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Industrial CCS enhances infrastructure productivity

Response to the National Infrastructure Commission call for evidence **March 2017**

Industrial Carbon Capture and Storage (CCS) is an emerging technology for reducing emissions which will be essential for infrastructure productivity and therefore fits this call for evidence by the National Infrastructure Commission.[1] Deep emissions reductions are a critical element of any assessment of infrastructure development over a 10-30-year time horizon, within which time the UK Climate Change Act legally binds the government to reduce emissions by at least 80% compared to 1990 levels.

About Sandbag

Sandbag is a London and Brussels-based not-for-profit think tank conducting research and campaigning for cost-effective climate policies.

Our research focus includes reform of the EU Emissions Trading System and the Effort Sharing Regulation; accelerating the phase-out of old coal in Europe; deep decarbonisation of industry through technologies including Carbon Capture & Storage; and improving climate governance.

For more information, visit sandbag.org.uk or email us at info@sandbag.org.uk

Our vision for 2025:

- The UK's first Carbon Capture and Storage infrastructure hub is producing zero-carbon cement, steel, and other conventionally high-emitting industrial products, with technology that is cost-competitive with offshore wind and nuclear.
- Decommissioned North Sea oil and gas infrastructure is repurposed for carbon storage.
- Low-carbon hydrogen is decarbonising the heat and transport networks.

In 2016, Lord Oxburgh's expert parliamentary group on CCS made clear the essential nature of CCS infrastructure to the UK economy.[2] The government's research hub have also stated that delaying the roll-out of CCS technology will make achieving the UK's legally binding emissions targets costlier.[3] Sandbag urges the National Infrastructure Commission to boost the rapid development of this exciting new technology.

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[1] *National Infrastructure Commission call for evidence: Technology* https://www.gov.uk/government/news/nic-launch-technology-study-call-for-evidence

[2] *Lowest Cost Decarbonisation for the UK: The Critical Role of CCS - Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage* http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/

[3] *Energy Technologies Institute. (2017). Achieving cost-effective CCS: the route forward.* https://d2umxnkyjne36n.cloudfront.net/insightReports/2017-02-06-Achieving-cost-effective-CCS-WEETF-slides-COMMS.pdf?mtime=20170208095336

The following sections briefly respond to the Commission's questions, alongside references that provide further context on the relevance of CCS to British industry and infrastructure productivity.

How does Industrial CCS improve British infrastructure productivity?

In common with its international counterparts, British industry is threatened by an existential problem. In little over 30 years global industry will have to move from CO_2- emitting operations to net carbon-negative processes.

This will be particularly challenging for some industrial sectors such as traditional steel and cement-making where CO_2 emissions are intrinsic to their processes, such as in the chemical reaction required to manufacture Portland cement. These emissions cannot be mitigated through energy efficiency measures, low carbon electricity or other commercially available technologies. Process emissions, which account for up to 60% of the embedded carbon in cement, for example, will still exist even if industrial processes are powered entirely by clean electricity; CO_2 disposal infrastructure is therefore needed to capture and safely sequester those emissions if these industries are to be viable. The only alternative is to replace those products entirely.

Carbon Capture and Storage is a prerequisite for traditional industry to flourish in a carbon-constrained world and to make the UK an economically attractive location for international manufacturing where industries can be protected from the trend towards global carbon pricing.[4] With industrial CCS, the UK can be the home for new-build steel and cement plants that would have otherwise located elsewhere. This would build a resilient industrial base in the UK.

What stage has the technology reached in terms of demonstration and uptake?

Norway has led the way in Carbon, Capture and Storage, recently celebrating its twentieth year storing CO2 in the North Sea at Sleipner gas field.[5] New industrial projects will begin storing CO_2 in the next few years; a waste-to-energy plant in Oslo, a cement plant and an ammonia plant.[6]

Industrial CCS plants have been running since 1972 worldwide,[7] with notable large projects on steel in Abu Dhabi, and hydrogen from steam methane reformers in Port Arthur, Texas. Meanwhile commercial power plants with CCS are now running in the US (Petra Nova in Texas), Australia (Gorgon in Western Australia) and Canada (Boundary Dam in Saskatchewan; Quest in Alberta).

What evidence is there supporting the potential benefits that may be expected?

The main benefit of CCS is a significant long term saving for the taxpayer in the cost of decarbonising the economy. Whilst power emissions are falling fast (UK coal emissions fell 66% in 2016[8]), industrial emissions are proving much harder (and more expensive) to reduce.

The United Kingdom's Committee on Climate Change, established under Climate Change Act, found that reducing emissions by 80% by 2050 was almost twice as expensive across the whole economy without CCS.[9] Industrial

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[4] As well as across Europe, carbon pricing now covers Canada, much of the USA, South Korea, and this year China's pilot schemes become national. There are a dwindling number of states where industry can escape paying for its pollution.

[5] British Geological Survey – The Sleipner Field http://www.bgs.ac.uk/science/CO2/home.html

[6] Bellona – Norway's industrial CCS http://bellona.org/news/ccs/2016-09-norway-breaks-vicious-cycle-of-inaction-on-ccs-deployment-with-concrete-plans-for-industry

[7] Industrial CCS – GCCSI https://www.globalccsinstitute.com/understanding-ccs/industrial-ccs

[8] Why does the Carbon Price Support matter? – Sandbag https://sandbag.org.uk/project/why-does-the-carbon-price-support-matter/

[9] The Fifth Carbon Budget- Power sector scenarios https://www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf

emissions only directly account for approximately 6% of UK emissions, although that proportion is growing as electricity emissions fall.[10]

The Intergovernmental Panel on Climate Change (IPCC) found that decarbonisation to 2050 was 138% more expensive without CCS and, moreover, found that under most scenarios it would be impossible to stay below the safe limit of 2 degrees warming without CCS.[11] The IPCC make clear that to cut industrial emissions, "strategies such as emissions efficiency (including e.g., fuel and feedstock switching, carbon dioxide capture and storage (CCS))" will be required in addition to energy efficiency and other methods.[12]

The IEA, in its 2013 CCS Roadmap, projected that 45% of the CO_2 captured globally to 2050, consistent with its 2˚C Scenario, would come from industrial applications.[13] The UK should be part of this growth industry.

The UK Energy Technologies Institute (ETI) has found that failure to deploy CCS in the UK would double the annual cost of carbon abatement from 1% to 2% of GDP by 2050,[14] and highlights the case for industrial CCS.

Finally, Lord Oxburgh, in the foreword to his expert group's report to government last year,[15] stated:

> *"I have been surprised myself at the absolutely central role which CCS has to play across the UK economy if we are to deliver the emissions reductions to which we are committed at the lowest possible cost to the UK consumer and taxpayer."*

What evidence is there supporting the likely costs of introduction?

A recent report by the Teesside Collective and the consultancy Poyry gives the most up-to-date insight on pricing for industrial CCS, indicating the total cost, including access to a transportation and storage network, to be £58/tonne CO_2 stored in the UK.[16] This makes Industrial CCS significantly cheaper as a means of reducing emissions than offshore wind (£200/tCO_2 avoided) and newbuild nuclear power (£128/tCO_2 avoided). Additionally, carbon dioxide transport and storage pipelines and rigs would be strategically important infrastructure projects, enabling future negative emissions, and possible income from other countries looking to store their CO_2.

What are the principal challenges and barriers which need to be addressed to enable the maximum uptake of the technology?

Previous CCS pilots in the UK have been hamstrung by the unwillingness of the government of the day to fully support first-of-a-kind projects and to balance risk between the private and public sectors. The government has

[10] *UK Greenhouse Gas Emissions – BEIS https://www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics*
[11] *Fifth Assessment Report – IPCC https://www.ipcc.ch/report/ar5/wg3/*
[12] *AR5: Industry - IPCC https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter10.pdf*
[13] *IEA Technology Roadmap https://www.iea.org/publications/freepublications/publication/technology-roadmap-carbon-capture-and-storage-2013.html*
[14] *Building the UK carbon capture and storage sector by 2030 – ETI http://www.eti.co.uk/insights/carbon-capture-and-storage-building-the-uk-carbon-capture-and-storage-sector-by-2030*
[15] *Lowest Cost Decarbonisation for the UK: The Critical Role of CCS - Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/*
[16] *Teesside Collective http://www.teessidecollective.co.uk/industry-coalition-demonstrates-the-financial-case-to-seed-clean-industrial-growth-in-tees-valley/*

indicated it intends to invest in strategically important infrastructure[17], as is the case for a CO_2 transport and storage network. The most cost-effective initial projects require government intervention, but can be achieved far more cheaply than other key infrastructure projects such as Hinkley Point C or even the London Array.[18]

The CO_2 transport and storage network requires similar governance to other national infrastructure (e.g. the electricity network), underpinning as it does the future of industry in the UK, alongside building the platform for negative emissions as a means of offsetting certain emissions that may be unavoidable for some time yet (for instance, aviation).[19]

Securing financing for industrial CCS financing has proved difficult due to uncertainty over the long-term future of CO_2-producing companies, as the closure of the Redcar blast furnace bears witness to. Transitioning from methane ('natural gas') to hydrogen production for the gas grid may help here, as there is an assumption that the Steam Methane Reformers needed for this process will be economically viable in the long term. The Leeds City Gate H21 project is already working to transition the Leeds metropolitan area to hydrogen gas.[20] Sandbag have made a separate submission to the National Infrastructure Commission on the potential for hydrogen decarbonisation.

Would the introduction of the technology imply major changes to existing infrastructure, require new infrastructure, or does it fit with existing infrastructure?

Decommissioning the North Sea oil and gas infrastructure is likely to cost the UK taxpayer £24 billion in the coming years.[21] An industrial CCS transport and storage network would likely be able to repurpose much of this infrastructure, cutting the costs of decommissioning and, importantly, saving some of the 350,000 jobs currently reliant on the North Sea oil and gas industry.

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[17] *HM Treasury. Autumn Statement 2016* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/571559/autumn_statement_2016_web.pdf

[18] *Cost – The London Array* https://www.theengineer.co.uk/issues/november-2013-online/your-questions-answered-the-london-array/

[19] *UK Climate action following Paris – The Climate Change Committee* https://www.theccc.org.uk/wp-content/uploads/2016/10/UK-climate-action-following-the-Paris-Agreement-Committee-on-Climate-Change-October-2016.pdf

[20] *Leeds Gate H21* http://www.h2fcsupergen.com/news/hydrogen-in-the-north-the-h21-leeds-city-gate-report-launches/

[21] *Decommissioning - The Financial Times* https://www.ft.com/content/9b1d17d0-d425-11e6-b06b-680c49b4b4c0