Comprehensive Spending Review (CSR): Decarbonised Gas Alliance submission

September 2020

1. Summary

- The hard-to-decarbonise sectors – industry, heavy transport (including maritime), domestic heating, and flexible back-up power – can all make extensive use of decarbonised gas – biomethane, hydrogen and carbon capture and storage (CCS) – to help reach net zero. Combined, these sectors account for around 180 million tonnes of CO2 equivalent – 40% of the UK's emissions.

- The integration of offshore energy systems alone, including oil and gas, renewables, hydrogen and carbon capture and storage, could contribute to deliver approximately 30% of the UK's total carbon reduction requirements needed to meet the 2050 net zero target. Alongside decarbonisation of industrial clusters, where major projects could abate over 10 million tonnes a year by 2030; use of hydrogen in heavy transport; use of hydrogen in power generation as flexible back-up to intermittent renewables; and domestic hydrogen conversion, this agenda could create jobs, level up economic opportunity in less affluent parts of the country, and help to make the UK a scientific superpower.

- Hydrogen and CCS development for broad-based decarbonisation could be a significant job creator, leading to 43,000 jobs for industrial decarbonisation alone, 195,000 jobs if hydrogen plays a full role in economy-wide decarbonisation, and 221,000 jobs if the UK also becomes a major hydrogen exporter. Overall, the global hydrogen market could reach £1.9 trillion a year by 2050.

- In order to achieve this, decarbonised gas development must take place at scale. The UK will need 29-79 TWh of hydrogen by 2030, which means 4-11 GW of blue hydrogen production capacity or 7-18 GW of green hydrogen production capacity – and in reality a combination of both.

- To deliver this scale of capacity, CfD and regulated asset business models are needed alongside other supportive policies, including a green gas levy scheme for biomethane, expansion of the RTFO to cover hydrogen fully and support for clean marine fuels such as ammonia.

2. The role of decarbonised gas in helping industry, heavy transport and homes reach net zero

The term 'decarbonised gas' refers to **biogases**, **hydrogen** produced from renewable and low carbon methods, and **carbon capture and storage** (CCS).

2.1 The hard-to-decarbonise sectors

The hard-to-decarbonise sectors – industry, heavy transport (including maritime) and domestic heating – can all make extensive use of decarbonised gas to hep reach net zero. Combined, these three sectors account for around 180 million tonnes of CO2 equivalent – 40% of the UK's emissions:

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

- **Hydrogen** is needed to provide high-temperature heat for industrial processes, and is also vital where the process requires a flame to come into contact with the product being made, for example glass and ceramics. There is existing industrial hydrogen demand, although the hydrogen is not low-carbon.
- There are several schemes for decarbonising steelmaking with hydrogen in Europe, through process changes to achieve zero-carbon steel production, including Hybrit in Sweden[2], Celsa in Norway[3], Arcelor Mittal in Germany[4], and Voestalpine in Austria[5]. The first trial of hydrogen to provide high-temperature heat in the steelmaking process has just been completed in Sweden.[6] A UK trial has been funded to evaluate the use of hydrogen in glass manufacture.[7]
- **CCS** is needed for other industrial processes, such as cement manufacturing, where there is little alternative to capturing the emissions created from the process itself. Process emissions account for over 60% of cement and around a quarter of total industrial emissions globally.[8]
- CCS, in combination with bioenergy (BECCS) or direct air capture (DAC), is also required for negative emissions, while will certainly be needed if net zero is to be achieved. The Committee on Climate Change's Net Zero report identified a need for 35 million tonnes of CO2 to be captured and stored each year via BECCS by 2050.[9]
- 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 CCS.[10]

Heavy transport – 35.3 million tonnes of CO2 equivalent (8% of UK total):[11]

- **Hydrogen** can be used in trucks, buses andtrains as a zero emission fuel. It is particularly suited to heavy transport where it's harder for vehicles to carry big enough batteries, and where hydrogen refuelling times are faster.
- Hydrogen can also play a key role in maritime decarbonisation, including through ammonia, where the volumetric energy density (including the fuel storage system) is similar to LNG and around 5 times higher than Li-ion batteries.[12]
- Hydrogen buses are being used successfully in Aberdeen, and HGV manufacturers are starting to roll out hydrogen models. In Germany, hydrogen trains are in operation, and the SWIFTH2 project is evaluating the potential for hydrogen ferries for Scottish islands.
- **Biomethane** buses and trucks are a growing sector, offering considerable carbon emission savings and air quality benefits, while being cheaper to operate over a lifetime than their diesel equivalents.

Domestic heating – 67.5 million tonnes of CO2 equivalent (15% of UK total):[13]

- The UK has around 28 million homes, and therefore needs to decarbonise heating in 1 million homes a year between now and 2050. 85% of homes are connected to the gas grid, and many of these are not suited to electrification, as they do not have hot water tanks or large radiators.
- **Biomethane** has the advantage of decarbonising domestic heating with no changes for consumers at all.
- **Hydrogen,** alongside some electrification, offers a cheaper and less disruptive option than full electrification.
- **Hybrids** also enable some electrification with limited disruption when paired with biomethane or hydrogen boilers.

- Hydrogen safety trials – for blended and 100% hydrogen – are taking place across the country, and a hydrogen-ready boiler has already been developed. The H21 North of England study showed how a cost-effective domestic conversion to hydrogen could take place.

Flexible power

Natural gas reforming with CCS could also play an important role in providing the hydrogen for reliable back-up power capacity, alongside hydrogen produced from surplus renewable **electricity.** 100% hydrogen-fired CCGT turbines are expected to ready for operational deployment at scale by the late 2020s and will be able to operate with flexibility. They are also natural anchors for hydrogen demand in industrial cluster developments. The majority of new CCGTs can be cost effectively replaced by hydrogen and CCS in a future power system with even higher penetration of renewables.[14]

Bringing this all together, the integration of offshore energy systems alone, including oil and gas, renewables, hydrogen and carbon capture and storage, could contribute to deliver approximately 30% of the UK's total carbon reduction requirements needed to meet the 2050 net zero target.[15]

2.2 Supporting government ambition and the priorities of the CSR

We welcome the Government's strongly stated ambition for the UK to be a global leader in clean growth. As the most recent BEIS Industrial Strategy White Paper explained:[16]

"The move to cleaner economic growth – through low carbon technologies and the efficient use of resources – is one of the greatest industrial opportunities of our time … We will increase our support for innovation so that the costs of clean technologies, systems and services are reduced across all sectors … We will align our policies, regulations, taxes and investments to grow the markets for these new innovations so that they are successfully commercialised in the UK. Our long-term goals are to make clean technologies cost less than high carbon alternatives, and for UK businesses to take the lead in supplying them to global markets."

Decarbonised gas supports many of the priorities of the CSR, as we explain in more detail in the "Benefits" section below, including:

- **Strengthening the UK's economic recovery:** Development of decarbonised gas can be a significant job creator in its own right. For example, hydrogen and CCS development could create 43,000 jobs for industrial decarbonisation alone,[17] and a widespread conversion of homes for hydrogen would require over 3,000 gas engineers,[18] with additional hydrogen training, for a number of years.

- **Levelling up economic opportunity:** In many less affluent parts of the country, energy intensive industries are the largest employers in the area, offering high quality jobs that pay above median wages. Decarbonised gas offers an opportunity for UK industry to take a leading international position in the production of low carbon industrial goods, with associated service expertise. Global markets are set to rise – for example, the global hydrogen market could reach £1.9 trillion a year by 2050.[19]

- **Making the UK a scientific superpower:** In our minds, being a scientific superpower doesn't just mean leading the development of technologies to meet net zero, but also benefitting economically from them. Too often, the UK has failed to commercialise its inventions or to build up a domestic manufacturing capability – for example, CfDs have been a world-leading way of reducing the cost of offshore wind generation, but most of the hardware is still made overseas. The UK has a leading position in a) many of the key decarbonised gas technologies, including fuel cells, electrolysers and advanced methane reforming, and b) the projects that could fit them all together at scale, including the various cluster decarbonisation plans, and the considerable offshore CO2 storage capacity.

3. Capacity needed

It is important to understand the required scale of deployment if decarbonised gas is to realise its full potential to help meet net zero – to make a meaningful impact on emissions, capacity will need to be substantial.

3.1 Hydrogen

The Committee on Climate Change has suggested a need for up to 270 TWh of hydrogen in 2050[20], and the three National Grid FES scenarios that achieve net zero require between 152 and 591 TWh of hydrogen by 2050.[21]

By 2035, the FES scenarios envisage 29-79 TWh of hydrogen supply. The DGA believes that a combination of blue and green hydrogen will be required, and that both technologies are complementary. Blue hydrogen is currently cheaper and larger volume than green hydrogen, and is likely therefore to kick-start hydrogen deployment at scale, including the hydrogen transport and storage infrastructure. This will help to pave the way for green hydrogen, where costs will fall rapidly. The following rounded figures should be taken as an approximate guide to the required scale in 2035, rather than a precise calculation:

- 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 7-18 million tonnes 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).[22]
- 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%.
- Overall, 5-15 million tonnes per annum of CO_2 would be saved if the hydrogen was used to replace natural gas.
- If the hydrogen was used to replace diesel and fuel oil in heavy transport instead, the CO_2 savings would be higher, firstly because of the higher emissions from the fuels, implying 7-20 million tonnes savings per annum (diesel and fuel oil have emissions of around 250 g/CO_2 per kWh)[23], and secondly because of the increased efficiency of fuel cells when compared with combustion engines.

To put this into context, the UK currently uses around 880 TWh of natural gas per annum.[24] The hydrogen production numbers shown above therefore represent 3-9% of the UK's current natural gas demand. The key point is that in order to make a substantial difference, we need hydrogen production at the GW scale. A few tens or hundreds of megawatts just isn't enough. This will require a significant contribution from blue hydrogen since there will be increasing demand for renewable electricity from new e.g. transport applications.

Hydrogen storage at scale will also be required. 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.[25]

3.2 Industrial clusters

Although there is considerable industrial capacity dispersed around the country, the large industrial clusters are critical to achieving net zero in practice, because shared infrastructure – including for hydrogen and CO_2 – can be developed and used by multiple facilities. The clusters are also major energy supply hubs, with offshore wind cables and offshore gas pipelines often coming to shore at these locations. These clusters can therefore benefit from major economies of scale to deliver considerable emissions abatement during this and subsequent decades.

The main clusters have detailed plans to achieve deep decarbonisation of multiple facilities using shared infrastructure:

- **HyNet:** HyNet is based in the North West of England, and would create hydrogen and CCS infrastructure to capture industrial emissions and supply hydrogen (from both natural gas and renewable electricity) for industry to use in place of natural gas. By 2026, with construction complete, over 1 million tonnes of CO_2 would be saved every year. By 2035, with wider hydrogen supply constructed for flexible power and transport, and negative emissions from bioenergy with CCUS, up to 25 million tonnes of CO_2 could be saved per annum.[26]

- **NECCUS:** NECCUS is an integrated plan for hydrogen and CCS in Scotland, incorporating the Acorn project. It would produce hydrogen from natural gas at the St Fergus terminal in North East Scotland for use in the gas network to decarbonise domestic heating, as well as for transportation and industrial use, and would also use a re-purposed pipeline to collect CO_2 from Scottish industry. The first phase would capture and store around 340,000 tonnes of CO_2 emissions from the St Fergus gas terminal, and could be operational in 2024. Subsequent phases would see large additional volumes of CO_2 abated each year. The nearby Peterhead port could also receive up to 16 million tonnes a year of CO_2 by ship from other clusters and countries, to be stored in the same offshore geological formations.[27] The Dolphyn project for offshore hydrogen production is part of the North East hydrogen integration plan which brings together blue hydrogen from Acorn and green hydrogen from Dolphyn for gas network, transport and industrial use.[28]

- **Net Zero Teesside:** Net Zero Teesside would create CCS infrastructure to capture emissions from industry and from gas and biomass power generation. The project is currently in the pre-application stage for a Development Consent Order (DCO), which it hopes to gain by the end of 2021. By 2030, up to 6 million tonnes of CO_2 would be captured and stored each year.[29]

- **South Wales Industrial Cluster (SWIC):** SWIC will establish a net zero carbon landscape for industry in South Wales – connecting together mini-clusters along the coastline from Newport to Milford Haven, which will act as a catalyst for a whole-systems decarbonisation of other sectors such as rail, heavy surface transport, power generation and home heating. Large-scale hydrogen infrastructure and CCS options will be developed, including establishing an international hydrogen and carbon shipping hub, and process solutions will be identified to reduce industrial carbon emissions at least cost. The cluster across the South Wales region is seeking to eliminate over 16 million tonnes per year of CO_2 emissions from industry and power generation, which would be further compounded through the coupling of both heat and transport vectors. SWIC is also seeking to support other cluster developments in the Black Country, Southampton, Plymouth and Falmouth.

- **Zero Carbon Humber (ZCH):** ZCH would create CO_2 transport and storage infrastructure, facilitating the Humber's transition to a net zero cluster before 2040. This infrastructure would support a hydrogen fuel switch and post combustion capture decarbonisation programme as well as capturing the 16 million tonnes per annum negative emissions (BECCS) from Drax power station. ZCH incorporates the Hydrogen to Humber Saltend (H2H Saltend) project, planned to be one of the the world's first at scale blue hydrogen plants. H2H Saltend will enable industrial customers in the Chemicals Park to fully switch over to hydrogen, and the power plant to move to a 30% hydrogen to natural gas blend. As a result, total emissions from the Chemicals Park will fall by c.900,000 tonnes to c.2.6 million tonnes of CO_2 per year. Humberside is the largest emitting cluster by a large margin, supporting over 55,000 jobs across strategically important industries including steel works, manufacturing and petrochemicals, and it is anticipated that the CCS infrastructure could be in place as early as 2026. The Humber has projected that annual capture rates in 2040 from industry across the cluster (13 million tonnes), hydrogen production (15 million tonnes) and BECCS from Drax power station (16 million tonnes) are achievable. This would result in 44 million tonnes of CO_2 stored each year.[30] There are additional opportunities for hydrogen from renewable electricity which are also being developed within the cluster.

If all these projects are developed to the maximum, then over 100 million tonnes of CO_2 could be abated each year by 2040, making a major contribution to net zero. The first phases of these four projects, most delivered before the Fifth Carbon Budget period starts, would abate over 10 million tonnes a year, helping to meet the carbon budgets in practice.

To meet net zero, all of the industrial clusters will need to decarbonise, which means that all of these projects will need to go ahead. An early establishment of CO_2 infrastructure in all these clusters will also enable optimal phasing and timing of subsequent decarbonisation projects in the clusters in addition to the initial projects. It is very welcome to see all of these cluster projects receiving phase 1 funding from the Industrial Decarbonisation Challenge.[31]

Through providing essential infrastructure, these projects also enable decarbonisation of other sectors, for example a conversion of parts of the gas grid to hydrogen, hydrogen refuelling for fleet vehicles, hydrogen or ammonia fuel for shipping, and the potential production of methanol or other clean fuels for aviation. They also support coupling of the electricity and gas sectors, with hydrogen produced from electrolysis using offshore wind electricity, for example.

4. Business models

4.1 CfDs and RABs for hydrogen and CCS

Funding mechanisms need to be sufficient to achieve the scale described above in practice, and should have three objectives:

1. Deliver the scale of hydrogen and CCS capacity required to be on track to meeting net zero.
2. Enable cost reductions to be delivered.
3. Support the development of a UK supply chain that can also export at scale.

As grants, while very welcome, are not sufficient, we are very supportive of the BEIS-led work on business models for hydrogen and CCS:

- For **hydrogen** production, our preference is for a variant on the CfD model, with a fixed payment to cover capex, and a variable part for when hydrogen is produced. We also favour separate buckets for blue and green hydrogen, to reflect the different costs of the two technologies, and the fact that both will be needed at scale. Equally there should be consideration for innovation, where alternative technologies that produce hydrogen fall between the two categories – for example, waste plastics to hydrogen reduces a waste stream and is therefore "turquoise" hydrogen.

- For the **carbon capture** part of CCS, we favour a CfD which would have as a reference price the wholesale power price for power sector capture, or the carbon price for industrial capture. For power generation, our preference would be for a baseload CfD for the first CCS plants, providing greater certainty, including for the developers of CO2 pipelines and storage infrastructure. A baseload CfD would also be the best model for BECCS plants that provide negative emissions. Then a flexible CfD with a capacity payment should be introduced subsequently, allowing CCS plants to play the most suitable role supporting renewable generation.

- For the **transport and storage** part of CCS, a Regulated Asset Base (RAB) model would be the most appropriate, as per the super sewer and electricity and gas networks. Pipeline and storage facilities need to be built with future use in mind – when multiple facilities are connected, including to handle CO2 imported by ship.

It is, however, crucial that timely announcements on business models are made to ensure that industrial cluster and other projects receive the investment needed. It is worth noting that Germany has sent a strong signal with a pledge of €9 billion in support for green hydrogen and a target of up to 5 GW of electrolyser capacity by 2030.[32]

Equally, 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).

Finally, we would note that while the CfD model has been a fantastic success at delivering renewable generation at scale, and enabling major cost reductions for offshore wind in particular, it has not succeeded in supporting a widespread UK manufacturing supply chain, with most of the hardware still made overseas. It is important not to make the same mistake with decarbonised gas, especially in view of the substantial existing UK based supply chain for oil and gas with similar expertise and disciplines.

4.2 Other sectors

Beyond a core CfD/RAB approach, it's important to consider other sectors, where different approaches may be needed.

- Firstly, **biomethane** injection. As stated above, biomethane can start to decarbonise domestic heating with no impact on consumers, and it can supply a growing fleet of clean HGVs and buses. The DGA responded to the recent BEIS consultation on a green gas support scheme to replace the RHI – we are strongly supportive of an ambitious target for biomethane injection and of the proposed green gas levy scheme to deliver it, as an interim step on the way to a more market-based support mechanism.

- Secondly, the **Renewable Transport Fuel Obligation** (RTFO). The RTFO has worked for biofuels, but it has not been successful for hydrogen as it has been too narrow. The RTFO should include all forms of low carbon hydrogen production, including green hydrogen with a grid connection, given the progressive decarbonisation of the electricity grid, and blue (and "turquoise") hydrogen.

- Thirdly, alongside options such as methanol, **ammonia** has promise as a maritime fuel, primarily because it has higher energy density than other zero carbon alternatives, such as liquid hydrogen or batteries, when considering both the fuel and the storage system properties.[33] Ammonia also benefits from existing transport and storage infrastructure, although marine bunkering facilities would need to be built,[34] and can be used as a cost-effective way to transport hydrogen around the world in future:[35]
    - As well as expanding the RTFO to cover hydrogen more effectively, the RTFO should also be expanded to include marine fuels. At the launch of the Government's Clean Maritime Plan last year, a pledge was made to hold a consultation on how the RTFO could be used to encourage the uptake of low carbon fuels in maritime – it is essential that this consultation goes ahead.
    - Decarbonising the committed long-distance marine fleet may also be economic using calcium looping by retrofitting the RECAST system, which uses low emissions lime as a CO2 sorbent and additional fuel.[36] A carbon price applied to marine fuel emissions would encourage this carbon capture solution .

5. Demand

One of the challenges for hydrogen development in particular is ensuring sufficient demand to make investment in production worthwhile.

Existing demand for hydrogen is a good starting point as there is a ready market, and the existing production is almost all "grey". Switching to blue or green hydrogen would therefore deliver immediate and large-scale emissions reductions, helping to meet interim carbon budgets on the path to net zero:

- UK hydrogen production is currently about 27 TWh from around 15 sites. About half is a by-product, mainly from the chemical industry, which is either used on site or sold as chemical feedstock, with a small percentage vented.[37]
- If we leave aside the by-product hydrogen, the majority of the UK's hydrogen is produced from natural gas via steam methane reforming (SMR), which has emissions of around 285 g/CO2 per kWh.[38] So at a very rough estimate, production of the 13 TWh or so of hydrogen that is not a by-product is responsible for around 3.7 million tonnes of CO2.
- As per the approximate calculations described earlier in the submission, replacing this with low carbon hydrogen would require around 2 GW of ATRs with CCS or 3 GW of electrolysers fed from offshore wind.

Establishing low carbon hydrogen production to replace existing high-carbon hydrogen would help to develop a hydrogen market, giving hydrogen producers confidence in demand, and other facilities looking to fuel-switch to hydrogen confidence that hydrogen production will be in place. Ideally, replacing existing high-carbon hydrogen demand and switching to hydrogen in other facilities and sectors should be developed in parallel.

It is worth noting that the EU Commission's recently-announced hydrogen strategy set a first-phase objective of 6 GW of electrolysers in the EU by 2024, producing up to 1 million tonnes of hydrogen, primarily to decarbonise existing hydrogen production but also to facilitate take up of hydrogen in new end-use applications, such as other industrial processes and heavy transport. As the strategy explained, this would help to lay the foundations for the second phase objective of 40 GW of electrolysers and up to 10 million tonnes of hydrogen production by 2030, with hydrogen becoming "an intrinsic part of an integrated energy system".[39]

6. Benefits

6.1 Job creation and investment

The development of decarbonised gas and associated infrastructure can be a significant job creator in its own right. It is worth noting that in order to achieve a Just Transition, the 250,000 or so jobs that rely on UK oil and gas production[40] need to be protected, for example, though ensuring sufficient domestic natural gas production to provide blue hydrogen at scale, expanded domestic offshore wind production to produce green hydrogen at scale, and through energy integration programmes that bring together oil and gas assets with offshore wind, hydrogen and CO2 transport and storage[41]:

- **Green hydrogen production:** 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 £4 billion and £12 billion per year over an extended period (up to 50 years) between 2040 and 2090.[42]

- **Domestic hydrogen conversion:** The H21 North of England report showed that a widespread conversion of homes to hydrogen would require over 3,000 gas engineers, with additional hydrogen training, for a number of years, with further management staff.[43]

- **CCS and hydrogen:** Hydrogen and CCS development for broad-based decarbonisation could be a significant job creator, leading to 43,000 jobs for industrial decarbonisation alone, 195,000 jobs if hydrogen plays a full role in economy-wide decarbonisation, and 221,000 jobs if the UK also becomes a major hydrogen exporter.[44] A recent Summit Power report also found that developing a network of CCUS projects along the East Coast of the UK, capturing 75 million tonnes of CO_2 per year, would provide £163 billion of economic benefits and 225,000 jobs, cumulatively, through to 2060.[45]

- **Upstream, midstream and downstream:** A recent report by the Hydrogen Taskforce found that, by 2035, upstream hydrogen production could deliver 28,500 jobs and £4.2 billion of GVA, midstream hydrogen transport could deliver 15,500 jobs and £5.3 billion of GVA, and downstream hydrogen use could deliver 30,500 jobs and £8.7 billion of GVA.[46]

6.2 Levelling up and exporting

In many less affluent parts of the country, energy intensive industries – iron and steel, cement, chemicals, oil refining, food and drink, pulp and paper and ceramics – are the largest employers in the area and offer high quality jobs that pay above the median wage. Overall, energy intensive industry accounts for £140 billion in economic value added and employs over 1.1 million people.[47]

But the UK has seen too much emissions reduction through offshoring of heavy industry, and is now the largest per-capita importer of CO2 emissions in the world.[48] To give one example, the closure of Redcar steelworks in late 2015 led to 2,000 job losses, but caused nearly half the fall in industrial emissions in 2016.[49]

Decarbonised gas provides an opportunity to turn this around, and develop UK exports of decarbonised industrial products, together with exports of hydrogen and CCS technology and services:

- Overall, the global hydrogen market could reach £1.9 trillion a year by 2050,[50] with the global fuel cell market reaching over £140 billion.
- The European electrolyser market will grow rapidly, given the EU Commission's ambitions for 6 GW of electrolysers by 2024 and 40 GW by 2030. The global market for electrolyser exports could reach £250 billion and exports of hydrogen from offshore wind could be worth £48 billion.[51]

International cooperation to ensure consistency on, for example, low carbon hydrogen standards, will be essential if the UK is to capture the full export potential.

6.3 Scientific superpower

In our minds, being a scientific superpower doesn't just mean leading the development of technologies to meet net zero, but also benefitting economically from them.

The UK has a leading position in a) many of the key decarbonised gas technologies, including fuel cells, electrolysers and advanced methane reforming, and b) the projects that could fit them all together at scale, including the various cluster decarbonisation plans, and the considerable offshore CO2 storage capacity. So we are well placed to take advantage of the global growth in decarbonised gas – revitalising energy intensive industry and developing new manufacturing and service industries.

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.

7. Supportive policies

As we have explained, the key priority is to put in place viable business models for decarbonised gas to grow and deliver the benefits described. But there are other supportive policies that matter.

7.1 Boiler scrappage scheme

In England, there are still almost 4.8 million older, less efficient non-condensing boilers in homes connected to the gas grid, and almost 900,000 oil boilers in off-gas properties.[52] A scrappage scheme that supported the replacement of these less efficient and higher polluting heating systems with clean alternatives – including hydrogen-ready boilers and bio-LPG boilers – would deliver emissions savings and reductions in heating bills, helping to reduce fuel poverty.

As an example of a scheme, we would support the EUA's recent call for an £80 million boiler scrappage programme. The proposal would seek to remove 200,000 G-rated boilers by offering a £400 Government funded voucher to incentivise the homeowner to swap to an A-rated boiler. The improved product efficiency, under 70 per cent to over 90 per cent, would deliver household bill savings of £205 a year for the average semi-detached property. It would also save 150,000 tonnes of CO2 each year, even without cleaner fuels.[53]

7.2 Fair taxation for hydrogen

A recent report by the Institution of Mechanical Engineers (IMechE) highlighted a number of anomalies in the tax system, which penalise hydrogen.[54] These include:

- **VAT rates:** Hydrogen is always standard rated at 20%, regardless of carbon content, whereas the VAT rate for red diesel, electricity at home to charge an EV and hydrocarbons used in homes and businesses is 5%.
- **Green hydrogen penalties:** Given the need for separate company structures between the power generation asset, the electrolysis asset and the end consumer, green hydrogen pays VAT and grid taxes for the electricity, as well as VAT on the end fuel sale.
- **Enhanced Capital Allowances:** Enhanced capital allowances for hydrogen refuelling and storage only apply to vehicles installed by business and do not apply to marine, aviation, rail or for other non-road vehicle users. But these sectors are those where hydrogen can make the greatest difference.
- **Additionality in the RTFO:** A public sector body can achieve zero emissions in their fleet operations by buying battery electric vehicles and signing a contract with a 100% renewable supplier e.g. Bulb or Octopus. However, if a council used electrolysis for hydrogen production and signed an agreement with the same supplier, that is not considered "additional" and therefore does not qualify under the Renewable Transport Fuel Obligation.

The IMechE report made several recommendations, which we support, including:

- Tie the rate of VAT on low carbon hydrogen to red diesel, so that hydrogen can compete fairly.
- Remove electricity and grid taxes 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.
- Expand the RTFO to apply to hydrogen uses for any mode of transport, including the hard-to-decarbonise heavy transport sectors. For transport equipped to capture its own CO2 emissions, such as the RECAST system, a carbon price applied to emissions from marine fuels would provide support.

7.3 Other policies

One issue that is little mentioned but hugely important is the planning system. The planning system risks holding back the development of the decarbonised gas infrastructure that is necessary to tackle the hard-to-decarbonise sectors. A Development Consent Order takes at least 3 years to obtain from start to finish, which is too long, and it is noteworthy that battery storage developers over 50 MW will be able to use the quicker and less costly Town and Country Planning route.[55]

We are also concerned that there are not sufficient numbers of planning inspectors to process the volume of applications under the Nationally Significant Infrastructure Planning (NSIP) regime, or to handle appeals for applications processed under Town and Country Planning.

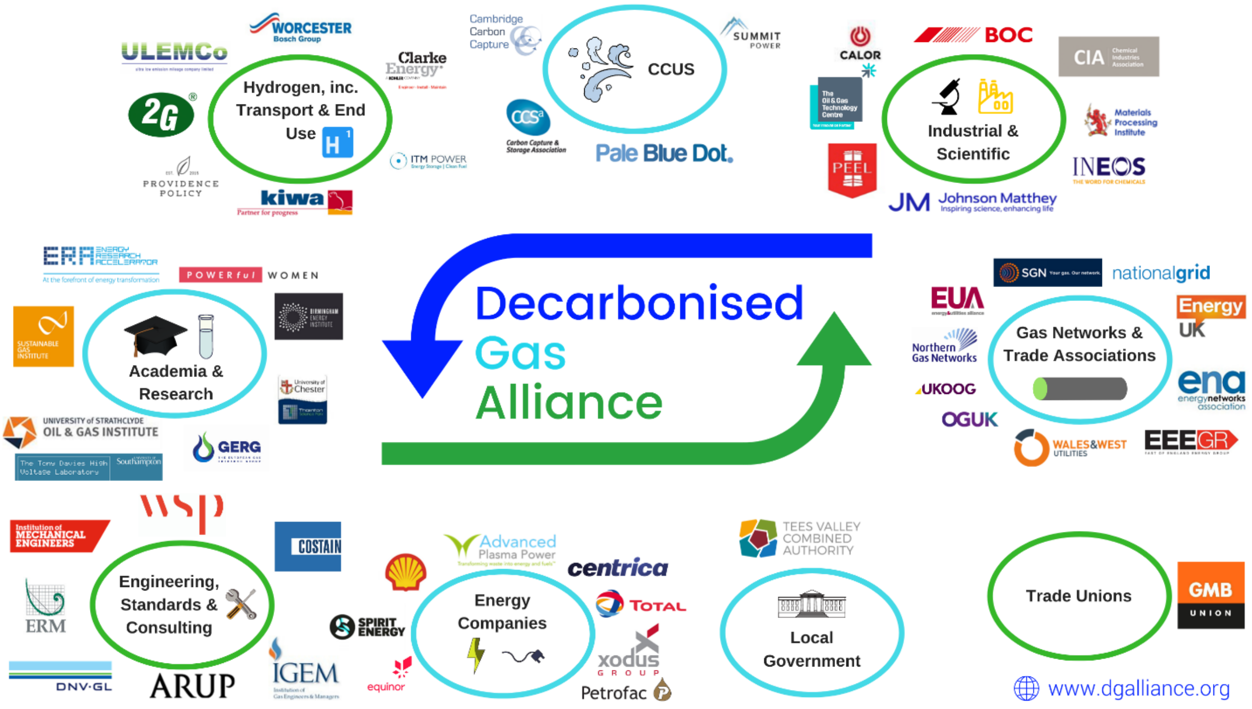
About the Decarbonised Gas Alliance

The Decarbonised Gas Alliance (DGA) is an alliance of over 50 gas producers, transporters, suppliers and users, hydrogen and carbon capture experts, alongside R&D, supply chain, trade union and local government specialists whose knowledge and expertise will be vital in decarbonising the UK's gas system and improving poor air quality. Our website is found at www.dgalliance.org

Our aim is to work with all levels of government and with other expert organisations to use the gas system as a whole to help deliver our emission reduction and air quality goals. We believe that decarbonising gas – including biogases and hydrogen from a variety of low carbon methods – would make best use of our existing infrastructure and lower the overall costs of decarbonisation.

The DGA is a broad-based alliance, established in late 2016, and has now expanded to over 50 signatory organisations, which are listed in full in the diagram below. The DGA secretariat is managed by DNV GL, a global specialist firm which provides advisory, certification and other technical assurance solutions covering a range of energy sources.

We welcome the opportunity to provide our views on the Comprehensive Spending Review, and we are happy to provide further detail, if this would be useful to HM Treasury.



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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.hybritdevelopment.com/

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