



National Audit Office



REPORT

Carbon Capture, Usage and Storage programme

Department for Energy Security & Net Zero

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HC 120

Key facts

**Up to
£20bn**

the amount HM Treasury has committed to supporting future costs of Carbon Capture, Usage and Storage (CCUS) projects

**78bn
tonnes**

the UK government's estimate of how much captured carbon could be stored on the continental shelf under the North and Irish Seas

**8.5mn
tonnes
per annum**

the amount of CO₂ storage capacity targeted for 'Track-1', the first phase of the CCUS programme

- 4** the number of CCUS clusters announced by the Department for Energy Security & Net Zero (DESNZ) across the UK
- 8** number of emitter projects selected by DESNZ as part of Track-1 that are currently going through negotiations
- 2** number of transport and storage projects selected by DESNZ as part of Track-1
- 20–30 million tonnes per annum** the government's CO₂ storage ambition for 2030
- £630 million** DESNZ's spending to date on the CCUS programme

Summary

Background

1 The government sees Carbon Capture, Usage and Storage (CCUS) as central to achieving net zero by 2050. CCUS can potentially address several challenges to decarbonising the economy, such as in the power sector, and may be the only practical way to decarbonise some industries, such as cement production. CCUS could also be used to capture carbon absorbed during the process of growing biofuel (such as biomass used for generating power), or through a technology known as Direct Air Capture, which captures carbon directly from the air, resulting in a net removal of carbon dioxide from the atmosphere. CCUS includes several technologies that cover the process of capturing carbon and permanently storing it before it can be released into the atmosphere. These technologies include hydrogen production, energy generation, industrial and waste processes, and Greenhouse Gas Removals. The government considers that the UK is well placed to deploy CCUS given the possibility of storing 78 billion tonnes of captured carbon in the continental shelf under the North and Irish Seas. The government also hopes that CCUS will generate jobs in the UK and that, in the future, there may be a market for the UK to store carbon captured overseas. While the government first set out its intention to support CCUS in the early 2000s, there are no facilities operating at a commercial scale in the UK.

2 The government has attempted to launch CCUS programmes in the UK twice before without success. We reported on these in 2012 and 2017.^{1,2}

- The Department of Energy & Climate Change cancelled the first competition for government support in 2011. It decided that the project could not be completed within the funding limits agreed by the government in its 2010 Spending Review. We concluded that the government had not undertaken sufficient planning and failed to recognise the significant commercial risks.
- The Department for Business, Energy & Industrial Strategy (BEIS) cancelled the second competition in 2016 when HM Treasury withdrew funding because of mounting costs. We highlighted how BEIS had not, at the outset, agreed with HM Treasury the amount of financial support that would be required for the programme's lifetime. The cancellation of these competitions dented industry confidence in the government's commitment to CCUS.

¹ Comptroller and Auditor General, *Carbon capture and storage: lessons from the competition for the first UK demonstration*, Session 2010–2012, HC 1829, National Audit Office, March 2012.

² Comptroller and Auditor General, *Carbon capture and storage: the second competition for government support*, Session 2016–17, HC 950, National Audit Office, January 2017.

3 The Department for Energy Security & Net Zero (DESNZ) has lead responsibility for the current CCUS programme. Through its CCUS programme, DESNZ aims to establish the technology in four industrial areas, or clusters, in the UK to capture and then store 20 to 30 million tonnes of carbon per year by 2030. DESNZ has set targets which are based on the trajectory required to meet Carbon Budget 6, which is its legally-binding interim target for the period 2033-37 towards achieving net zero in 2050.

4 In October 2021, DESNZ announced that the first two clusters in the CCUS programme (known as Track-1) would be HyNet, spanning north-west England and north Wales; and the East Coast Cluster covering Humberside and Teesside. In March 2023, DESNZ announced that it had short-listed eight emitter projects across these clusters to proceed to commercial negotiations. DESNZ plans to identify additional emitters that could join these clusters later (known as Track-1 expansion). The application process for Track-1 expansion at HyNet was launched in December 2023. DESNZ also intends to launch two further clusters (Track-2) before 2030. These will be Acorn (centred on Peterhead, north of Aberdeen) and Viking (on Humberside), although no formal timeline has been announced.

5 In the March 2023 Budget, HM Treasury announced up to £20 billion to support the early development of the CCUS programme. This is a combination of direct government funding and consumer levies and, for example, levies on suppliers. DESNZ ultimately wants CCUS to run without public subsidy and published its CCUS Vision in December 2023, setting out at a high level how this might work in practice from the 2030s.

Scope and purpose of this report

6 This report examines:

- how DESNZ responded to the lessons of previous attempts to support CCUS in designing the current programme;
- the progress DESNZ has made with the current CCUS programme; and
- the key risks and issues that DESNZ will need to address to meet its targets for CCUS deployment.

7 This report is intended to support Parliament's understanding of the CCUS programme and the key issues DESNZ faces in achieving its objectives. We have assessed whether DESNZ has set up the CCUS programme in a way that is likely to achieve value for money and made recommendations aimed at supporting DESNZ's management of the programme. In doing so, we recognise DESNZ is operating in a high-risk environment given the inherent challenges of CCUS as a technology; the fact that DESNZ is aiming to support 'first of a kind' projects; and the complexities and high ambition of DESNZ's approach. This means risks of project failure, high upfront costs, and obsolescence will need to be accommodated if they are deemed to be outweighed by the programme's potential long-term benefits, particularly given the central role that DESNZ expects CCUS to play in achieving net zero. We also recognise that the CCUS programme is going to be one of government's largest projects financially, meaning HM Treasury has a crucial role to play in overseeing and managing the financial risks.

8 As DESNZ is currently conducting commercial negotiations with the Track-1 projects we have not included information that is commercially sensitive and which might negatively affect these negotiations if made public. Given its long-term nature, we expect to report again on the CCUS programme in the future to assess whether DESNZ is achieving value for money and whether it is effectively managing the risks we have identified in this report.

Key findings

Setting up the CCUS programme

9 **DESNZ and HM Treasury must manage a range of risks to be successful in deploying the first commercial-scale CCUS facilities in the UK.** For example, DESNZ needs to manage risks inherent to CCUS, such as introducing a complex technology at scale and the uncertainties around the potential capacity and performance of storage sites. Given the approach to implementation it is adopting, DESNZ will need to define and agree appropriate allocations of risk between the government and private investors providing the capital for the projects, as well as between companies involved within projects (for example, between carbon emitters and transport and storage companies). Ultimately, these individual projects need to be operational at the same time for the programme to be successful. Given the expected scale and longevity of the CCUS programme, HM Treasury will have an important role in ensuring there is a clear plan for funding, either via the Exchequer or through consumers' bills, and will need to be closely involved in cross-government governance arrangements (paragraphs 1.11 to 1.13, 2.2, 3.2 and Figure 6).

10 DESNZ identified lessons from previous failed attempts to launch CCUS in the UK and sought to address them. DESNZ introduced its current approach to CCUS in 2018. It reflects lessons learned from previous attempts by introducing a new method of creating transport and storage companies that are separate from the emitter projects that will capture carbon. This is intended to reduce the risks from projects that manage the capture of carbon, its transportation and storage all together. By separating out the stages, DESNZ hopes that issues can be dealt with by those best able to manage them (for example, so that a problem with a storage site has less of a direct impact on the associated capture projects). Instead of single projects, DESNZ's current approach is built on emitters in tight geographical clusters. It considers this will reduce risks by connecting projects across sectors, so that they share the costs of transport and storage infrastructure. DESNZ is looking to secure competitive tension from the selection of emitter projects in each cluster (paragraphs 1.12, 1.13 and 2.6).

11 DESNZ acknowledges that its design of the CCUS programme introduces new risks. Launching new technology at scale is inherently challenging as there are a range of technical and commercial risks that need to be addressed and there are no established solutions. DESNZ will need to conduct negotiations and conclude agreements with a range of emitting projects as well as transport and storage projects simultaneously, all against tight deadlines, while handling the different commercial risks that arise from each different business model. DESNZ told us that it considered competitive tension would be created through its ability to 'walk away' from negotiations and by the projects being considered for Track-1 expansion, which might replace Track-1 projects currently in negotiations (paragraphs 1.12, 1.13, 2.1 and 2.2; Figure 6).

12 DESNZ has taken steps to fill the capability and capacity gaps it has identified. Carrying out separate negotiations across different sectors each with its own business model, has placed considerable demands on DESNZ's capacity and capabilities. DESNZ established the CCUS Directorate in January 2021, which worked with the Hydrogen and Industrial Carbon Capture Directorate to manage the programme. At that time, this group had 51.5 full-time equivalent (FTE) staff, compared with the 103.5 FTE that DESNZ assessed it needed. As the CCUS programme progressed, DESNZ calculated that it would need many more staff. By 2023-24 DESNZ had a target of 206.5 FTEs, but an actual staffing level of only 144.5 FTE at the start of the year. DESNZ is confident it now has the resources in place to conclude negotiations around Track-1 (paragraphs 1.13 and 2.13).

13 DESNZ has increased its reliance on CCUS to contribute to meeting its net zero targets since it began designing the current programme but it has not fully considered whether this should result in changes to the programme’s design.

DESNZ’s predecessor, BEIS, began developing its approach to supporting CCUS in 2018, when the government’s overall climate ambition was to reduce carbon emissions by 80% in 2050 compared with 1990 levels. At that time, the government was committed to ‘having the option to deploy CCUS at scale during the 2030s’. In 2019, the government established its net zero target, for which the Climate Change Committee (CCC) has said CCUS is “essential”. The CCUS programme has subsequently adopted the ambitions for carbon capture in 2030 that are implied by the CCC’s balanced net zero pathway – a far higher level of ambition than at the outset of the programme. DESNZ told us that it considered whether, for example, an approach where government carried more of the cost and risk of the first projects was required in the light of the ambitions for CCUS, but we have not seen any substantial evidence of such an assessment (paragraph 1.8).

14 DESNZ and HM Treasury have committed up to £20 billion to the early deployment of CCUS, responding to lessons they had learnt from past failings, but uncertainty remains around the funding available for future stages of the CCUS programme. HM Treasury announced this commitment in the spring 2023 budget, but neither it nor DESNZ specified which elements of the programme are covered. DESNZ and HM Treasury acknowledge that further funding will be required for the CCUS programme and that they plan to agree the funding available in stages. Agreeing this will be important so that DESNZ can tailor its approach to the later stages of the programme within the available funding limits. In setting funding limits, they will need to give investors certainty without undermining the government’s negotiating position by making clear to commercial parties the maximum funding available. HM Treasury told us it hoped agreeing government support for Track-1 projects would give industry confidence about the government’s commitment to CCUS (paragraphs 1.11 and 3.17)

Progress to date

15 The government has so far spent £630 million on its CCUS programme, primarily through grants to support the early development of projects. For example, it has spent almost £200 million through the Industrial Decarbonisation Challenge fund (which invests in developing carbon capture and storage technologies) and a further £346 million on research and development projects. Around £30 million of this spending was through the Carbon Capture and Storage Infrastructure Fund, a total potential fund of £1 billion, which the government first announced in 2020. This Fund was established primarily to support the capital costs of establishing transport and storage infrastructure and early industrial capture projects. DESNZ will allocate the remainder to support construction through its negotiations with emitter projects. In addition, DESNZ has spent at least £84 million administrative support for the programme (paragraphs 1.9 and 2.13).

16 DESNZ is behind schedule in agreeing government support for the Track-1 projects. In November 2020, BEIS stated that it wanted to deploy CCUS in a minimum of two industrial clusters by the mid-2020s. DESNZ has now reduced its ambition so that it is “supporting” two clusters by the mid-2020s, rather than them being in operation by this date. DESNZ has pushed back the Final Investment Decision (FID) for the Track-1 cluster projects to at least September 2024, around nine months later than the original plan to have this stage completed by the end of 2023. However, DESNZ is considering whether it should have different FID dates for some of these projects, to prioritise the projects which can start construction rather than waiting for all projects to reach this stage (paragraphs 2.15 to 2.17).

17 DESNZ has reduced the amount of carbon it expects Track-1 projects to store because of delivery constraints in one of the two shortlisted clusters. DESNZ considered two options for Track-1 – one which involved 15.5 million tonnes per annum (Mtpa) of carbon storage and one which aimed for 8.5 Mtpa. DESNZ initially preferred the 15.5 Mtpa option as it offered lower lifetime delivery costs and a clear trajectory to meet its 2030 ambitions. In November 2022 it reversed its preferred option because of feasibility challenges with some storage sites. In addition to supporting fewer carbon capture projects overall, DESNZ concluded that the 8.5 Mtpa option was not compatible with a bioenergy with carbon capture and storage (BECCS) project. It is therefore unclear how DESNZ will meet the 2030 target for engineered Greenhouse Gas Removals as it expected BECCS to contribute significantly to the 5 Mtpa ambition (paragraphs 2.8 to 2.10).

18 There has been significant private sector investment in the programme, which DESNZ attributes to its creation of business models that allocate costs and risks between government and investors. DESNZ plans to support CCUS in eight sectors with taxpayer and consumer funding. To date, it has focused on developing business models for waste and industrial carbon capture, power generation, the production of hydrogen from methane (which, with carbon capture, is known as blue hydrogen production), and transport and storage networks. Across these, DESNZ is taking a proportion of the risk to incentivise private sector investment. This is supported by different funding structures which look to, for example, encourage technology specific outcomes such as investment in facilities and the functioning transport and storage network. Industry estimates that the private sector has invested around £1 billion of development expenditure in projects, which reflects its willingness to negotiate terms based on these business models (paragraphs 2.2 and 3.17, and Figures 6 and 7).

19 DESNZ has organised its negotiations with Track-1 projects to manage the risk of conducting multiple negotiations simultaneously. DESNZ has established a high-level mandate to guide negotiations for each business model and has established an approach to identifying and then managing risks across these. The precise terms of government support provided through its business models are subject to negotiation, such as the target rate of return for investors and the thresholds for government intervention. The effectiveness of DESNZ's approach can only be fully assessed once negotiations are complete (paragraphs 2.11 to 2.13).

20 DESNZ and HM Treasury are developing the framework for assessing the value for money of the Track-1 projects and deciding whether to award them government support. DESNZ and HM Treasury have been clear that the government's FID will be subject to assessments of value for money. HM Treasury told us that the parameters of its value for money assessment were still under review. Track-1 projects have particular characteristics which need to be considered when assessing value for money, such as being 'first of a kind' projects and potentially enabling greater benefits to be achieved by later stages of the programme. DESNZ and HM Treasury will also need to take account of the downside of not proceeding with support, particularly the government's environmental goals and the impact on investor confidence (paragraphs 1.12, 2.10 and 3.16).

Future risks to manage

21 Future progress of the CCUS programme is dependent on reaching FID for at least some of the Track-1 projects. While agreeing deals to support Track-1 projects on a slower timeframe than initially planned could be accommodated, not reaching FID at all would have a significant impact on the confidence of investors to engage with the government, as happened in the wake of the cancellation of the previous CCUS competition in 2016. Reaching FID will require the government to assure investors in the Track-1 projects that they have the prospect of a securing a return on their investment, which could be over a long period of operation following their initial expenditure on construction. There is a risk that failing to achieve FID on Track-1 projects would result in a delay of several years in deploying CCUS in the UK and may require the government to seek alternative approaches to meet its carbon budgets (paragraphs 2.14 to 2.16).

22 Once FID is achieved, DESNZ will have a new and significant set of risks to manage as the programme moves into the next stage of implementation. Numerous technical issues remain. For example, carbon capture facilities need to be installed onto existing plants, and pipelines need to be built to connect these to onshore terminals and then to undersea sites. There is also uncertainty surrounding the practicalities of the proposed methods for capturing and storing carbon. This includes how effective the solvents that projects will use to capture carbon will prove and whether proposed storage areas are viable. Fundamental to the programme's successful operation is the proper functioning of the regulatory framework, responsibility for which sits with Ofgem and other bodies (paragraphs 3.2 to 3.8 and Figure 10).

23 Slower progress with getting Track-1 up and running means that DESNZ will struggle to achieve its 2030 ambitions for carbon capture. This is for a number of reasons.

- DESNZ reduced its ambitions for the amount of carbon that could be stored. It estimates that the amount of carbon which could be captured by the eight emitters with which it is currently negotiating for Track-1 is less than a quarter of its lower target for 2030.
- There are currently no dedicated BECCS or other Greenhouse Gas Removal (GGR) projects being negotiated under Track-1, creating significant risk that it could miss its ambitions to capture and store 5 Mtpa of carbon from GGRs by 2030.
- DESNZ has launched a process to expand the HyNet Cluster and has begun engagement with the Track-2 clusters. However, it is likely that negotiations for Track-1 expansion and Track-2 will not advance significantly until DESNZ has concluded negotiations with Track-1 (paragraphs 2.8 to 2.10 and 3.12).

Conclusion on value for money

24 DESNZ and the CCC have described CCUS as being ‘essential’ to achieving net zero. The government does not have and is currently not developing a credible alternative pathway without the use of CCUS. In this context, it is critical that DESNZ succeeds with its CCUS programme if the UK is to achieve its legally binding climate ambitions. DESNZ has applied lessons it has learnt from previous failed attempts to launch CCUS. But the inherently challenging nature of CCUS remains, given the nascency of aspects of the technology. And DESNZ’s current approach brings new complexities to be managed, depending on parallel, interdependent negotiations with projects across different technologies. Completing negotiations to support the Track-1 projects will be a very significant milestone in signalling the programme’s commercial feasibility and the government’s commitment to CCUS. 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. The government will extract greater value for money from the first wave of projects if it ensures lessons are captured, both in terms of the negotiation process and technologically, to enable costs to come down in future, as has been the experience for offshore wind.

Recommendations

25 DESNZ and HM Treasury should:

- a** should ensure that the criteria for considering value for money, ahead of deciding whether to proceed with government support for the Track-1 projects, consider the follow-on benefits that will be achieved by launching a new technology in the UK;
- b** consider which sectors of the UK economy are most reliant on CCUS to decarbonise and what viable alternative means of decarbonisation may be available for the UK to achieve net zero; and
- c** in light of the outcome of Track-1 negotiations and prior to commencing negotiations on Track-1 expansion, consider what actions government needs to take to sustain investor confidence in the CCUS programme. This might include agreeing and communicating indicative funding available for Track-1 expansion and Track-2.

26 DESNZ should:

- d** identify lessons from its Track-1 negotiations, particularly relating to business models, resourcing and maintaining competitive tension, and ensure that these are carried over to its subsequent work on Track-1 expansion and Track-2;
- e** ensure it maintains sufficient oversight of the progress of Track-1 projects during construction and operation so that it can identify early any issues arising that impact on the CCUS programme's objectives, such as delays to construction or lower-than-planned injection capacity, and so that it can draw technical and commercial lessons that can inform projects in later stages of the programme; and
- f** ensure that the scale and timing of these next steps are achievable, given the resources available to it and, in turn, whether this enables the CCUS programme to achieve the emissions reductions required under Carbon Budget 6.