CCSA response to PAC CCUS Report

7 February 2025

The Carbon Capture and Storage Association (CCSA) wishes to respond to the conclusions of the Public Accounts Committee's inquiry into Carbon, Capture Utilisation and Storage (CCUS). The CCSA brings together a wide range of specialist companies across the spectrum of Carbon Capture, Utilisation and Storage (CCUS) technology, as well as a variety of support services to the energy sector. The CCSA promotes the acceleration of commercial deployment of CCUS in the UK, EU and internationally through advocacy and collaboration to achieve net zero emissions by 2050.

Summary

The CCSA provide our response to the Committee of Public Accounts (PAC) report on CCUS. This follows the PAC inquiry undertaken late last year. Within this document, the CCSA provide a response to each of the recommendations that have been made under the 6 key conclusions presented within the report.

When considered in isolation, most of the recommendations provide helpful actions to be considered while delivering first-of-a kind-(FOAK) projects in UK. However, the CCSA disputes the narrative and conclusions upon which these recommendations are based. The Committee has not taken onboard expert advice on delivering against our Carbon Budgets and securing our leadership in tackling climate change, including the Intergovernmental Panel on Climate Change (IPCC) and the Climate Change Committee (CCC) who state that CCUS – a proven technology that has successfully been capturing and storing CO2 for over 25 years across the globe - is essential to achieving net zero.

In the following sections of this document, the CCSA provide the Committee with clarifications in response to the conclusions presented throughout their report. These clarifications seek to address vital gaps in evidence upon which the conclusions of the report have been based, and presents factual evidence that has, thus far, failed to be considered by the Committee.

CCSA Response

1. The Department is taking a high-risk approach by backing first-of-a-kind, unproven technologies with large amounts of taxpayer and consumer funding.

The Department has learnt from its previous two failed attempts to support CCUS in its design and early implementation of the current programme. This includes supporting 'clusters' of projects and developing a new approach to managing risks between emitter projects and transport and storage companies. Additionally, the Department has secured significant financial support from HM Treasury – almost £22 billion over 25years for five Track 1 projects. The government is also underwriting risks relating to the programme, creating contingent liabilities estimated to be worth up to £34 billion. But there are not any examples of CCUS technology operating at a commercial scale in the UK, meaning the performance of early projects is uncertain. The written evidence we have received raises concerns that CCUS projects may not capture as much carbon as expected and experience from Norway suggests that performance on the scale expected by the Department is far from guaranteed. The Department acknowledges the first-of-a-kind risks associated with the programme. It considers its approach for allocating costs and risks between the government and the projects reduces taxpayer and consumer risk because projects do not get paid until they deliver. But at this stage in the programme these models remain untested in practice.

Recommendation: *The Department should, as the projects it is supporting progress, make sure it is assessing on a regular basis whether taxpayer and consumer exposure is in line with expectations. This should include an assessment of whether its approach for allocating costs and risks between government and the projects is performing as intended.*

CCSA Response:

On international projects

- The CCSA agrees with the recommendation to regularly assess taxpayer and consumer exposure, but reiterates the societal cost of doing nothing; both in terms of the increased cost to emit under the UK ETS, but also the increasing risks posed by climate-induced impacts, such as extreme weather events.
- The PAC Committee do not appear to have considered this at all in its report, and we refer you to our response to Recommendation 3 for further details.
- While there are no commercial scale projects operating in the UK, there are numerous operational CCUS projects in other jurisdictions, demonstrating that this technology can be deployed at scale. The fundamentals of the underlying chemical and physical principles of CCUS technologies remain consistent, regardless of national boundaries, and are a clear demonstration of the proven viability of CCUS.
- Several advanced economies in Europe, North America, Asia and the Middle East are developing CCUS at pace. 2024 represented another year of exponential growth[1] in project development, with 50 commercial CCS projects operating around the globe and another 44 under construction. As of July 2024, the pipeline includes 628 projects - a 60% year-on-year increase.
- While there are numerous projects in operation globally, the report cites experience from Norway suggesting that performance on the scale expected by the Department is far from guaranteed. Equinor have provided a clear statement on the matter, highlighting that:
    - Issues with the measuring equipment for CO2 capture on Sleipner 2020-21 is well known, and a topic Equinor have been transparent about. Equinor detected this issue themselves and corrected it. The Sleipner and Snøhvit CCS projects have both had a long record of successfully storing the captured CO2 volumes, with nearly continuous injection histories. Equinor

[1] Global CCS Institute (2024): Global Status of CCS. Link.

and their partners so far have stored over 25 million tonnes of CO2 since 1996.
    - Based on the assessment of available data from other relevant systems, Equinor have no indication of measurement errors before this error, and none after the faulty equipment was replaced. The injection system has been fully operational in the entire period. As an example, the last 5 years Equinor have injected 99.7% of the CO2 that has been captured on Sleipner into the ground. The injection status and storage reservoir integrity, including monitoring results, are reported regularly to the authorities, which in this case is the Norwegian Environment Agency (Miljøverndirektoratet). the carbon intensity of all fields connected to Sleipner will be significantly reduced going forward due to the electrification project that came into effect in 2024[2].

On the UK's experience in establishing first-of-a-kind (FOAK) industries

- CCUS is a FOAK technology in the UK, so the initial projects will need some level of Government support in order to de-risk them and crowd in further investment to realise the opportunities. Without this initial investment, the sector cannot get off the ground and realise the potential benefits. This is consistent with how other FOAK industries were established, such as for offshore wind (OSW), a technology for which the UK is now a global leader.
- Deploying CCUS would aim to repeat the success of the £7.6 billion/year committed in the 2011 Levy Control Framework (LCF) – this should be compared to the current £0.8bn a year currently committed to kick-starting the CCUS industry - for renewable electricity generation, (now the Control for Low Carbon Levies) which secured private sector investment into the UK's OSW development pipeline.
    - Following strong initial investment and the design of a Contracts for Difference (CfD) regime for competitive allocation, the levelized cost of energy (LCOE) for solar PV and fixed offshore wind have come down sharply over time. This is in contrast to the nuclear sector, where stop-start investments and uncertain policy direction from Government have hindered cost reduction.
- Indicative cost modelling[3] indicates that costs and annual support revenues can significantly reduce over time following initial investments by Government. The CCSA is currently finalising a study demonstrating cost reduction strategies for CCUS.
- Recent research by SINTEF Energy Research and TU Delft[4] shows that implementing CCS in industrial facilities can result in significant CO_2 reductions at a minimal cost to the public.
- The business models which underpin CCUS are designed from examples and principles drawn from other more developed sectors, most notably a regulated asset base (RAB) and CfD mechanisms.
    - The Low Carbon Contracts Company (LCCC) are the nominated counterparty to the CCUS business models. The LCCC have provided guidance and advice to the government on how best to operationalise and

[2] Equinor (2024): Reducing emissions from Sleipner and Gudrun. Link
[3] CCSA (2024): Spring Budget Submission 2024: The UK's pathway to decarbonise industry, create jobs and boost our economy with CCUS. Link
[4] SINTEF (2023): New research from SINTEF and TU Delft shows that CCS can resuly in significant CO2 reductions at a marginal cost. Link.

manage the contracts to give the schemes longevity, future investment opportunities and to ensure their future success.
    - This draws on the LCCC's experience in the delivery of the CfD scheme since 2014, which has successfully facilitated investments in 29.4 gigawatts of renewable energy generation.
- Therefore, the conclusion that the CCUS business models are 'untested' does not recognise the success of the principles and experiences of establishing FOAK renewable sectors upon which they have been established.

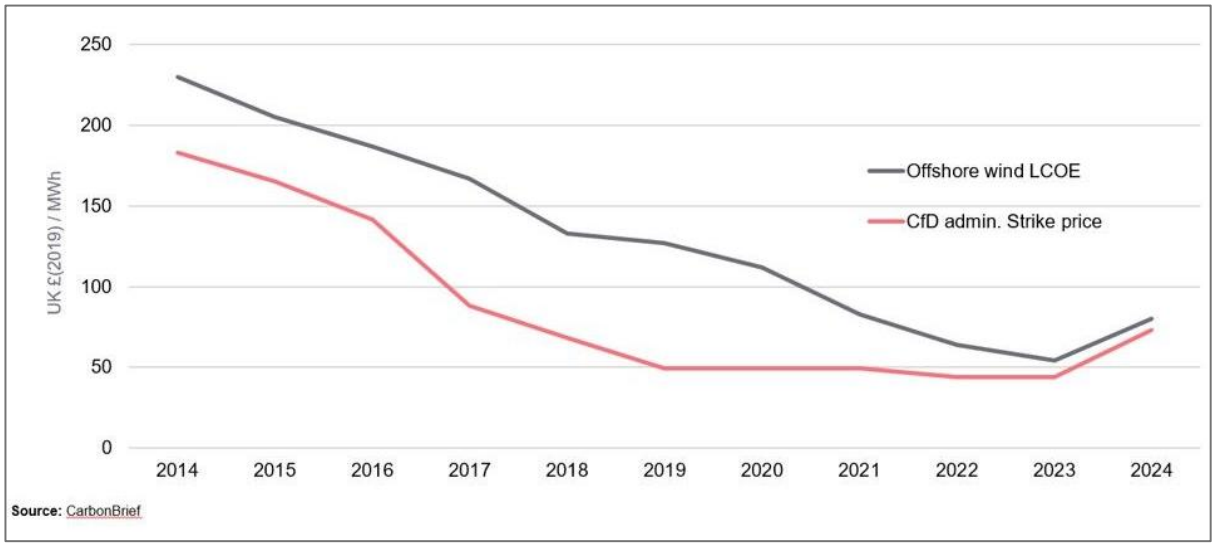

Figure 1: Reduction in UK Offshore Wind Levelised Cost and CfD Strike Price (£/MWh)[5]

[5] FutureBridge (2024): Is the Future of Offshore Wind Winding Down? Assessing Trends and Prospects. Link

2. While the Department is taking steps to incentivise efficient delivery of the CCUS projects, it has not established mechanisms to make sure that taxpayers and consumers will benefit financially should the programme be successful.

The Department has developed a range of business models for applying CCUS to a range of sectors. The models form the basis of negotiations between the Department and the private sector and outline how risks will be allocated between the different parties and set the payment mechanism. While the projects will receive the bulk of taxpayer and consumer support only when they are operational, the sums involved are substantial. Should the programme be successful, projects might eventually earn significant profits that are partly a result of early public support. Neither of the two contracts that the Department has already signed include any provision for the government to share profits or take an equity stake, or for consumers to benefit from lower energy bills should things go well. Nor does the Department seem to have considered any such 'gainshare' mechanisms when negotiating with the Track 1 projects.

***Recommendation** For all future CCUS projects, the Department should introduce mechanisms to make sure taxpayers and consumers benefit financially from the success of the projects they have supported financially.*

CCSA Response:

- Recent CCUS cluster studies conclude that every £1m invested in CCUS will deliver a benefit of up to £2m to the economy, highlighting the critical contributions of CCUS to maximising the UK's growth outlook[6].
- Deploying public finance through GB Energy and the National Wealth Fund presents opportunities for the taxpayer to hold a share in critical energy and infrastructure projects, while catalysing private sector investment through reducing initial project risk. This will see further benefits to the taxpayer to benefit from the growth and development of world-leading FOAK industries, such as CCUS.
- Government noted that deploying CCUS at scale in Teesside and Merseyside will attract £8 billion of private investment - directly creating 4,000 jobs and supporting 50,000 indirect jobs in the long-term[7].
- Overall government investment in existing Track 1 and 2 CCUS sector has the potential to deliver 44,000+ new jobs by 2040, while protecting thousands of existing jobs in industrial heartland that would otherwise be lost. This is expected to deliver a cumulative GVA of £67bn for the UK.[8] These numbers could also increase given number of further clusters that have the potential to deploy across the UK.
- Significant social and economic benefits will also be provided through the decarbonisation of key foundational industries and development of related emerging sector critical to wider decarbonisation efforts. For example, the cement sector employs over 29,300 people and contributes an annual GVA of £14,381 million to the UK.[9] CCS is critical to maintain these jobs and benefits, while having a domestic low carbon cement supply chain remains critical to the significant levels of construction required to deliver industrial growth in the UK.
- The CCC reiterate that CCUS is a necessity, not an option in several instances and failure to deploy CCUS will lead to offshoring of emissions and loss of jobs and

[6] CCSA (2024): Autumn Budget Submission 2024. (Unpublished)
[7] UK Government (2024): Government reignites industrial heartlands 10 days out from the International Investment Summit (Press Release), Link.
[8] Analysis conducted for CCSA Spending review submission, identified through a literature review of the cluster-specific studies for the Track-1 and Track-2 clusters.
[9] WPI Economics (2023): Economic benefits of industrial decarbonisation: A low carbon industrial future for the UK. Link.

economic activity across the UK. Over £1 billion has already been spent at risk by prospective project developers of CCUS projects in the UK[10].

- The later the UK delivers its first CCUS projects and provides routes to market for next projects and clusters, the greater the likelihood of critical industries closing down or relocating abroad and emissions being offshored rather than decarbonised.

[10] CCSA (2023): CCUS Delivery Plan Update 2023. Link.

3. The Department and HM Treasury have yet to assess the full financial impact of the CCUS programme on taxpayers and consumers.

The costs of the CCUS programme are significant: in November 2024 the government announced £21.7 billion of funding over 25 years to cover only the first five CCUS projects. There are three more projects that are still under negotiation as part of Track 1, an unquantified number of additional projects that are expected to join the HyNet and East Coast clusters as part of Track 1 expansion, and all the projects that will join the Track 2 clusters at Peterhead and Humberside. The Department has not indicated the likely cost of these projects. The Department and HM Treasury expect that around 75% of the cost of supporting these early projects will be met by levies on consumers who are already facing significant financial pressures, with the remainder funded by the Exchequer. Drawing on a recent report from the National Energy System Operator (NESO), the Department has concluded that supporting the deployment of CCUS in gas-fired power stations offers lower costs compared to alternatives. But NESO also concluded that this approach would require more upfront financial support. The Department has not looked at the likely financial impact on bills of the full CCUS programme at a time when households are already facing high energy prices.

Recommendation *The Department and HM Treasury should assess whether the full CCUS programme will be affordable for taxpayers and consumers, given wider pressures on energy bills and costs of living.*

CCSA Response:

- While the CCSA agrees with the recommendation to regularly assess the impact on the taxpayer and consumer, as noted in response to Recommendation 1, this must be considered against the future cost of emissions. Decarbonisation has a cost to society, and this report does not recognise the inevitable cost to consumers over time as a result of the increasing cost to emit under the UK ETS – as well as the societal costs of dealing with the impact of climate change e.g. flooding, and continued reliance upon imports.
- In this context, the CCSA challenges the report's framing of the cost of CCS in comparison to today's cost of doing nothing. It must be framed in terms of either the societal cost of the carbon emitted if CCUS isn't deployed, or the costs of alternative decarbonisation methods.
- Ultimately, the required investment for CCUS is significantly lower than the societal cost of carbon and the net cost to the UK economy of unabated emissions. To build an energy system fit for the future, which offers domestic security of supply and delivers net zero, will require initial investment.
- During the second session on 5.2.25, of the Energy Security and Net Zero Committee on "Work of the Department for Energy Security and Net Zero, Chris Stark, head of Mission Control for Clean Power 2030, outlined that he believes CCS will provide a "meaningful" contribution towards 2030 and emphasised the enormous benefits of clean dispatchable power to the energy system.
- The NESO, in its clean power plan to Government, finds that a future scenario utilising CCUS in fact adds value. It notes[11] that: *dispatchable low-carbon technologies "add significant value to the system", with even relatively small levels of operational capacity materially reducing the overall challenge for the rest of the clean power programme.*
- The Clean Power Plan will involve an **investment programme averaging £40 billion, or more, annually over the next 5 years, predominately from the private sector,** which, with the right policy mix, can be delivered without increasing costs for

[11] National Energy System Operator (2024): Clean Power 2030 – Advice on achieving clean power for Great Britain by 2030. Link

consumers, without compromising security of supply, and while bringing local economic and job opportunities.

- The plan also states that over the longer term, its *new dispatch pathway* – which deploys more CCUS and other dispatchable technologies **is overall cheaper than the *further flex and renewables pathway*** which focuses more on renewable energy generation for clean power.

- The CCSA also notes that the report's suggestion that LNG specifically will be used to 'run several CCUS projects' is misleading. It is accepted that LNG is GHG-intensive, and that the growing proportion in the UK mix is a challenge for gas-based projects. It is therefore critical that low-carbon dispatchable solutions are considered against a counterfactual of unabated gas.

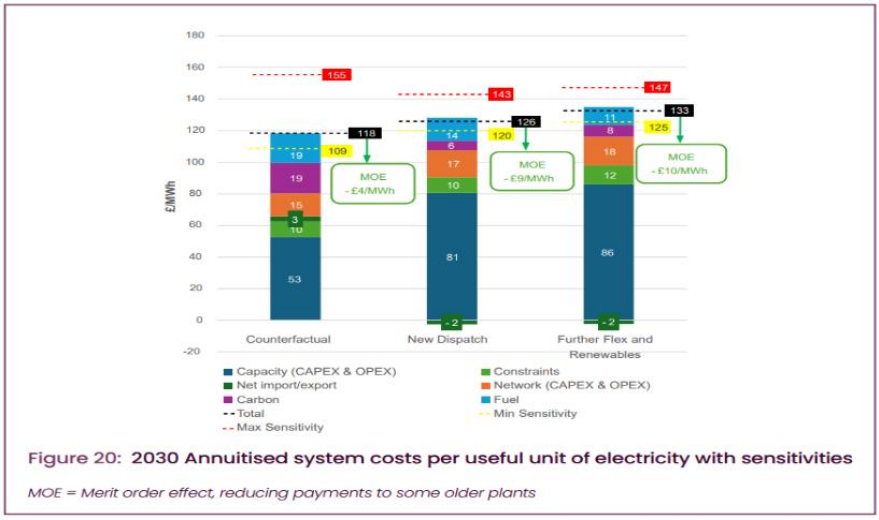

Figure 20: **2030 Annuitised system costs per useful unit of electricity with sensitivities**

MOE = Merit order effect, reducing payments to some older plants

Figure 2: 2030 Annuitized system costs per useful unit of electricity with sensitivities (NESO 2024, Clean Power 2030. Link)

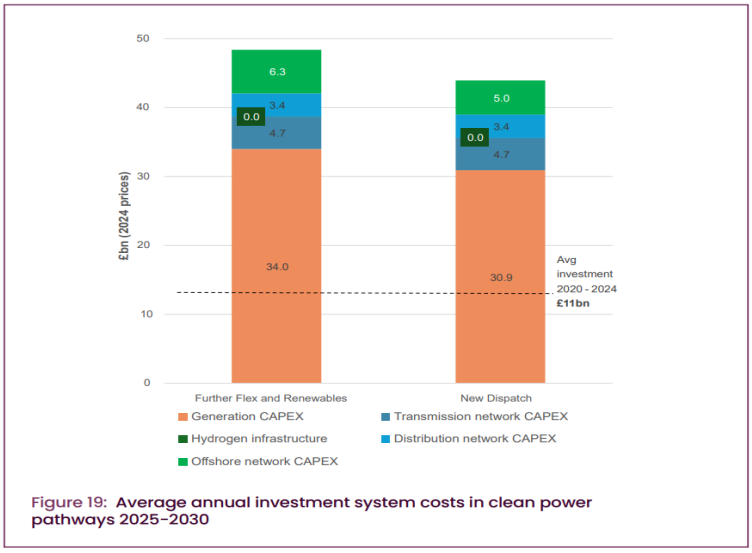

Figure 19: **Average annual investment system costs in clean power pathways 2025–2030**

Figure 3: Average annual investment system costs in clean power pathways 2025-2030 (NESO 2024, Clean Power 2030. Link)

4. The Department and HM Treasury lack clarity on how they would take account of project underperformance and advances in scientific understanding as part of their ongoing assessment of the programme's future.

The Department had a clear set of five factors it considered when assessing the value for money of the first two clusters and then the individual projects it selected as part of Track 1 of the programme. The Department and HM Treasury were also clear that projects would be subject to a further value for money assessment before awarding contracts. As part of this assessment it would consider the cost effectiveness of capturing carbon and wider economic issues such as investment in particular regions. But some recent scientific evidence suggests that producing liquid natural gas (which will be used to run several CCUS projects, such as Net Zero Teesside) leaks more methane, a potent greenhouse gas, into the atmosphere than previously thought. As CCUS will not reduce these 'upstream' emissions, this could undermine the rationale for pursuing certain projects. The government also expects bioenergy with carbon capture (BECCS) to play a significant role in providing negative emissions to offset residual emissions in other sectors. However, the National Audit Office has previously concluded that the government could not demonstrate the adequacy of monitoring arrangements for its existing schemes to support bioenergy in giving it confidence industry was meeting sustainability standards. In addition, Ofgem's critical findings in its recent investigation on Drax (which has received more than £6 billion of public funding over the last two decades) over its approach to reporting against sustainability criteria, have raised concerns over whether BECCS offers a genuine path to reducing emissions. We are therefore concerned that any government support for BECCS at Drax will not necessarily support its net zero ambitions and are minded to examine further the issue soon. If not all of the materials used were meeting the government's own sustainability standards this would be completely unacceptable.

***Recommendation** The Department and HM Treasury should reappraise on an annual basis its approach to assessing the value for money of CCUS projects which it intends to support. As part of this assessment they should consider the impact of up-to-date scientific understanding of CCUS. They should also make sure any future support for BECCS is accompanied by monitoring arrangements that provide real assurance that industry is meeting sustainability criteria.*

CCSA Response:

- The CCSA supports the recommendation, but it is vital that credible evidence is used to make a fair and accurate assessment.
- The NAO report[12] concluded that: DESNZ's current approach to CCUS deployment brings new complexities to be managed, depending on parallel, interdependent negotiations with projects across different technologies.
    - Achieving this may require the government to accept that some risks can only be partly mitigated, including higher costs to support early projects, **but this could be a risk worth taking if it determines that the potential costs of delays or pursuing alternatives could be significantly higher.**
    - Furthermore, the report highlights that **Government does not have, and is currently not developing, a credible alternative pathway without the use of CCUS, thus it is critical that DESNZ succeeds with its CCUS programme if the UK is to achieve its legally binding climate ambitions.**
- It should be reiterated that blue hydrogen and Gas-CCS have a significantly lower climate footprint than natural gas combustion; blue hydrogen, when used as fuel or feedstock in industry, can lead to significant cuts in GHG emissions; and utilising blue-hydrogen in the power and transport sectors can be a cost-effective steppingstone in the energy transition, kickstarting a UK hydrogen economy.
- The CCSA supports the use of stringent sustainability governance arrangements for the use of BECCS. Drax, and the wider biomass industry, has supported efforts to further evolve sustainability requirements, building on the already world-leading

[12] National Audit Office (2024): Value for money report on the UK CCUS programme. Link

and robust governance frameworks in place. We note that both the NAO report and Ofgem investigations cited by the committee did not find any evidence of biomass generators failing to meet existing sustainability requirements. Instead, both reports emphasised the need for improvements in evidencing and reporting—an issue the sector is actively addressing.

- As acknowledged in the NAO report, biomass will continue to play a crucial role in achieving net zero, particularly through carbon removals facilitated by BECCS. This aligns with net zero scenarios outlined by the Climate Change Committee, the International Energy Agency, and the IPCC, all of which indicate that targets cannot be met without significant carbon removals.
- To achieve this, the CCSA highlights the recommendations of *BECCS Done Well*, an initiative backed by leading environmentalist Jonathan Porritt. This framework outlines that BECCS can, and is, being done sustainably where critical conditions are met.

5. To date, the Department has done little to ensure that government support for CCUS is directed to the sectors or locations where it will be essential for achieving net zero.

CCUS is currently seen as the only way to decarbonise certain industries. For example, it is estimated that 60–70% of carbon emissions from the cement industry comes from chemical reactions. The government sees CCUS at the only means to prevent these from being released into the atmosphere. Projects producing energy from waste are also reliant on CCUS due to the lack of alternate green energy sources. Other applications for CCUS capture carbon from the burning of fuels and there can be alternative methods to decarbonise these processes (for example, through electrification). However, the Department's current cluster-based approach focuses on supporting carbon capture projects that are located close to one another. While this makes sense in terms of maximising the use of infrastructure such as pipelines, it does not ensure that financial support for CCUS is directed at the sectors which will need it most. The Department has not decided how it will support the use of CCUS at sites outside of industrial clusters, known as dispersed sites.

***Recommendation** The Department should set out its rationale for supporting CCUS in each sector where it could be applied, including considering whether alternative approaches could be more cost effective.*

CCSA Response:

- The CCSA challenges this statement, highlighting that it has been clear that the government's approach has been to apply CCUS in industrial heartlands, exactly where it is needed, to address the hardest-to-abate, residual emissions in industrial clusters.
- A substantial amount of work informed the government's CCUS cluster approach, which we expand on below, and provide references to in the appendix of this response.
- This CCUS cluster approach also ensures maximised value for money (VfM) by allowing a variety of industries to connect to a shared CO2 transport and storage (T&S) network over the longer term, offering a viable route to decarbonisation for other co-located industry. Addressing only very few industrial emitters as the report suggests, would not create economies of scale and electrification will simply not be possible for a large number of industries as well as heat and transport sectors.
- The focus of the approach is to achieve economies of scale, and the department has run a competitive allocation process to identify which projects it wants to prioritise (both VfM and potential to capture emissions). Each project looks at the viability of CCUS vs other technologies and – given the complexities and cost - it's extremely unlikely any project would do CCUS if there is a viable alternative.
- The CCUS clusters across the UK offer significant and targeted opportunities to contribute to emissions abatement:
    - The Humber and Teesside regions (East Coast Cluster and Viking Cluster), are estimated to produce roughly 50% of the UK's total industrial cluster emissions, making it a significant target area for decarbonisation efforts in the country.
    - North West of England and North Wales (HyNet Cluster), which will produce, transport and store low carbon hydrogen, aims to cut carbon emissions by 10 million tonnes annually by the early 2030s across the region. This is the equivalent of removing four million cars from the road.
    - Scotland: The industrial sites included in the (Scottish Cluster) emit an estimated 9.3 million tonnes of CO2 per year, accounting for around 80% of Scotland's industrial emissions. By 2030, the Scottish Cluster and Acorn

partnership aims to capture and store between five and 10 million tonnes of CO_2 each year - that is up to one third of the UK Government's total CO_2 emissions reduction target for that year.

- Peak District (Peak Cluster) is home to 40% of the UK's cement and lime production, and will cut 3 million tonnes of CO_2 emissions[13].
- South Wales (South Wales Industrial Cluster and 7CO2 Cluster) : The region is the second largest industrial emitter in the UK, releasing the equivalent of 16 million tonnes of CO_2 per year across industry and energy generation.

[13]Peak Cluster: Securing a low carbon future. Link

6. The Department has downgraded its ambitions for the CCUS programme, stating that the original 2030 ambitions are no longer achievable.

The current CCUS programme is the government's third attempt to introduce the technology. Compared with previous attempts, the government is now more reliant on CCUS succeeding as it sees the technology as essential to achieving net zero by 2050. But over the course of the CCUS programme's development, the Department has reduced its expectations of the carbon that will be captured and stored by the first wave of projects, known as Track 1. Its progress has also been slower than planned: the government recently agreed financial terms with two projects in the East Coast Cluster, around two years later than scheduled. In December 2024, the Department concluded that its target to capture 20 to 30 million tonnes of CO2 annually by 2030 will not be met. It has yet to announce revised targets for the programme. The 2030 ambitions for the CCUS programme were aligned with the government's pathway for meeting the decarbonisation goals for Carbon Budget 6 (2033–2037). As these targets have now been abandoned, it is not clear by what alternative means government will meet these legally binding goals.

Recommendation
a. *The Department should set out, as a matter of urgency, new targets for how much carbon it intends to capture through its CCUS programme and by when, and make clear how it will make up the shortfall created in its overall net zero pathway.*
b. *The Department should consider how it will monitor and report on the performance of CCUS projects in relation to the amount of net carbon captured.*

CCSA Response:

- The CCSA would agree with these recommendations. However, it should be noted that the 2030 ambition for the CCUS programme is no longer achievable due to Government delays in taking forward the necessary decisions, steps and developing the appropriate frameworks, including the CCUS Business Models, in order for projects to move ahead. Industry has been ready to progress and investing at risk for a number of years.
- Track 2 CCUS clusters were selected nearly a year and a half ago (July 2023) with no update provided to them since that time. However, private investment into these clusters continues with projects conducting detailed assessments and FEED studies, demonstrating that industry is still working towards timely delivery. In addition, Track 1 cluster projects were initially selected more than 3 years ago, while the final selection only took place in March 2023, showcasing the delays and slow pace of the programme development.
- Meanwhile, countries like Denmark progressed its CCUS programme much faster and at pace, awarding its first large-scale CCS project with a state-sponsored contract in 2023 and the project beginning to capture CO2 in 2025, demonstrating that with the right amount of certainty, industry and investors are able to deliver within the timescales required.
- Due to these Government delays and given the **CCC states that CCUS is an essential technology to achieve net zero, we simply cannot afford to roll back on CCUS deployment without compromising on the UK's net zero targets.**
- This is a critical decade for our net zero targets as the world is already well on its way to exceed the Paris Agreement 1.5 °C warming goal. According to a study by Imperial College London, "if we were to exceed 1.5°C there are clear benefits to reversing warming by acting to achieve net negative emissions globally"[14]. Carbon removal technologies enabled by CCUS infrastructure are therefore clearly crucial to address those residual emissions and they need to be deployed now to avoid the

[14] Imperial College London (2024): Reversing global warming as part of a climate overshoot likely to be difficult. Link

negative effects of an overshoot and to increase our chances of reversing any negative effects before it's too late.

- The CCSA would also strongly support the Department setting out how they are planning to meet carbon budget legally binding decarbonisation goals. It is clear by the 81% reduction by 2035 Nationally Determined Contribution (NDC) target that the UK submitted to the Paris Agreement, that this target is ambitious and requires huge efforts from all parts of society, industry and Government to reach it. This cannot be achieved without CCUS as it often the only solution available to decarbonise hard-to-abate industrial sectors. New capture and storage targets will be essential for investors and industry to deliver these projects whilst any Government hesitation on setting these will unavoidably risk the UK meeting its carbon budgets.

Appendix: CCUS Cluster Studies

As referenced in our response to recommendation 5, a substantial amount of work informed the government's cluster approach and selection. We provide examples of relevant work and studies below:

- UK Government (2021): Cluster Sequencing for Carbon Capture Usage and Storage Deployment Phase 1 – Background and guidance for submissions. Link.
- Global CCS Institute (2016): Global Status of CCS Special Report – Understanding Industrial CCS Hubs and Clusters. Link.
    - The report notably highlights that hub and cluster networks offer several distinct advantages for network participants, compared with 'point-to-point' projects. The hub and cluster approach reduces costs and risks for many potential CCS projects, and enables CO2 capture from small volume industrial facilities.
- Global CCS Institute (2015): The Global Status of CCS 2015. Link.
- The Oxford Institute for Energy Studies (2015). The evolution of European traded gas hubs. OIES Paper: NG 104. Link.
- IEAGHG (2015): Carbon capture and storage cluster projects: review and future opportunities. Link.
- Scottish Carbon Capture and Storage (2015): A CCS future for Europe: catalysing North Sea action. Link.
- TUC & CCSA (2014): The economic benefits of carbon capture and storage in the UK. Link.
- Zero Emissions Platform (2014): Business models for commercial CO2 transport and storage – Delivering large-scale CCS in Europe by 2030. Link.
- The Crown Estate, UK Government & CCSA (2013): CCS Cost Reduction Taskforce Final Report. Link.
- Global CCS Institute (2013): The Global Status of CCS 2013. Link.
- Hughes, C., (2013): Capacity Charging Mechanism for Shared CO2 Transportation and Storage Infrastructure.
- The Economist (2009): Clustering. Link.
- Melzer, L. S., (2007): CO2Transport –Building on the current framework to meet the demands of widely deployed, commercial scale CCS systems. Paper presented to the Sixth Annual Conference on Carbon Capture and Sequestration, Pittsburgh May 6-10, 2007.
- Tobin, J. (2003): Natural Gas Market Centers and Hubs - A 2003 Update. Link.

The report *Cluster Sequencing for Carbon Capture Usage and Storage Deployment: Phase-1* further demonstrates government's work on the cluster approach and selection:

- By identifying and supporting the CCUS clusters best suited to deployment in the mid-2020s, government aims to realise several key benefits of CCUS deployment. This will improve investor confidence and willingness to commit to CCUS projects by successfully demonstrating the operability and viability of the technology, as well as the demonstrating the effectiveness of the commercial frameworks and risk allocation mechanisms which enable their operation at scale. This will:
    - Generate key learnings across CCUS applications to improve cost certainty and reduce cost profiles for future deployment.
    - Improve certainty across the sector in mapping the UK's pathway towards successful industrial decarbonisation and the net zero transition.

- Demonstrate international leadership in CCUS and decarbonisation more widely, particularly in the context of the UK's role as chair of both the G7 and COP26 in 2021.
- Position the UK as a world leader in CCUS technologies, and accessing the economic benefits associated with this position, through both domestic infrastructure deployment and export opportunities.
- Contribute to both near-term and long-term emissions reduction targets under national carbon budgets.