-9% of the UK's current natural gas demand and is therefore not enough. To make a substantial difference, we need hydrogen production at the GW scale. This will require a significant contribution from blue hydrogen since there will be increasing demand for renewable electricity from new e.g. transport applications.

Further improvements in production technologies are also needed. This will include (but is not limited to) more efficient and larger electrolysers; more advanced methods of reforming natural gas into hydrogen, with higher carbon capture rates; better fuel cell and micro-CHP technologies; lower-cost hydrogen boilers; larger gas-fired power

stations with carbon capture; and metering and measurement systems to allow the gas network to handle a much wider range of gases.

Britain's Hydrogen Network Plan sets out the steps that the gas networks are taking to repurpose our world-leading gas network infrastructure. If all operational UK salt caverns for natural gas storage are converted to 100% hydrogen, it would provide 3.7 TWh of storage (based on a third of the current energy storage capacity, given hydrogen's lower volumetric energy density). Repurposing the Rough storage facility could provide 12.6 TWh, and the cost of doing so could be offset against avoided decommissioning expenditure.[15] Although there is considerable industrial capacity dispersed around the country, the large industrial clusters are critical to achieving net zero in practice and will provide the basis for a wider rollout of hydrogen across the country.

4. How to achieve an economic and timely transition to hydrogen that retains and promotes UK industry

Funding mechanisms need to be in place. It is crucial that timely announcements on **hydrogen production business models** are made to ensure that industrial cluster and other projects for all forms of low carbon hydrogen and associated storage receive the investment needed. We support a variant on a CfD model as one viable option.

Business models for other parts of the hydrogen value chain (transport, storage, industrial equipment investment, domestic conversion) are needed, together with a full consideration of business models for negative emissions (given the importance of negative emissions to achieving net zero). This needs to be supplemented by policy support as outlined below.

These steps must ensure that UK industry can remain competitive in global markets and that decarbonisation is not achieved through offshoring of industry. This will allow the UK to remain a global industrial leader, enabling the export of skills and technology and a leading position in the provision of low-carbon industrial products.

5. Opportunities to accelerate hydrogen activity in the UK

The commitments on Hydrogen and Industrial Decarbonisation in the Ten Point Plan should be seen as minimum ambition. The UK can accelerate progress by developing multiple clusters and integrating that activity with the conversion of the first towns to hydrogen in the late 2020s and early 2030s, supported by the policy proposals below.

We have significant concerns that BEIS' proposed two-track approach to cluster development, will lead to stalling of credible projects, a loss of skills and expertise, will inhibit collaboration and knowledge sharing, and could the jeopardise UK Government's ambition of 1GW of Hydrogen Production by 2025, and 5 GW by 2030.We would prefer to see a commitment to a flexible and open process to cluster development throughout the 2020s, a willingness to engage with all credible clusters on a timeline that is optimal for development of each cluster

6. Policies required to unlock the UK hydrogen economy

1. A robust **carbon pricing** mechanism that will transparently increase over time to encourage early decarbonisation of industry.
2. **Demand-side policies** to encourage uptake of low-carbon industrial products including mandates, product standards and public procurement mechanisms that create a favourable environment for procurement of these products, recognising that on a purely economic basis, low-carbon products may not be the cheapest option.
3. **Carbon Contracts for Difference (CCfD)** could help to provide a sufficiently reliable, "investible" carbon price to underpin the business case for commercial scale industrial deep decarbonisation deployment. [19]
4. We need **Contracts for Difference (CfDs)** for hydrogen and carbon capture. The successful investment and cost-reduction framework for renewable electricity, which was started nearly two decades ago, should be extended to decarbonised gas. This includes decarbonised gas used for power generation as well as sectors such as industry.
5. **Carbon Contracts for Difference (CCfDs)** should be considered as an alternative to decarbonise the production of materials.
6. **Continue with RED II** or its equivalent.[16]
7. **Boiler scrappage scheme** that incentivises homeowners to swap to higher efficiency, hydrogen ready boilers. The EUA's call for an £80 million boiler scrappage programme would deliver emissions savings of 150,000 tonnes of CO_2 each year and deliver household bill savings of £205 a year for the average semi-detached property. [17] Hydrogen ready boilers should be mandatory from 2025 at the latest.
8. **The Renewable Transport Fuel Obligation (RTFO)** needs to be amended to support all forms of low carbon hydrogen, including green hydrogen with an electricity grid connection, and should also be extended to cover fuel for rail and marine, as well as road. At the the time of writing there is an open DfT consultation on the future of the RTFO.

9. **Electricity and grid taxes** should be removed for hydrogen produced for heat consumption to prevent double taxation and ensure the tax rate is equivalent to the natural gas that the hydrogen is displacing.
10. Tie the **rate of VAT** on low carbon hydrogen to red diesel, so that hydrogen can compete fairly.
11. **The planning system** needs to be accelerated to support decarbonised gas infrastructure. A DCO takes at least 3 years to obtain. In comparison, battery storage developers over 50 MW will be able to use the quicker Town and Country Planning route.[18]
12. There should be **Enhanced Capital Allowances** for factories that replace natural gas burners with hydrogen ones, and equivalent mechanisms for facilities not making a profit should also be considered.
13. The permitted **volume of hydrogen into the gas grid** should be 2 or 3 per cent now. Once HyDeploy has been safely completed, the volume of hydrogen into the grid should be raised to 20 per cent.
14. Ofgem should proactively support the delivery of network investment and innovation for hydrogen through RIIO-2 (2021-26), and take early steps to develop price control mechanisms which meet ambitions for hydrogen in the late 2020s as well as modifying network codes in preparation for future system operation.
15. **Public opinion tracking** will be vitally important if the Government is considering future wide-reaching policy interventions on any scale like the one we have seen with COVID-19.
16. **Net zero communication**. The Government should start to prepare the public for the reality of the changes required to meet net zero.

As a scientific superpower in hydrogen technologies and leader in various hydrogen cluster decarbonisation plans, the UK is well placed to take advantage of the global growth in decarbonised gas. The UK will have an opportunity to earn export revenue from manufacturing hydrogen technologies, including appliances, electrolysers and gas reformers; storing CO2 on behalf of other countries and/or through capturing and storing CO2 from industrial processes and then exporting the low carbon products; and exporting renewable hydrogen.

But these opportunities will only be realised if the UK produces hydrogen at home. If we wait for other countries to take the lead – and there are plenty of countries that are keen to take the lead – the opportunity will be diminished.

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[1] NB: Includes: All industrial processes, Iron and steel combustion and electricity, Industrial combustion and electricity (excluding iron and steel), Commercial and miscellaneous combustion and electricity. BEIS, Final UK greenhouse gas emissions national statistics 1990-2018, Table 3 https://data.gov.uk/dataset/9568363e-57e5-4c33-9e00-31dc528fcc5a/final-uk-greenhouse-gas-emissions-national-statistics

[2] See https://www.ovako.com/en/newsroom/news--press-releases/ovako-press-release-detail/?releaseId=389A46FDB96CDB2F

[3] See https://www.gov.uk/government/publications/industrial-fuel-switching-to-low-carbon-alternatives/industrial-fuel-switching-demonstration-successful-projects-phase-3

[4] These projects are: HyNet (North West), NECCUS (Scotland), Net Zero Teesside, South Wales Industrial Cluster, Zero Carbon Humber

[5] National Infrastructure Commission, NET ZERO: Opportunities for the power sector, March 2020 https://www.nic.org.uk/wp-content/uploads/Net-Zero-6-March-2020.pdf

[6] Offshore Wind Innovation Hub, Future Offshore Wind Energy Integration: Outlook & Analysis https://offshorewindinnovationhub.com/industry_insight/future-offshore-wind-energy-integration-outlook-analysis/

[7] H21 North of England, 2018, pp.284-285 https://northerngasnetworks.co.uk/h21-noe/H21-NoE-23Nov18-v1.0.pdf

[8] Element Energy and Equinor, Hy-impact Study 1: Hydrogen for economic growth, November 2019 http://www.element-energy.co.uk/wordpress/wp-content/uploads/2019/11/Element-Energy-Hy-Impact-Series-Study-1-Hydrogen-for-Economic-Growth.pdf

[9] Summit Power, Clean Air – Clean Industry – Clean Growth: How Carbon Capture Will Boost the UK Economy: East Coast UK Carbon Capture and Storage Investment Study, October 2017 http://www.ccsassociation.org/news-and-events/reports-and-publications/clean-air-clean-industry-clean-growth/

[10] Hydrogen Taskforce, Economic Impact Assessment: Hydrogen is ready to power the UK's Green Recovery, August 2020 https://www.hydrogentaskforce.co.uk/resources/#:~:text=The%20Taskforce%20has%20produced%20an,drive%20towards%20NetZero%20by%202050.

[11] Committee on Climate Change, Net Zero – Technical Report, May 2019, Table 2.1 https://www.theccc.org.uk/publication/net-zero-technical-report/

[12] National Grid, Future Energy Scenarios, 2020 https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents

[13] See UK Government GHG Conversion Factors for Company Reporting https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

[14] BEIS, DUKES 2020, Table 4.1 https://www.gov.uk/government/statistics/natural-gas-chapter-4-digest-of-united-kingdom-energy-statistics-dukes

[15] Data provided by Centrica

[16] RED II is an EU objective that extends the existing Guarantees of Origin (GoOs) scheme to include decarbonised gases. It encourages investment and facilitates cross-border trade, which will drive competition and ultimately drive down prices, in the decarbonised gas market.

[17] EUA, A Boiler Scrappage Scheme, May 2020 https://eua.org.uk/uploads/5EBBAA4106F2B.pdf

[18] See https://www.lexology.com/library/detail.aspx?g=1b8ea829-31b0-4043-941c-a31f75db61bc

19 Institute for Sustainable Development and International Relations - Decarbonising basic materials in Europe: How Carbon Contracts-for-Difference could help bring breakthrough technologies to market.
https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Etude/201910-ST0619-CCfDs_0.pdf