National Audit Office

Report
by the Comptroller
and Auditor General

Department for Business, Energy & Industrial Strategy

Carbon capture and storage: the second competition for government support

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Key facts

£1bn

capital support available to bidders in the government's second competition for supporting carbon capture and storage

£100m

cost to government of the second competition prior to its cancellation

£8.9bn

upper limit of the Department's range of expected cost to consumers over a 15-year period once the two competition projects started generating electricity

16	examples of operational large-scale carbon capture and storage (CCS) projects worldwide at January 2017
0	examples of large-scale CCS in the UK
2007–2011	years the government ran its first competition for support to build CCS
2012–2015	years the government ran its second competition for support to build CCS
2	preferred bidders that undertook design and engineering stage research and development during the second competition
75%	percentage of the bidders' design and engineering costs that the government planned to meet
£168 million	amount the Department of Business, Energy & Industrial Strategy (the Department) has spent (2015-16 prices) on the two CCS competitions
£30 billion	the Department's 2015 estimate of the cost to meet the UK's 2050 decarbonisation target without CCS in the power sector

Summary

1 The Department for Business, Energy & Industrial Strategy (the Department) has lead responsibility for solving the UK's energy 'trilemma': ensuring a secure supply of energy that is affordable for consumers and helps the UK to meet its decarbonisation target to reduce carbon dioxide emissions in 2050 by 80% compared to 1990 levels.[1] In 2012, the Department launched its Electricity Market Reform strategy, which set out how it would secure investment in new generating capacity to achieve this target while meeting the challenge posed by increasing demand for electricity and closures of existing capacity in the 2020s and beyond.

2 Carbon capture and storage (CCS) formed an important part of the Department's plans to reduce carbon dioxide emissions. The Department expected CCS to enable existing and new fossil-fuelled power stations to produce low-carbon electricity. In 2015, the Department estimated that it would cost the UK £30 billion more to meet the 2050 target without CCS in the power sector because a more expensive mix of low-carbon technologies would be required. Once established, CCS could also potentially help to decarbonise the industrial sector and domestic heating systems.

3 CCS is a process to avoid the release of carbon dioxide (CO_2) into the atmosphere. It involves capturing CO_2 from sources such as power stations and energy-intensive industries, transporting it through pipes and storing it, usually underground. Globally, there are 16 examples of large-scale CCS operating with 22 more being developed. Most aspects of the transport and storage technology are well established in the oil and gas sector. However, only two of the 16 examples operating globally are at a large power station and the commercial viability of designs for capturing CO_2 from power stations has not been fully established.

4 Like other low-carbon power technologies, CCS is currently too expensive in the UK to be commercially viable for private developers without public support. CCS faces additional investment barriers due to a lack of supporting infrastructure and the risks involved in being the 'first-of-a-kind' in this country. The government has twice tried to help developers overcome these barriers. The Department launched its first competition for the government to support the development of the first CCS projects in 2007, but cancelled it in 2011 before awarding funding.

1 On 14 July 2016, the government announced that the Department of Energy & Climate Change (DECC) would close and its responsibilities for energy markets and climate change would transfer to a new department, the Department for Business, Energy & Industrial Strategy (BEIS). References to 'the Department' throughout this report that relate to events prior to July 2016 are referring to the then DECC.

5 In 2012, it launched a new CCS programme, with an objective to enable developers to invest in CCS in the early 2020s with government support that is comparable to other low-carbon generating technologies. The second competition was the start of this plan, with the Department hoping it would demonstrate the commercial and technical viability of deploying CCS in the UK.

6 In its 2015 Spending Review, the government announced the £1 billion capital funding allocated to the second competition was no longer available. This decision led to the two competition bidders, Shell and Capture Power Limited, cancelling their projects. It came shortly before the Department was due to receive their bids and decide whether either would receive support. In July 2016, we reported on the Spending Review process that led to HM Treasury, which runs spending reviews, withdrawing funding for the second competition.[2] We found HM Treasury considered:

- the costs to consumers through contracts for difference (the consumer-funded mechanism for supporting projects once up-and-running) would be high and regressive;
- the competition was aiming to deliver CCS before it was cost-efficient to do so;
- the competition would not guarantee the further investment required to expand CCS; and
- there were better uses for the £1 billion.

7 Had the competition been successful, the Department expected it to enable further CCS projects, with gradually reducing deployment costs and a decreasing requirement for government support. Given its potential to decarbonise different sectors, many stakeholders still regard CCS as being critically important to the UK achieving its decarbonisation target. It is currently inconceivable that CCS projects will be developed without government support. This may change, particularly if the price generators are required to pay for emitting CO_2 increases. Additionally, CCS may need to play less of a role in decarbonising the power sector if there are developments in storage, demand-side or nuclear technologies, which mean other forms of low-carbon generation become better suited to meeting the country's low-carbon energy needs affordably. The Department will indicate in due course what role, if any, CCS will play in meeting the 2050 target, or whether it now expects to reduce CO_2 emissions through other means.

2 National Audit Office, *Briefing: Sustainability in the Spending Review*, July 2016.

Scope of our report

8 This report assesses how the Department ran the second competition before its cancellation. It builds on the recommendations we made in our 2012 report on the first competition and makes new recommendations relating to the Department's future CCS plans.[3] The report:

- gives an overview of the CCS technology and its challenges (Part One);
- describes the government's efforts to support CCS through the competitions, the costs it has incurred and assesses the value that the competitions have generated (Part Two);
- assesses how the Department designed the second competition (Part Three); and
- evaluates how the Department planned to fund the competition projects (Part Four).

We do not assess whether withdrawing funding for the competition, leading to its cancellation, was the correct decision, but do identify ways in which the Department's running of the competition contributed to this outcome.

9 We evaluate the Department's performance according to: its objectives for the competition; the recommendations in our 2012 report; and good practice we have identified in assessing other government projects. We set out our audit approach in Appendix One and our evidence base in Appendix Two.

Key findings

The role of CCS

10 CCS could make a significant contribution to decarbonising the economy, but there are challenges which increase the costs to deploy it in the UK. CCS has the potential to contribute to the decarbonisation of the power, industrial, transport and heating sectors. Together these make up around 83% of the UK's CO_2 emissions. At present, there are no working commercial-scale examples of CCS in the UK, which makes it more expensive because investors in the first projects require a higher return in line with the greater risk. CCS also requires investment in new transport and storage infrastructure, which creates additional costs. The Department has stated that the costs to deploy CCS must come down for it to fulfil its potential in contributing to decarbonisation (paragraphs 1.4 to 1.13).

3 Comptroller and Auditor General, *Carbon capture and storage: lessons from the competition for the first UK demonstration*, Session 2011-12, HC 1829, National Audit Office, March 2012.

Costs and benefits of the competitions

11 The government has spent £168 million on its two CCS competitions. The Department spent £100 million on the second competition, in line with its budget for the stage it had reached. The Department spent £68 million on developing the first competition, which it cancelled in 2011. Cancelling the second competition has impacted on investors' confidence and means they may demand better conditions to engage with the government again, such as being required to bear less risk (paragraphs 2.7 and 2.8).

12 The value of the Department's spending on the second competition will depend on how it takes forward CCS. The competition achieved some benefits. It improved the Department's and bidders' understanding of the risks and technical and commercial challenges involved in deploying CCS in the UK. The two short-listed developers have produced a set of publicly accessible 'key knowledge deliverables', which set out learning about the projects' design, construction and commissioning. The Department expects developers to use these in any future CCS projects. Some of this learning could apply to other projects, such as appraisals of two potential storage sites and learning about commercial risk-sharing. But other learning could be lost, as project teams disband, or because it was specific to the projects being developed (paragraphs 2.9 to 2.13).

Competition design

13 The Department opted for a two-phase outcome-based competition because the commercial and technical uncertainties were too great to set a more detailed specification at the outset. In early 2012, the Department considered 21 different options for deploying CCS, of which it assessed five in detail. The Department concluded that the commercial, technical and cost uncertainties around CCS meant it could not identify which option would best meet its objective to reduce costs of future projects. Rather than specifying the technical details of the projects it wanted, the Department opted to start a two-phase outcome-based competition. In the first phase, it would shortlist two developers to undertake work that would reduce the uncertainties, before deciding whether to award contracts to either project to build their facility in the second phase (paragraphs 3.3 and 3.4).

14 The Department designed the competition so it could withdraw from supporting its preferred bidders without incurring cancellation costs. We have reported on many government projects to design, build and operate infrastructure or IT systems. We have found that, in many cases, departments awarded contracts where the commercial arrangements did not give them sufficient flexibility to manage uncertainties from the outset. In this case, the Department was not contractually obligated to the preferred bidders beyond the first phase. This limited its liability when it cancelled the process before deciding whether to contract either developer to build their facilities (paragraphs 3.5 to 3.7).

15 However, the terms of the competition contributed to one of the shortlisted projects being unlikely to reach the construction phase. The Department required projects to cover the 'full CCS chain' – from generation to storage – or have access to a full chain. Capture Power Limited, a consortium of companies looking to obtain external investment in the project, accepted this condition. However, it was struggling to allocate risks between the parties covering the different elements of the CCS chain in a way that would enable it to secure external investment. The project also could not find a partner to manage the storage facility. On this basis, this project would not have been able to present a final proposal fully in line with the Department's specifications (paragraphs 3.8 to 3.13).

16 The other competition project was more commercially viable but had less potential to reduce the costs of subsequent CCS projects. Shell took responsibility for the full chain of its project, meaning it did not face the same challenges as Capture Power Limited. This meant it was more able to submit a bid in line with the Department's specification. However, its location meant there would be fewer subsequent projects that could share its infrastructure. The Department noted this in its scoring of the project bid at the outset of the competition. It considered having a full-chain project operating in the UK would increase subsequent investors' confidence sufficiently to outweigh the disadvantages of its location. But HM Treasury withdrew funding partly because it concluded that the competition projects would not enable the CCS sector to expand without significant further costs to consumers (paragraphs 3.14 and 3.15).

17 Many stakeholders think the government needs to carry more risk to make CCS more affordable to consumers. The Department's approach to allocating risk was in line with wider energy policy that the private sector should, as far as possible, bear the construction and operating risks of new generating capacity. The Department received bids on this basis, which it took as evidence of the CCS sector's acceptance. But it is now clear that, of the two shortlisted projects, only Shell's appeared able to comply in full with the risk allocation. Many in the CCS sector do not consider it likely that certain conditions around Shell's project can be replicated and therefore think the government should bear more risks, particularly over stored CO_2, for CCS to be built in the UK. Government taking a greater share of the risk could reduce delivery costs, as developers and investors require lower returns when they carry less risk, but would expose taxpayers to losses in the event of risks materialising (paragraphs 3.16 and 3.17).

Funding the competition projects

18 The Department began the competition without agreeing with HM Treasury on the amount of financial support available over the lifetime of the projects. In our report following the first competition, we recommended that the Department and HM Treasury should be clear about the funding available across the life of the programme. For the second competition, the £1 billion capital towards construction was clear from the outset. There was less clarity on the revenue support that would be available through consumer-funded contracts for difference (CfDs), which fix the 'strike price' that developers receive for each unit of electricity they sell. When it launched the competition, the Department was uncertain about how much it would cost consumers and expected their contribution would be between £2 billion and £6 billion. But the Department did not agree with HM Treasury an overall budget for the total cost of the projects from the outset, which would have enabled it to tailor its approach to the competition within known affordability constraints (paragraphs 4.2 to 4.5).

19 The Department expected the unit costs of electricity from the competition projects would be higher than for subsequent CCS projects and other low-carbon technologies. Building the first CCS projects is made more expensive than established technologies by the risks inherent with being the 'first-of-a-kind' in this country, but the Department's competition design added additional costs to the first projects. The Department's long-term CCS programme plan required the competition projects to build and pay for the transport and storage infrastructure, reducing the costs of subsequent projects that could share it. The Department's allocation of most risks to bidders also increased the return the developers required on their investment, over and above the higher return already required for developing 'first-of-a-kind' projects. Additionally, the terms of the competition limited the size of generating plant that could take part, which reduced unit cost savings achievable through economies of scale. The Department established a Cost Reduction Task Force, which set out in 2013 how the costs of deploying CCS would reduce in subsequent projects. The competition projects' expected costs were in line with the task force's predictions (paragraphs 4.6 and 4.7).

20 The expected costs to consumers of the competition projects contributed to HM Treasury's decision to withdraw its support. By the time of the 2015 Spending Review, when it knew more about the competition projects through its negotiations, the Department had increased its estimate of the costs to consumers to between £3.9 billion and £8.9 billion. HM Treasury had sight of the Department's estimates during the competition through the CCS programme board. But during the 2015 Spending Review, HM Treasury noted the projects' CfD strike prices were expected to be around £170 per megawatt hour (MWh) compared with the wholesale market price of around £45, meaning costs to consumers of the projects would be high and regressive. It also concluded that reducing subsequent projects' costs further would require significant additional consumer support through CfDs. Following the competition, the Department identified the importance of clearly articulating, particularly within government, why the programme was necessary and why the competition projects were more expensive than mature and extensively deployed low-carbon technologies (paragraph 4.8).

CCS in the Levy Control Framework

21 Flaws in the design and implementation of the Levy Control Framework impacted on CCS investors' confidence. The Department would have included the costs of CfDs for CCS in its Levy Control Framework (the Framework), which caps the costs of certain consumer-funded policies up to 2020-21. We recently reported how the Framework has not met its potential to support investor confidence because of poor forecasting, a lack of transparency and its short and reducing time frame.[4] In April 2015, the Department forecast it would breach the Framework limit, leading it to reduce support for low-carbon technologies other than CCS. Developers of CCS projects outside the competition found these reductions in support caused them to have concerns that the government would also not provide further support for CCS beyond the competition, even before it was cancelled. During the Spending Review, the Department set out to HM Treasury its intention to provide support through CfDs for up to two future CCS projects. It could not make decisions about the nature and amount of this until the Spending Review and the competition had concluded (paragraphs 4.9 to 4.11).

Conclusion on value for money

22 The Department's plan to use a competition to develop and deploy carbon capture and storage was ambitious but, ultimately, unsuccessful. Achieving this goal was challenging because the untried nature of the technology in this country meant the costs and benefit of the proposed projects were inherently uncertain. Given the level of challenge, it was an achievement for the Department to sustain negotiations with the preferred bidders so that it gained valuable technical and commercial knowledge about how to deploy the competition projects. But the Department did not agree a funding limit with HM Treasury for the cost of contracts for difference to ensure it could manage the competition within the bounds of agreed affordability constraints. HM Treasury then withdrew its funding, partly because it concluded the proposed projects were too expensive and would not provide strategic benefits to warrant the impact they would have on consumers' bills.

23 We conclude that the Department has not achieved value for money from the £100 million it spent on the competition. Any value that could be gained is contingent on the Department and the CCS industry applying the lessons they learnt as a result of the competition. The Department should take some credit for designing the competition in a way that enabled withdrawal from proceedings without significant additional financial consequences.

4 Comptroller and Auditor General, *Controlling the consumer-funded cost of energy policies: The Levy Control Framework*, Session 2015-16, HC 725, National Audit Office, October 2016.

Recommendations

24 In developing its next phase of supporting CCS, the Department should:

a **Maximise the potential value from the competition by incorporating the lessons it and the key stakeholders have learned into any new CCS strategy.** The Department will be more likely to achieve this if it limits the dissipation of skills, knowledge and experience where possible, both within government and the wider CCS industry.

b **Ensure it understands, from the outset, the position of CCS developers and their ability or willingness to carry certain risks and applies this in its approach.** This should, for example, dictate which strategy is feasible and what delivery model is appropriate. In particular, it should consider how it will allocate storage risk, and learn from the challenges of sharing risks between participants in a project that are responsible for separate elements of the CCS process.

c **Assess options for how it can make early projects more affordable to taxpayers and consumers.** Experience from the competition has indicated that affordability considerations are as important as the long-term benefits of each option.

d **Agree early with HM Treasury any affordability constraints.** Crucially, this needs to take into account the costs of both capital support and any subsequent operational support, be that through CfDs or an alternative mechanism.

25 More generally, the Department should:

e **Work with HM Treasury to establish and use a consistent way of measuring the value of investments in different generating technologies that enable meaningful comparisons.** HM Treasury sets out guidance for departments in its Green Book on evaluating the costs and benefits of different programmes and projects. Some metrics that can be used to compare energy generation projects, such as the strike price, are not appropriate for comparing the costs and benefits of technologies at different stages of development and with different characteristics. Compared to established technologies such as wind power, CCS requires additional spending to build supporting infrastructure but could provide additional benefits, such as availability of power when it is needed.

f **Regularly revisit its commercial strategy and the value-for-money case in light of the evolving understanding of the delivery environment and market conditions.** This includes working with stakeholders to re-evaluate benefits and emerging challenges of its programmes at regular intervals. These should be clearly communicated across government and to wider stakeholders.

g **Consider the possible consequences of, and its risk appetite for, scenarios that are outside its central forecast or expectation when it develops a new project or programme.** The Department launched the competition with the intention of enabling construction of the first CCS projects without fully considering the negative impacts on investor confidence that would occur if it could not achieve this objective.