Science and Technology Select Committee: Technologies for meeting Clean Growth emissions reduction targets inquiry

Decarbonised Gas Alliance response

October 2018

About the Decarbonised Gas Alliance

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

2. 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 would make best use of our existing infrastructure and lower the overall costs of decarbonisation.

3. The DGA is a broad-based alliance, established in late 2016, and has now expanded to over 40 signatory organisations, which are listed in full in the diagram in the appendix. The DGA secretariat is managed by DNV GL, a global specialist firm which provides certification and other technical assurance covering a range of energy sources.

4. The DGA is happy to nominate a spokesperson from one of our signatory organisations to provide oral evidence to the inquiry, if this would be useful for the Select Committee.

The strategy – progress on meeting carbon budget targets to date and areas where more progress is needed going forward

5. Overall, the UK has reduced emissions by 41% since 1990, which represents impressive progress:
    a. In particular, the UK has reduced CO_2 emissions by 122 million tonnes from power stations, a reduction of 57%.
    b. The UK has also made large progress in reducing certain non-CO_2 gases, particularly methane and nitrous oxide, including from waste management. Overall, non-CO_2 gases have fallen by 111 million tonnes of CO_2 equivalent, a reduction of 56%.
    c. These two areas combined account for over 70% of the UK's total decarbonisation since 1990.[1]

6. Other sectors, however, have made far less progress:
    a. Transport emissions have fallen by just 0.7%.
    b. Residential emissions have fallen by less than 15%.[2]

7. While business and industrial process emissions have fallen by 56 million tonnes, or 42%,[3] too much of this fall has occurred due to offshoring of manufacturing, which may well increase global emissions, as manufacturing in many countries is less energy efficient and more dependent on coal than in the UK. Between 1997 and 2015, when comparable data is available:

a. Manufacturing has fallen from 17% to just 10% of the UK's GVA.[4]
b. Imports of carbon emissions, embedded in the goods and services that the UK consumes, have risen by 31%.[5]
c. To give one example of this, the closure of Redcar steelworks in late 2015, with the loss of 2,000 jobs,[6] caused nearly half the fall in industrial emissions in 2016.[7]

8. Overall, the reduction in the UK's *consumption* of emissions is far less impressive than its record of *production* of emissions. Between 1997 and 2015, when comparable data is available, the UK's production of emissions fell by 33%, but its consumption of emissions only fell by 4%.[8] We do not believe that a viable Industrial Strategy or Clean Growth Strategy can continue to record the loss of UK manufacturing as positive for emissions reduction.

9. This suggests to us that a lot more progress is needed in three key areas going forward:
   a. Domestic heat, which accounts for the bulk of domestic emissions.
   b. Transport, where emissions have flatlined.
   c. Industrial emissions, including from industrial heat, through decarbonisation of industry in the UK, rather than the offshoring of manufacturing industry overseas.

10. We cannot wait for action in these sectors. As the Committee on Climate Change has concluded, the UK is currently off-track to meet the Fourth and Fifth Carbon Budgets.[9] While progress is being made, it is happening far too slowly. There needs to be a much greater sense of urgency if we are to meet the forthcoming carbon budgets, especially in light of the latest IPCC report.

The strategy – the extent to which current and future technologies can help to meet the carbon budgets

11. We believe it is important not just to examine technologies, but also to look at systems and infrastructure that can be used effectively by existing and new technologies.

12. The UK's gas system is a very high capacity, extremely reliable and safe means of transporting and storing energy, as Table 1 shows. It heats 84% of UK homes,[10] has a far higher level of capacity and storage than the UK's electricity network, and delivers far cheaper energy for consumers:
   a. Electricity costs consumers at least three times more per kWh than gas, and this is true for domestic, commercial and industrial consumers.[11] This is very significant for both industrial competitiveness and fuel poverty – indeed, households off the gas grid are far more likely to be in fuel poverty.[12]
   b. The gas network can carry 1,100 TWh of energy a year, including gas used for electricity generation, and typically carries around 800-900 TWh a year. By contrast, the electricity network typically carries up to around 400 TWh a year.[13] At peak times the gas network is meeting demand that is around five times higher than electricity.

Table 1: UK gas and electricity network comparators – 2016[14]

	Gas network (for heat)	Electricity network
Peak demand (GW)	300	60
Storage duration (hours)	900	9
Storable energy (TWh)	50	0.027
Retail energy cost (£/MWh)	48	154
Carbon intensity (gCO_2/kWh)	185	375

13. Making best use of the UK's extensive gas infrastructure to support decarbonisation will be essential to avoid the costs of increasing the size of the electricity network several times over (with much of the larger electricity network then lying idle in summer, when domestic heat is not needed). This opens up a number of technological possibilities in the sectors where more decarbonisation progress is needed (the list below is not exhaustive).

Biogases

14. Biomethane is currently injected into the gas grid at over 80 sites across the UK, with 6 TWh injected as of September 2018.[15] It can be used progressively to decarbonise the gas grid, but its most valuable use is probably for transport. Compared with the newest Euro VI diesel, compressed natural gas (CNG) HGVs emit 96% fewer particulates, 41% less harmful NOx and 74% less NO2, helping to reduce air pollution.[16] If fuelled by biomethane, they also emit 84% less CO_2.[17]

15. Biomethane for transport is growing. Companies such as Waitrose are already starting to use HGVs fuelled by compressed natural gas,[18] while Reading has a fleet of natural gas buses.[19] There are 11 LNG fuelling stations across the UK, including 1 in Scotland, and 6 CNG fuelling stations.[20] Two of the CNG stations – at Crewe and Leyland – make direct use of biomethane.

16. BioSNG, generated from black bag waste, is also another promising technology, reducing emissions and the quantity of waste going to landfill. Cadent has operated a pilot bioSNG plant in Swindon, and is now part of a consortium constructing the UK's first commercial scale plant at the same site, which is due to start production later this year.[21]

Hydrogen

17. Hydrogen is an extremely promising low carbon energy source, with virtually zero emissions at the point of use, and a versatility of applications. The Clean Growth Strategy estimates that the potential market for low carbon hydrogen in the UK could be as high as 700 TWh a year in 2050, almost as large as the current gas market.[22]

18. **Transport:** Hydrogen can power more cars, buses and HGVs with a similar driving range to diesel and petrol, with no carbon dioxide or air pollutants at the point of use, and at the same time improve city air quality. There is an opportunity for hydrogen vehicles to operate alongside battery electric vehicles, reducing the extent of grid reinforcement needed for battery charging. At the same time, hydrogen powered trains have been piloted, and these offer a much cheaper alternative to rail electrification. Hydrogen fuelled ships are also being examined.

19. **Storage for excess renewable generation:** The 'HyDeploy' project is looking at the feasibility of increasing the hydrogen blend within the gas grid from the current limit of 0.1% to up to 20%, without the need to change appliances.[23] The gas system could therefore act as a form of battery, supporting the electricity system as the share of renewables increases, and allowing the development of a smarter and cheaper electricity network. Estimates suggest that, across the UK, excess renewable electricity could be used to produce between 10 TWh and 32 TWh of hydrogen a year.[24] Simply allowing the hydrogen blend to be increased up to 2%, as a first step, would help to unlock this market.

20. **Heating and cooking:** The Iron Mains Replacement Programme is replacing almost all of the UK's gas distribution network with polyethylene pipes, which are suitable for transporting 100% hydrogen. With conversions to appliances, similar to those that were carried out in the 1970s during the wholesale switch from Town Gas to natural gas, homes could use 100% hydrogen for

heating and cooking. Unlike a switch to electric heat pumps, households would not need to change the entire central heating system, so would experience far less disruption and cost:

a. The H21 project envisages converting the whole city of Leeds, as the first step to a wider national conversion programme, and its current phase is testing the gas distribution grid. The H21 project also envisages using salt caverns to store hydrogen at scale seasonally, something which batteries, which are built to provide power for hours, simply cannot achieve.[25]
b. The BEIS Hy4Heat programme is looking at the safety of hydrogen in the home, including appliances.
c. In Scotland, the H100 project will trial 100% hydrogen in around 300 homes.[26]

21. Industry: the HyNet project in the North West of England aims to use hydrogen extensively in a cluster of energy intensive industry, with the remainder blended in the gas grid.[27] Industrial use would be relatively constant across the year, so the need for seasonal storage is reduced.

22. Overall, hydrogen could make a major contribution to decarbonisation:

a. Modelling for the Committee on Climate Change carried out by E4tech, University College London Energy Institute and Kiwa Gastec showed that hydrogen could become the main source of energy for heating and transport by 2050, enabling dramatic reductions in emissions.[28]
b. On more modest assumptions, Energy Research Partnership calculations suggest that 80 million tonnes a year of CO2 could be saved from domestic and commercial heat and from transport by 2050 – based on 9 million homes heated by hydrogen and 16 million fuel cell cars, with some additional commercial buildings, HGVs and buses also using hydrogen.[29]

Hydrogen production

23. We believe that a mix of low carbon hydrogen production technologies will be needed. Firstly, electrolysis of water, using excess renewable electricity, has the potential to reduce the amount of renewable energy that is curtailed, as renewable capacity grows. It also produces hydrogen at the right purity levels for fuel cells, so is likely to be particularly important for transport needs. UK firms are leading electrolysis development internationally, including the construction of the world's largest electrolyser, at 10MW, in Shell's Rhineland refinery.[30]

24. Secondly, reforming of natural gas with carbon capture, utilisation and storage (CCUS) has the potential to provide the scale of hydrogen needed for wider industrial and gas grid decarbonisation at the lowest cost. The recent hydrogen and fuel cells roadmap found that the cost was about half that of electrolysis,[31] and recent work by Scottish Enterprise has confirmed that the delivered cost of hydrogen from methane reforming with CCUS is the lowest out of any of the hydrogen production technologies[32]. For this reason, we believe that methane reformation will be important for hydrogen in industry and the domestic grid.

25. Methane reformation with carbon capture has been proved in Texas,[33] Canada[34] and Japan[35], and Norway has been successfully storing CO_2 under the Norwegian North Sea since 1996.[36] The UK has over 100 years of CO_2 storage in the North Sea.[37] The Committee on Climate Change has repeatedly said that the costs of meeting the UK's 2050 carbon reduction target could be twice as high without CCUS.[38]

Energy efficiency

26. A key challenge facing decarbonisation of the gas system (as well as all other decarbonisation pathways) is cost to the consumer in an environment where fuel poverty rates are already too high. Therefore, it is not only essential to improve the energy efficiency of the building stock, but to improve energy efficiency in the home as well.

27. Combined Heat and Power (CHP), including at the micro level, could deliver substantial energy savings, with the aim of offsetting bill increases from a higher unit cost of energy. Fuel cell CHP units could be fuelled by natural gas and then modified to use hydrogen at a later date.

Power

28. It is also important not to forget the power sector. Although the CCS projects that were cancelled in 2015 were both power generation projects, technology development since then opens up the possibility of CCUS in the power sector once again.

29. The Allam Cycle uses CO_2 rather than steam to drive the turbine in a gas-fired power station, providing a pure stream of CO_2 for transportation and storage, and increasing the overall efficiency of the process to the same level as a CCGT without carbon capture. A 50 MW demonstration plant is operating in Texas.[39]

30. This could radically improve the economics of gas-fired power with CCUS. If CCUS is developed within industrial clusters, then new Allam Cycle plants could be located to use existing CO_2 transportation and storage infrastructure, providing firm low-carbon power.

How the development and deployment of technology can best be supported, and the extent to which the government should support specific technologies or pursue a 'technology neutral' approach

31. It is worth noting two things at the outset:
    a. Technology support has to be paid for by either taxpayers or consumers, and therefore it needs to be designed in as efficient a way as possible, that incentivises cost-reduction.
    b. Most low-carbon technology support is not provided on a technology neutral basis at present. Given that some of the technologies we highlight above are at an earlier stage of deployment than technologies such as offshore wind, an approach that takes into account the stage of development of relevant technologies is important.

32. To simplify, there are essentially three elements to developing technologies:
    a. Research that discovers and tests new processes and materials.
    b. Development that brings component technologies along the road to commercial readiness.
    c. Deployment to provide cost-reduction through economies of scale and learning-by-doing.

33. All three of these elements need to be supported. Funding for research and development needs to be accompanied by mechanisms to support deployment. In the case of deployment, there needs to be consideration of operational cost as well as capital cost, and the development of a market that stimulates demand for the technology in question, including the infrastructure that may be needed to allow widespread deployment.

34. A consistent approach is also needed to reduce the risks for investments in longer-term projects, which in turn will reduce the cost of capital, a key element in reducing the overall cost of the technology.

35. A number of policy tools have been used in the UK, including *contracts for difference*, *obligations*, and *carbon pricing*, together with *research and development funding* through, for example, the Industrial Strategy Challenge Fund. These tools can be used for the future development of technology.

36. Another avenue for technology support can be found in the US, where the 45Q *tax credit* for CCUS is being progressively increased to $50 a tonne by 2026 for dedicated geological storage, and $35 a tonne for enhanced oil recovery and other utilisation.[40] The tax credit is supporting a particular sector, but it is neutral about specific carbon capture, transportation and storage/usage technologies. It also avoids the need to levy a high carbon price on the whole economy, and therefore any compensating subsidies to energy intensive industry. We believe that the 45Q tax credit is a promising mechanism, and that further work should be undertaken to determine its potential applicability to the UK.

37. Last, but very much not least, it is vitally important to communicate with consumers, as any change will bring some disruption. Potentially mandated changes to people's homes should not be undertaken lightly, and the smart meter programme provides an example of how difficult it can be to encourage consumer uptake.

The relative priority that should be attached to developing new technologies compared to deploying existing technologies, including consideration of the costs and pollution involved in the decommissioning of technologies or infrastructure

38. Our overall view is that many of the technologies for decarbonising the gas system already exist, but that further improvements in these technologies, achieved through development and deployment, are absolutely vital to achieve necessary reductions in cost and increases in scale. 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; production of bio-SNG; 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.

39. New infrastructure is also needed, including (but not limited to) for the transportation and storage of hydrogen and the transportation and storage of CO_2.

40. Using the gas system to support decarbonisation can also ensure that assets are re-purposed rather than decommissioned. This could include the nearly 300,000 km of gas pipelines, if the gas network is repurposed to carry biogases and hydrogen, and certain offshore oil and gas pipelines and facilities, if CCS is developed.

41. Whole systems thinking is important in this context. For example, Wales & West Utilities has developed a "2050 Energy Pathfinder" model to assess the feasibility of how different future energy mixes would work in practice, with the outputs including indicative levels of network investment.[41]

Examples of specific technologies whose development and deployment have been effectively supported so far, as well as those that show particular promise for meeting the Government's carbon emissions targets or supporting the UK's economy, or which would benefit from specific Government action, in the future

42. Offshore wind is a good example of a technology where sustained support for deployment has reduced costs by more than half since 2011,[42] with direct employment in the sector rising to around 10,000.[43]

43. As we explain in our answers to the questions above, the full range of decarbonised gas technologies will be needed to ensure that the UK meets its decarbonisation targets. In particular we would note that CCUS will be vital to meeting targets at least cost – the Committee on Climate Change has repeatedly said that the costs of meeting the UK's 2050 carbon reduction target could be twice as high without CCUS.[44]

The role of the Industrial Strategy 'Clean Growth Grand Challenge' and what the Government should do to ensure it contributes effectively to meeting emissions targets

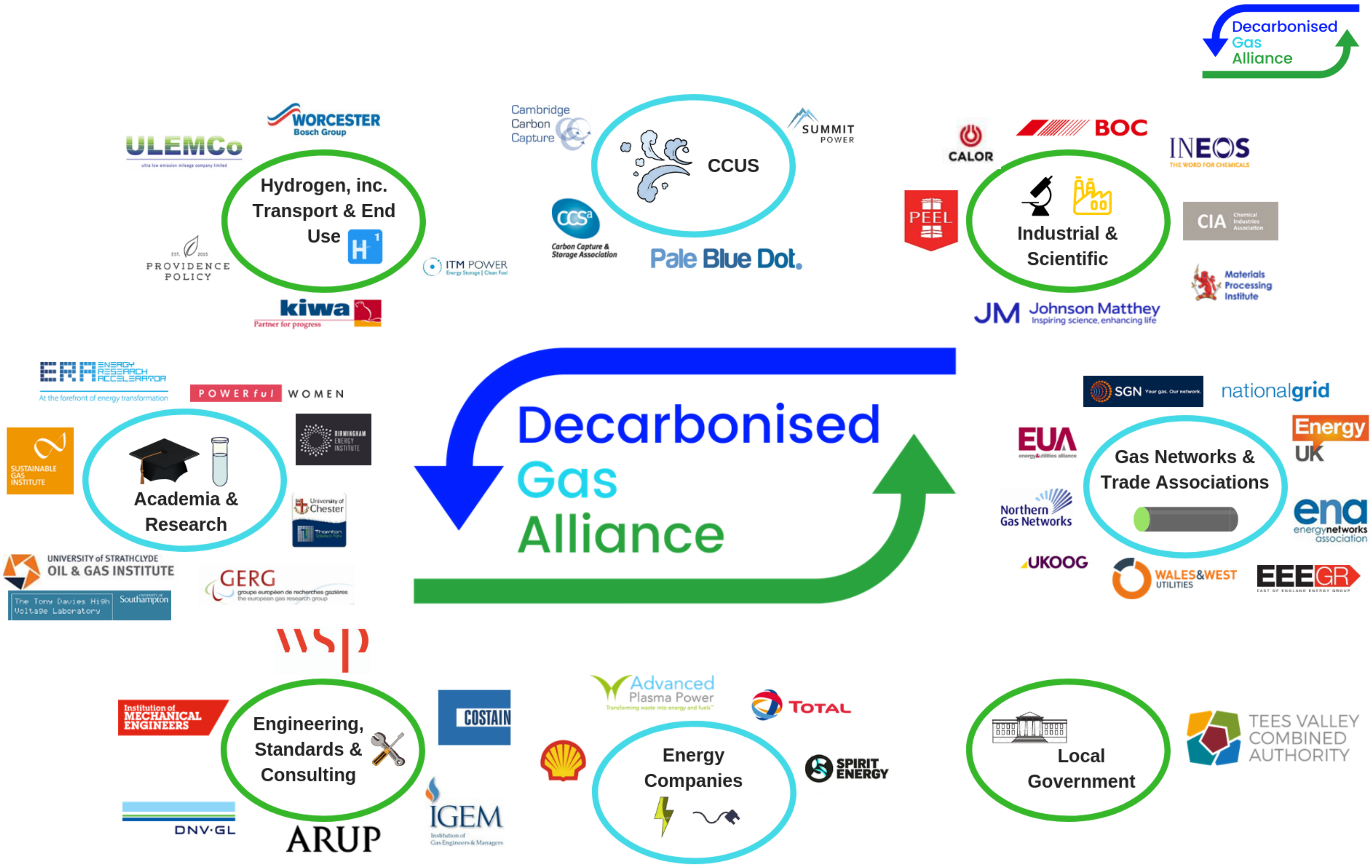
44. We believe that the Clean Growth Grand Challenge (and the Industrial Strategy Challenge Fund) is extremely important in helping the UK meet its emission reduction goals, and it needs to support industrial decarbonisation. There are several key reasons for this.

45. First, energy intensive industries – including iron and steel, cement, chemicals, oil refining, food and drink, pulp and paper and ceramics – are vital to the UK. They contribute around £140 billion in GVA (8% of the UK economy); employ around 1.1m workers and 70% of businesses are exporters.[45] They are at the heart of communities, tending to be in areas of economic disadvantage, often being the largest employer in the area, and offering high quality jobs that tend to pay above the UK median wage. But as the Government's Clean Growth Strategy highlighted, business and industrial emissions now account for approximately 25% of the UK total, with around two thirds of industrial emissions coming from a small number of sectors including the aforementioned industries.[46]

46. Second, as mentioned above, the UK has carried out far too much decarbonisation through offshoring in recent decades. Between 1997 and 2015, manufacturing has fallen from 17% to 10% of GVA,[47] and the UK's imported emissions have risen by 31%, meaning that this country's consumption of emissions only fell by 4%.[48] A worthy industrial strategy needs to turn this around, supporting low carbon industrial development in this country.

47. Third, there are potentially enormous global opportunities. The global CCS market could rise to £100 billion a year,[49] and the global hydrogen market could reach £1.9 trillion a year by 2050.[50] This presents sizeable export opportunities, including for customers who will increasingly want to purchase low carbon industrial goods and services.

48. Fourth, industry is operating in a fiercely competitive global market, with very tight margins. Low carbon projects often require large investments, long-lead times, and coordination of risk allocation across multiple asset owners. The Clean Growth Grand Challenge and Industrial Strategy Challenge Fund are ideally placed to support large-scale pilot projects, together with the research and development of component technologies. Together with supportive policies, they can provide the foundation for a wider roll-out of low carbon industrial projects.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Hydrogen, inc. Transport & End Use
CCUS
Industrial & Scientific
Academia & Research
Gas Networks & Trade Associations
Engineering, Standards & Consulting
Energy Companies
Local Government

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