Carbon capture usage and storage

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Summary

Carbon capture usage and storage (CCUS) refers to a set of processes that capture carbon dioxide (CO₂) from waste gases produced at industrial facilities and either: (i) permanently store it in offshore geological storage sites (Carbon capture and storage or CCS); or (ii) reuse it in industrial processes such as the production of chemicals, minerals, plastics and synthetic fuels (Carbon capture and usage or CCU). CCS and CCU are increasingly being looked at in a joint way: Carbon Capture Usage and Storage (CCUS).

CCUS is widely expected to be key to mitigating against climate change and helping the UK reach its emission reduction targets. This is because CCUS reduces the release of CO₂ from large emission sources across a number of sectors (electricity, heating, industry and transport) into the atmosphere. CCUS also creates potential for CO₂ to be re-used, for instance to generate low-carbon power, to aid industrial processes and make new products.

Despite carbon capture and storage being considered a viable technology and the development of carbon capture usage progressing, at March 2020 there were no operational CCUS sites in the UK. Key barriers to the deployment of CCUS include high infrastructure costs, lack of commercial viability, and concerns around safety.

The UK Government supports the development of CCUS. There have been some policy delays: in 2007 and 2012 successive Governments launched and cancelled two initiatives to support the establishment of the UK’s first carbon capture storage site. More recently, the Government’s guidance on UK carbon capture, usage and storage set out its new approach to CCUS:

The approach is designed to enable the UK to become a global technology leader for CCUS and ensure that Government has the option of deploying CCUS at scale during the 2030s, subject to costs coming down sufficiently.

To progress this ambition, the Government has set out action under 3 themes:

- re-affirming our commitment to deploying CCUS in the UK subject to cost reduction;
- international collaboration on CCUS; and
- CCUS innovation.

The Government launched a CCUS Cost Challenge Taskforce in 2017 to provide advice on the steps needed to reduce the cost of deploying CCUS in the UK. It concluded that the deployment of CCUS at scale was key to driving cost reductions; it recommended that industry and Government needed to work together to create CCUS clusters – regional groups where several CCUS facilities share infrastructure. This led to the launch of the CCUS Deployment Pathway in November 2018 which sets out the Government’s plan to (i) enable the development of the first CCUS facility in the UK from the mid-2020s, and (ii) deploy CCUS at scale during the 2030s subject to costs coming down sufficiently.

During 2017-19, the Government launched a number of programmes which would fund CCUS technology development and deployment: (i) as part of wider schemes – for instance the Industrial Strategy Challenge Fund and the Industrial Energy Transformation Fund – and (ii) specific CCUS grant funding – such as the CCUS Innovation Programme and Carbon Capture Usage and Demonstration Programme. Budget 2020 announced a new £800 million Carbon Capture and Storage Infrastructure Fund to establish CCS in at least two UK sites, one by the mid-2020s, a second by 2030, noting that budgets would be finalised at the Comprehensive Spending Review.
The Government’s approach to CCUS has faced some criticism, namely for lack of progress despite widespread acceptance of the viability of the technology. The House of Commons Business, Energy and Industrial Strategy Committee published a report in April 2019 which concluded that, despite some progress, the Government’s targets were ambiguous “with no clarity on the ‘scale’ of deployment that Government plans to bring forward, nor a definitive answer on the apparent precondition that this essential technology must become cheaper before it is widely deployed.” The House of Commons Science and Technology Committee came to similar conclusions about the “lack of clarity and ambition” in the CCUS Action Plan in its August 2019 Clean Growth report.
1. Carbon Capture Usage and Storage

1.1 What is CCUS?
Carbon capture usage and storage (CCUS) refers to a set of processes that capture carbon dioxide (CO₂) from waste gases produced from fuel combustion or industrial processes and either: (i) permanently store it (Carbon Capture and Storage or CCS); or (ii) reuse it in industrial processes such as the production of chemicals, minerals, plastics and synthetic fuels (Carbon Capture and Usage or CCU). CCS and CCU are increasingly being looked at in a joint way: Carbon Capture Usage and Storage. In this paper CCUS will be used as a broad term unless the context requires otherwise.

Box 1: Carbon dioxide (CO₂)
Carbon dioxide (CO₂) is a colourless and odourless gas which makes up less than 1% of the atmosphere. It occurs naturally in the Earth’s atmosphere.

CO₂ is produced through the respiration of living things and during the combustion of any material containing carbon. All energy production using combustion emits CO₂ such as industrial processes, driving vehicles, electricity production and heating.

CO₂ is removed from the air through a) photosynthesis by plants – which convert CO₂ and water to make their own food, and b) dissolving in sea water.

CO₂ is a greenhouse gas, which contributes to the greenhouse effect – this happens when greenhouse gases accumulate in the Earth’s atmosphere and trap heat. These gases are naturally occurring but since the late 1700s, people have been releasing larger quantities into the atmosphere: greenhouse gas emissions increased by 70% between 1970 and 2004. Emissions of CO₂ rose by about 80% during the same time. As the level of greenhouse gases rise, so does the temperature of the Earth. The rise in Earth’s average temperature contributed to by human activity is known as global warming.

Climate change is a consequence of global warming: it refers to the broader range of changes that are happening to the planet such as rising sea levels, ice melting and shrinking ice glaciers.

1.2 CCUS and climate change
CCUS is widely perceived to be pivotal to mitigating against climate change and helping the UK reach its CO₂ reduction targets (see Boxes 1 and 2). Power stations, cement production and refineries are among the largest sources of CO₂ emissions in the UK, and yet they are vital to the UK economy. CCUS reduces the release of CO₂ from these large emission sources into the atmosphere and can do so effectively because it is designed to work at scale.

The Committee on Climate Change (CCC) described Carbon Capture Storage as “a necessity, not an option” for meeting the UK’s 2050 net zero target (see Box 2):

1 International Energy Agency, Carbon capture, utilisation and storage [accessed 9 March 2020]
2 Parliamentary Office of Science and Technology, Carbon Capture and Usage, October 2018 [accessed 9 March 2020]
3 National Geographic, What is global warming, explained [accessed 13 January 2020]
4 OECD, Glossary of Statistical Terms: Carbon Dioxide (CO₂), April 2013 [accessed 9 March 2020]
5 National Geographic, What is global warming, explained [accessed 13 January 2020]
6 NASA, What’s the difference between climate change and global warming, February 2020 [accessed 9 March 2020]
8 Global CCS Institute, Policy priorities to incentivise large scale deployment of CCS, April 2019 [accessed 9 March 2020]
[...] we stress that all currently credible pathways through which the UK could reach net-zero emissions domestically all involve a significant role for CCS, especially for industry and “greenhouse gas removal”.  

Box 2: UK climate change targets

The UK is part of an international effort to combat climate change. It is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and as such has signed up to international climate change obligations, including the Paris Agreement. The Paris Agreement’s central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

Under the Climate Change Act 2008 (the 2008 Act), the Government must meet a headline emissions reduction target and set five-yearly carbon budgets, twelve years in advance, from 2008 to 2050. The Government is required to consider—but not follow—the advice of the Committee on Climate Change (CCC, also created under the 2008 Act) when setting these budgets.

Following the advice of the CCC, the headline target of the 2008 Act was amended in June 2019 to reflect the ambition of the Paris Agreement and the Government’s net zero ambitions. The aim is to meet the 2008 Act’s target of reducing greenhouse gas emissions by 100% by 2050 compared to 1990 levels.

More information is available in the Library Briefing paper on Legislating for net zero.

1.3 How does CCUS work?

The Parliamentary Office of Science & Technology’s POSTbrief 30: Carbon Capture and Usage provides detailed information about the technology of Carbon Capture Usage and Storage. A brief summary is provided below.

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9 Committee on Climate Change, Net Zero – the UK’s contribution to stopping global warming, May 2019
Capturing CO₂

The capture process is common to both CCU and CCS. Capture involves separating the CO₂ from industrial processes and energy supply such as power plants. Carbon capture technology can capture up to 90% of CO₂ released by burning fossil fuels. There are three main types:

<table>
<thead>
<tr>
<th>Post-combustion capture</th>
<th>CO₂ is separated from a mixture of gases at the end of the industrial or energy process.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-combustion capture</td>
<td>The CO₂ is removed from the fossil fuel before the final stage of a reaction (combustion).</td>
</tr>
<tr>
<td>Oxyfuel technology</td>
<td>Pure oxygen is used to combust fuel instead of air which means that all the gas is composed of CO₂ and water vapour. The CO₂ is then separated by cooling and condensation.</td>
</tr>
</tbody>
</table>

Cost

Cost is widely understood to be one of the main barriers to large-scale roll-out of CCUS and the capture process is the most expensive part due to high instalment and energy costs. This can discourage investment. For example, the Government cancelled two CCS projects in 2007 and 2012 and the estimated capital required for them was between £1bn and £2.5bn to install CCUS at a coal- or gas- fired power station (see Section 3 for more information on the projects).

However, the costs of CCUS vary across power generation and industrial applications depending on the facilities and the concentration of CO₂ in exhaust cases. Research and development efforts are trying to reduce the cost. See Section 4 for more information on the Government’s approach to cost reduction.

Transporting CO₂

Once the CO₂ is captured it is compressed into liquid state and transported by pipeline, ship or road tanker to a location for storage or usage.

Pipelines are considered to be the cheapest form of transport and a well-known and reliable technology because it is the same as those used extensively for transporting natural gas, oil and many other fluids around the world. In some cases, it is also possible to re-use existing but redundant pipelines.

In the last few years, Government CCUS policy has steered towards developing “clusters” where CO₂-intensive industries could locate. This would mean that transporting infrastructure

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11 London School of Economics, Grantham Research Institute on Climate Change and the Environment, What is carbon capture and storage and what role can it play in tackling climate change?, May 2018 [accessed 9 March 2020]
12 As above
13 As above
14 As above
15 National Audit Office, Carbon capture and storage: the second competition for Government support, January 2017
16 National Audit Office, Carbon capture and storage: the second competition for Government support, January 2017
17 Global Carbon Capture and Storage Institute, Written evidence to the House of Commons BEIS Committee, June 2018
18 As above
19 CCS Association, CCS: Transport [accessed 9 March 2020]
Carbon capture usage and storage could be shared by a number of industrial sources to make it more cost-efficient.\textsuperscript{20} See Section 4.4 for more information on clustering.

There are a number of challenges associated with transporting CO\textsubscript{2}: ideally CO\textsubscript{2} would be stored where it is captured, because transporting long distances can be expensive and, practically, it has to be at the right temperature and pressure so that it remains in the correct state along the length of the pipeline.\textsuperscript{21}

Using CO\textsubscript{2}
CCU involves the utilisation of CO\textsubscript{2} once it has been captured – it is an alternative to CO\textsubscript{2} storage. CO\textsubscript{2} usage is an industrial process that makes an economically valuable product using CO\textsubscript{2} at concentrations above atmospheric levels. It is either transformed using chemical reactions into materials, chemicals and fuels, or used directly in processes.\textsuperscript{22}

There is a range of potential uses for CO\textsubscript{2}, some of which have been used commercially for a number of years, for example in the food and drink sector and in horticulture in the UK (see below). There is growing interest in its potential to reduce greenhouse gas emissions and how it may complement CCS.\textsuperscript{23} CCU is seen as an important factor in carbon capture development: if CO\textsubscript{2} could be used to make valuable zero-carbon products it could make it more economically attractive, as companies would be incentivised to invest in CCUS technology and, in the long term, this could reduce the overall costs of climate change mitigation.\textsuperscript{24}

There are two main categories of usage:

Conversion (indirect use)
The CO\textsubscript{2} is converted into a product using a chemical or biological process before being used commercially.

CO\textsubscript{2} is used as “feedstock” – a raw material to supply or fuel a machine or industrial process – in:

- Producing chemicals, including polymers (plastics) and urea (fertiliser);
- Manufacturing minerals that form the basis of building materials (for example CO\textsubscript{2} can be an ingredient in concrete production);
- Producing fuels for transport; and
- Growing micro algae which is used to manufacture biodiesel and other fuels.

There are challenges with CO\textsubscript{2} conversion: although CO\textsubscript{2} is generally an inexpensive waste product, it is difficult to make industrially viable processes because the CO\textsubscript{2} cannot be converted (for instance into chemicals or fuels) without significant inputs of energy. This, in turn, can generate significant amounts of waste and can result in more emissions.\textsuperscript{25}

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\textsuperscript{20} CCS Association, \textit{CCS: Transport} [accessed 9 March 2020]

\textsuperscript{21} Kelektsoglou, Kyriaki, Democritus University of Thrace, \textit{Carbon Capture and Storage: A Review of Mineral Storage of CO\textsubscript{2} in Greece, November 2018}

\textsuperscript{22} Carbon brief, \textit{Guest post: Ten ways to use CO\textsubscript{2} and how they compare}, 7 November 2019 [accessed 9 March 2020]

\textsuperscript{23} Imperial College London, \textit{Assessing the Potential of CO\textsubscript{2} Utilisation in the UK}, 2017

\textsuperscript{24} Carbon brief, \textit{Guest post: Ten ways to use CO\textsubscript{2} and how they compare}, 7 November 2019 [accessed 9 March 2020]

\textsuperscript{25} The National Academies of Sciences, Engineering and Medicine, \textit{Gaseous Carbon Waste Streams Utilisation: Status and Research Needs, Chapter 4: Chemical Utilisation of CO\textsubscript{2} into Chemicals and Fuels}, 2019
Non-conversion (direct use)

CO₂ is used directly within a commercial process. For example:

- Enhanced oil recovery (EOR): the CO₂ is injected into oil reservoirs, increasing the pressure and forcing the oil out. The CO₂ can then be permanently stored. It is possible to operate EOR so that more CO₂ is injected and stored than is produced.

- Food and drink: CO₂ can be used to carbonate drinks, in food freezing, chilling and packaging.

- Horticulture: CO₂ can be added to greenhouses to enhance the production of crops.

In the UK, high purity CO₂ – such as that used in food and drink and horticulture – is available through a network of suppliers who source the CO₂ from a limited number of industrial plants, for example ammonia plants in Teesside and Chester, and distilleries in Scotland.

Overall, there are some limitations on the capacity of CO₂ usage to reduce emissions. The CO₂ storage time can vary greatly, ranging from less than one year for fuels, up to ten years for chemicals, and millions of years for storage in building materials. Also, the future market for CO₂-derived products is also difficult to assess and is expected to remain small in the short term. A 2017 study commissioned by the Department for Business Energy and Industrial Strategy estimated that by 2030 demand from selected CCU technologies would be less than 1% of the UK’s carbon emissions.

The International Energy Agency has said that CO₂ use can complement CO₂ storage, but is not an alternative:

- CO₂ use can support investment in CO₂ capture opportunities, technology refinement and (in limited cases) early development of CO₂ transport infrastructure.

- However, CO₂ use cannot replace CO₂ storage in delivering the very significant emissions reductions needed to meet Paris Agreement ambitions. This reflects the expected smaller scale of many CO₂ use opportunities, their very limited scope for negative emissions, and their early stage of technology and market development.

The Committee on Climate Change has said that CCS is the long-term option:

- Whilst CCU could help to facilitate progress in the 2020s, the volumes of CO₂ that can be utilised as a feedstock rather than permanently sequestered appear likely to be small relative to the necessary role for CCS in the long-term. However, CCU could be of benefit in particular niche areas (e.g. where CO₂ capture costs are relatively low but geological storage of the CO₂ is impractical).

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26 CCS Association, Enhanced hydrocarbon recovery [accessed 9 March 2020]
27 Carbon brief, Guest post: Ten ways to use CO₂ and how they compare, 7 November 2019 [accessed 9 March 2020]
28 Imperial College London, Assessing the Potential of CO₂ utilisation in the UK, May 2017
29 Imperial College London, Assessing the Potential of CO₂ utilisation in the UK, May 2017
32 Ecofys, Assessing the potential of CO₂ utilisation in the UK, May 2017
34 Committee on Climate Change, Independent Assessment of UKs Clean Growth Strategy, 2018
Storing CO₂

CCS and, some applications of CCU, seek to permanently store the CO₂. It can be stored in three ways: geological formations, ocean water or in the form of mineral carbonates.  
Currently, in the UK, storage of CO₂ will only take place in geological formations.

<table>
<thead>
<tr>
<th>Geographical Storage Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geological storage</td>
<td>The CO₂ is injected directly into sedimentary rocks in old oil fields, gas fields or saline formations (rocks with porous spaces). It is believed that geological storage sites can store CO₂ permanently, which is defined as more than one thousand years.</td>
</tr>
<tr>
<td>Ocean storage</td>
<td>CO₂ is injected into the ocean and then either allowed to diffuse or be trapped in a specific location. However, the environmental effects of this are generally believed to be bad, and the process is still being researched. Large concentrations of CO₂ kill ocean organisms and CO₂ increases the acidity of ocean water.</td>
</tr>
<tr>
<td>Mineral storage</td>
<td>Captured CO₂ is held in storage sites to bind chemically to the surrounding rocks, which contain naturally-occurring magnesium and calcium containing minerals. Magnesium and calcium minerals are abundant and stable, so the CO₂ does not get released back into the atmosphere. However, the reactions are slow under normal temperatures and therefore more energy would be required to speed it up, or minerals would need to be pre-treated.</td>
</tr>
</tbody>
</table>

The North Sea is believed to contain a large amount of geological storage space. Research by the Energy Technologies Institute (ETI) – which was an industry and Government-funded research institute - found that “the UK has the CO₂ storage capacity to meet its needs out to 2050 and beyond” and “based on the appraisal work to date, there are no technical barriers to the storage of CO₂ in offshore stores that would limit the CCS industry developing at scale in the UK”. The ETI’s 2017 report contained a map of major UK CO₂ storage sites and emission points.

One of the key barriers to geological storage is concerns that once the CO₂ is stored underground, it could leak out into the atmosphere (see Section 4.6). Research from the University of Aberdeen and University of Edinburgh in 2018 on CO₂ storage security and leakage based on a numerical program that calculates CO₂ storage security and leakage to the atmosphere over 10,000 years concluded that there is a small risk of surface leakage if CO₂ storage is well-managed. It found that “realistically well-regulated storage in regions with moderate well densities has a 50% probability that leakage remains below 0.0008% per year.”

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36 Health and Safety Executive, Carbon Capture and Storage (CCS) [accessed 9 March 2020]
38 The Maritime Executive, Ocean Storage of CO₂, July 2018 [accessed 9 March 2020]
39 Intergovernmental Panel on Climate Change, Carbon dioxide capture and storage, 2005
40 British Geological Survey, How can CO₂ be stored? [accessed 9 March 2020]
41 British Geological Survey, How can CO₂ be stored? [accessed 9 March 2020]
42 Energy Technologies Institute, Taking Stock of UK CO₂ Storage, 2017
43 Carbon brief, World can ‘safely’ store billions of tonnes of CO₂ underground, 6 December 2018 [accessed 9 March 2020]
with over 98% of the injected CO₂ retained in the subsurface over 10,000 years”. However, it did highlight that the long-term behaviour of CO₂ in the subsurface remains a key uncertainty.

**Greenhouse gas removal technologies and CCS**

CCS has a unique role in creating a storage destination for greenhouse gas removal (GGR) technologies such as bioenergy and carbon capture storage (BECCS) and direct air carbon capture and storage (DACCS), which are also known as “negative emissions technologies” (NETs).

GGR technologies remove greenhouse gases such as CO₂ from the atmosphere either by capturing it directly (DACCS) or indirectly via biomass (BECCS) – these processes are explained in more detail below.

**Direct air carbon capture and storage (DACCS)**

DACCS is the direct extraction of CO₂ from the atmosphere using a sorbent – a material used to absorb or adsorb liquids or gases. DACCS is at a much earlier stage in development than BECCS, however interest in it is growing because of concerns about other options (discussed in more detail below). A study into direct air capture published in July 2019 for Nature Communications found that DACCS has a number of advantages (emphasis added):

> Like other NETs, it can address **distributed emissions**, such as those from transport, aviation and intensive industrial sectors... Designs for DACCS plants are diverse, some of them being modular, which extends a prospect of more **rapid scaling**. Most demand **little land**, although some might still require significant although reduced water inputs.

However, there are some concerns around the cost of DACCS because the diluteness of CO₂ in ambient air makes extraction very energy-intensive, and large volumes of air must be processed to obtain a significant amount of pure CO₂.

**Bioenergy and carbon capture storage (BECCS)**

Bioenergy is electricity and gas that is generated from biomass – organic matter such as plants, timber or food waste. In a BECCS chain, CO₂ from the atmosphere is absorbed via photosynthesis into the plant materials (biomass). The plant material is then burned or converted in power plants, industrial facilities or biorefineries equipped with technologies that capture the CO₂, which is then stored. This process would not be carbon negative without the carbon capture and storage element:

> This process results in a net transfer of CO₂ from the atmosphere to the ground, provided that emissions associated with supplying the biomass and capturing the CO₂ do not exceed the amount removed from the air by photosynthesis. In theory, by delivering net-negative emissions in the long-term, BECCS compensates for any short-term increases of greenhouse gas emissions caused by delays in implementation of climate policy.

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44 Nature Communications, *Estimating geological CO₂ storage security to deliver on climate mitigation*, June 2018

45 As above

46 Greenhouse gas removal (GGR) technologies are also known as “negative emissions” technologies. GGR has been used in this paper as the UK Government tends to refer to them as such.


49 UK Energy Research Centre, *Bioenergy with carbon capture and storage, and direct air carbon capture and storage: Examining the evidence on deployment potential and costs in the UK*, April 2019

50 Imperial College London, *Grantham Institute Briefing paper No 28: BECCS deployment: a reality check*, January 2019

51 Imperial College London, *Grantham Institute Briefing paper No 28: BECCS deployment: a reality check*, January 2019
There has been debate about the sustainability of BECCS technology and whether it is truly carbon neutral. For example:

- Conflict with other uses of land such as food production because BECCS relies on growing plants;
- Availability (scale and cost) of CCS technology and biomass fuel;
- Energy and CO₂ cost of steps of the process, for example collection from source, transportation; and
- High CO₂ emissions in the lifecycle of biomass could potentially outweigh the amount of CO₂ captured.

The Grantham Institute January 2019 report **BECCS deployment: a reality check** concluded that “BECCS cannot deliver the scale of negative emissions required in current emissions projections… we should expect BECCS to make a necessary but only limited contribution to meeting our climate change targets.”

Nevertheless, the UK Energy Technologies Institute has argued that despite the risks, BECCS has a significant role to play in reducing greenhouse gas emissions:

> Although modelling has shown that BECCS technologies are not the cheapest means of producing bioenergy nor the cheapest for producing renewable energy, their value comes from offsetting the need for more expensive decarbonisation measures elsewhere in the energy system.

There is more information on biomass in the CCC’s November 2018 report **Biomass in a low-carbon economy**.

There is more information on **Bioenergy with Carbon Capture & Storage** in Parliamentary Office of Science and Technology Note 618.

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52 European Academies Science Advisory Council, *Negative emissions technologies: What role in meeting Paris Agreement targets?*, February 2018

53 As above

54 European Academies Science Advisory Council, *Negative emissions technologies: What role in meeting Paris Agreement targets?*, February 2018

55 Imperial College London, *Grantham Institute Briefing paper No 28: BECCS deployment: a reality check*, January 2019

56 Imperial College London, *Grantham Institute Briefing paper No 28: BECCS deployment: a reality check*, January 2019

57 Imperial College London, *Grantham Institute Briefing paper No 28: BECCS deployment: a reality check*, January 2019
2. Government responsibility

2.1 Departmental responsibility

The Department for Business, Energy and Industrial Strategy (DBEIS) leads on Government policy on CCUS, which forms part of the department’s plans to reduce CO₂ emissions and was a key focus of the 2017 Clean Growth Strategy. CCUS policy is reserved to the UK Government (as part of energy policy), but related powers such as environmental permitting and planning are devolved.

Regulator

The Oil and Gas Authority (OGA) regulates offshore CO₂ storage, approves and issues storage permits, and maintains the carbon storage public register. The offshore area comprises both UK territorial sea and beyond designated as a “gas importation and storage zone”.

More information on the OGA’s role is available on the OGA website.

2.2 Scotland

The Scottish Government supports the development of CCUS:

Scotland’s industrial clusters and largest sources of carbon dioxide in North East and Central Scotland are linked by a network of pipelines to depleted and well-mapped oil and gas fields in the North Sea. These depleted gas fields and aquifers offer vast carbon dioxide storage potential, providing Scotland with a competitive advantage in CCUS.

In its Energy Strategy, the Scottish Government committed to funding: research into CCUS and BECCS, and individual projects. It worked with the UK Government as a member of the UK CCUS Cost Reduction Taskforce and is currently on the CCUS Council (more information in Box 3 below).

2.3 Wales

The Welsh Government identifies CCUS as one of the most important technologies to “stimulate the shift to a low carbon economy” and “significantly reduce Welsh emissions by 2050”. The Welsh Government is concerned that the deployment of CCUS in Wales “will be towards the end of the window of UK deployment” and that this “reflects the greater practical difficulty and cost in the Welsh Context relative to other parts of the UK.” The Committee on Climate Change has said that “Wales has less opportunity for CO₂ storage” than the rest of the UK.

In June 2019, the Welsh Government published Prosperity for All: A Low Carbon Wales in which it committed to the following action on CCUS:

- Working with the UK Government on the CCUS Council (see Box 3 below);
- Commissioning an independent economic and technical feasibility study on CCUS;
- Working with industry to gather “more detailed and Wales-specific information”;

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58 National Audit Office, Carbon capture and storage: the second competition for Government support, January 2017
59 Scottish Government, Oil and gas: carbon capture, utilisation and storage [accessed 9 March 2020]
60 Scottish Government, Oil and gas: carbon capture, utilisation and storage [accessed 9 March 2020]
61 Welsh Government, Prosperity for All: A Low Carbon Wales, March 2019
62 Committee on Climate Change, Net Zero - The UK’s contribution to stopping global warming, May 2019
• A programme of work towards the end of 2019 to “explore the potential to collaborate cross-border between North Wales and North-West England”.  

2.4 Northern Ireland

In its February 2019 report *Reducing emissions in Northern Ireland*, the CCC recommended that Northern Ireland should “make preparations to deploy Carbon Capture and Storage at scale in Northern Ireland in the 2030s”.  

The CCC said that this would be necessary to meet legislated climate targets. Northern Ireland does not currently have its own long-term target for emissions but is included within UK targets.  

In January 2020, the UK and Irish Governments agreed a deal to restore devolved government in Northern Ireland. This deal included commitments from the Northern Ireland Executive to introduce both legislation and targets for reducing carbon emissions in line with the Paris Climate Change Agreement and a new Energy Strategy. There was no explicit mention of CCUS.

**Box 3: Key advisory bodies involved in CCUS**

**Former**

- **The Parliamentary Advisory Group on CCS**, led by Lord Oxburgh, was formed to assess the contribution of CCS to cost-effective UK decarbonisation. It reported to the Secretary of State for BEIS in summer 2016.
- **The CCS Cost Challenge Taskforce** was established by the Government in 2017 to provide advice on the steps needed to reduce the cost of deploying carbon capture, usage and storage (CCUS) in the UK. The work of the Taskforce informed the CCUS Deployment Pathway: Action Plan published in 2018.
- **The CCS Cost Reduction Taskforce** was set up in spring 2012 to advise the Government and industry on the steps needed to reduce the cost of CCS, so that it could compete with other low carbon technologies in the 2020s. The Task Force published its final report in May 2013.

**Currently active**

- **The CCUS Council** is co-chaired by the Minister for Climate Change and the Chair of the Carbon Trust and comprises representatives from across the sector: energy providers, CCS associations and academics. Its role is to review the progress of the Government’s approach to CCUS as set out in the Clean Growth Strategy. It is the primary forum for engaging the CCUS sector on key issues.
- **The CCUS Advisory Group (CAG)** is an industry-led group established in March 2019 as part of the Government’s CCUS Deployment Pathway: An Action Plan. Its role is to consider the specific challenges facing the development of CCUS market frameworks and providing insight into potential solutions, making recommendations to Government. Supported by BEIS and the CCS Association, the CAG brings together experts from across the CCUS industry, finance and legal sectors.

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63 Welsh Government, *Prosperity for All: A Low Carbon Wales*, March 2019
64 Committee on Climate Change, *Reducing emissions in Northern Ireland*, February 2019
65 Committee on Climate Change, *Net Zero - The UK’s contribution to stopping global warming*, May 2019
71 The CCUS Advisory Group, *Terms of Reference* [accessed 9 March 2020]
3. Historic Government support

3.1 Timeline of key policy developments

The UK has had a series of CCUS policy initiatives. The timeline below outlines these policy developments, alongside broader energy and climate change legislation.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>The 2003 Energy White Paper first recognises that “Carbon capture and storage may offer a promising way forward”. 72</td>
</tr>
<tr>
<td>2007</td>
<td>Department for Business, Enterprise and Regulatory Reform (DBERR) launches a competition for industry to run a project to design, construct and operate the UK’s first commercial-scale carbon capture and storage demonstration project at a coal-fired power station. 73</td>
</tr>
<tr>
<td>2008</td>
<td>Climate Change Act commits the UK to reducing greenhouse gas emissions by at least 80% by 2050. 74</td>
</tr>
<tr>
<td>2010</td>
<td>Spending Review makes £1bn available for the CCS demonstration project. 75</td>
</tr>
<tr>
<td>2011</td>
<td>DBERR cancels the CCS demonstration project. 76</td>
</tr>
<tr>
<td>2012</td>
<td>The Department of Energy and Climate Change (DECC) launches its Electricity Market Reform strategy which sets out how it would secure investment in new generating capacity to achieve its climate change targets while meeting increased demand for electricity. 77</td>
</tr>
<tr>
<td></td>
<td>DECC launches its new CCS strategy – the UK’s CCS Roadmap – and the second CCS commercialisation competition. 78</td>
</tr>
<tr>
<td></td>
<td>CCS Cost Reduction Task Force is set up to advise the Government and industry on the steps needed to reduce the cost of CCS. 79</td>
</tr>
<tr>
<td>2013</td>
<td>The CCS Cost Reduction Task Force publishes its final report. 80</td>
</tr>
<tr>
<td>2014</td>
<td>The 2014 Budget provides for £60m to develop new low-carbon technologies to support carbon capture and storage. 81</td>
</tr>
<tr>
<td>2015/16</td>
<td>HM Treasury withdraws funding for the CCS programme (made available in 2014 Budget), and the bidders announce they will not progress with their projects. DECC formally closes the competition. 82</td>
</tr>
<tr>
<td>2017</td>
<td>UK Government launches The Clean Growth Strategy, which outlines how it expects the UK to meet its decarbonisation targets. 83</td>
</tr>
<tr>
<td></td>
<td>The Clean Growth Strategy provides support for CCS: £100m investment in CCUS and industrial innovation to lower costs, a CCUS Ministerial Council which will review progress on carbon capture and a CCUS Cost Challenge Taskforce to provide advice on the steps needed to reduce the cost of deploying CCUS in the UK. 84</td>
</tr>
<tr>
<td></td>
<td>Carbon Capture and Utilisation Demonstration (CCUD) innovation programme is launched. The Department for Business, Energy and Industrial Strategy allocates £20m to design and construct CCU demonstration projects. 85</td>
</tr>
<tr>
<td></td>
<td>CCUS Cost Challenge Taskforce publishes its report. 86</td>
</tr>
</tbody>
</table>

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73 National Audit Office, *Carbon capture and storage: the second competition for Government support*, 2017
74 UK Government, *Climate Change Act 2008*
75 National Audit Office, *Carbon capture and storage: the second competition for Government support*, 2017
76 As above
78 National Audit Office, *Carbon capture and storage: the second competition for Government support*, 2017
80 As above
82 National Audit Office, *Carbon capture and storage: the second competition for Government support*, 2017
84 As above
85 Department for Business, Energy and Industrial Strategy, *Carbon Capture and Utilisation Demonstration (CCUD) innovation programme*, July 2019
86 CCUS Cost Challenge Taskforce, *Delivering Clean Growth*, July 2018
BEIS launches a £15m [CCUS Innovation Programme](https://www.gov.uk/government/consultations/the-ccus-innovation-programme) which offers grant funding for CCUS projects to cut the costs of deployment. This was increased to £24m in January 2019.


The Government publishes the [UK CCUS Deployment Pathway: An Action Plan](https://www.gov.uk/government/consultations/uk-ccus-deployment-pathway-an-action-plan), following the advice of the Cost Challenge Taskforce. This sets out the next steps Government and industry should aim to take to deploy CCUS at scale during the 2030s.

The Government announces its [Industrial Clusters Mission](https://www.gov.uk/government/consultations/what-is-the-industrial-clusters-mission) at COP24, which sets out its ambition to establish the world’s first net-zero carbon industrial cluster by 2040, and at least one low-carbon cluster by 2030.

Two decarbonisation funds for capital expenditure are announced: the £315m [Industrial Energy Transformation Fund](https://www.gov.uk/government/consultations/industrial-energy-transformation-fund) and the [Industrial Strategy Challenge Fund](https://www.gov.uk/government/consultations/industrial-strategy-challenge-fund) which provide £170m upfront public support and £260m matched from industry.


Industry-led [CCUS Advisory Group](https://www.gov.uk/government/consultations/ccus-advisory-group) is set up to “accelerate the development of CCUS technology.” It publishes a report on Investment Frameworks for the Development of CCUS in the UK.

The Government amends the [Climate Change Act 2008](https://www.gov.uk/government/consultations/climate-change-act-2008-amendments) and introduces the net zero target: at least 100% reduction of greenhouse gases (compared to 1990 levels) in the UK by 2050.

In the Autumn [Spending Round](https://www.gov.uk/government/consultations/budget-2020), BEIS is allocated an additional £30m to accelerate progress on developing decarbonisation schemes.

BEIS launches a consultation on potential business models for CCUS.

The [December 2019 Queen’s Speech](https://www.gov.uk/government/consultations/december-2019-queen-s-speech) commits the Government to “supporting the decarbonisation of industry and power by investing £800m to build the first fully deployed carbon capture storage cluster by the mid-2020s.”

Budget 2020 announced a new £800 million Carbon Capture and Storage Infrastructure Fund to establish CCS in at least two UK sites, one by the mid-2020s, a second by 2030, noting that budgets would be finalised at the Comprehensive Spending Review.

### 3.2 Previous CCS competitions

In the past 12 years, successive Governments have launched and cancelled two major initiatives to support the establishment of the UK’s first CCS site(s):

- In November 2007, the Labour Government’s Department for Business, Enterprise and Regulatory (BERR) launched a competition for capital funding to design, construct and operate the UK’s first CCS demonstration project. BERR planned to meet the entire cost

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87 Department for Business, Energy and Industrial Strategy, [CCUS Innovation Programme](https://www.gov.uk/government/consultations/ccus-innovation-programme), June 2017
88 Department for Business, Energy and Industrial Strategy, [International CCUS Summit](https://www.gov.uk/government/consultations/international-ccus-summit), November 2018
91 Department for Business, Energy and Industrial Strategy, [CCUS Innovation Programme](https://www.gov.uk/government/consultations/ccus-innovation-programme), June 2017
93 Department for Business, Energy and Industrial Strategy, [UK’s largest carbon capture project to prevent equivalent of 22,000 cars’ emissions from polluting the atmosphere from 2021](https://www.gov.uk/government/consultations/uk-s-largest-carbon-capture-project-to-prevent-equivalent-of-22000-cars-emissions-from-polluting-the-atmosphere-from-2021), June 2019
95 Department for Business, Energy and Industrial Strategy, [UK becomes first major economy to pass net zero emissions law](https://www.gov.uk/government/consultations/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law), June 2019
98 Prime Minister’s Office, [The Queen’s Speech 2019](https://www.gov.uk/government/consultations/the-queens-speech-2019), December 2019
of building the project at an existing power station, which it expected to be up and running by 2014.

- In October 2011, the Conservative-Liberal Democrat coalition’s Department of Energy & Climate Change (DECC) withdrew from negotiations with the remaining bidder in the competition stating that it was protecting value for money and because the project could not be funded within the £1bn budget agreed at the 2010 Spending Review.99

- In April 2012, the coalition Government launched a second competition as the first major part of its new long-term CCS programme. The aim for this competition was that developers should be able to build CCS-equipped fossil fuel power stations in the early-2020s without capital subsidy from the Government, at a price competitive with other low-carbon generation technologies.100

- The Conservative Government closed the competition in January 2016 before receiving full project proposals. This was because HM Treasury had withdrawn the £1bn capital funding previously available for successful bids during its Spending Review the previous November.101

The National Audit Office (NAO) concluded that HM Treasury withdrew the money because: the cost to consumers would be high, the competition was aiming to deliver CCS before it was cost-efficient to do so, further investment was not guaranteed and, ultimately, there was better uses for the £1bn.102

In the same 2017 report on Carbon capture and storage: lessons from the competition for the first UK demonstration, the NAO found that the Government spent £168 million on its two CCS competitions. The NAO concluded:

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. ... [However] 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.103

In the 2017 Clean Growth Strategy, the Government reflected on cancellation of these competitions:

While we have explored ways to deploy CCUS at scale in the UK since 2007, the lack of a technological breakthrough to reduce the cost of CCUS and the cost structures and risk sharing that potential large-scale projects have demanded has been too high a price for consumers and taxpayers.104

The launch of the Clean Growth Strategy marked a change in policy approach towards CCUS, with the Government’s focus shifting to technological innovation, international collaboration and cost reduction. This is covered in Section 4.

99 National Audit Office, Carbon capture and storage: lessons from the competition for the first UK demonstration, March 2012
100 National Audit Office, Carbon capture and storage: the second competition for Government support, 2017
101 National Audit Office, Carbon capture and storage: the second competition for Government support, 2017
102 National Audit Office, Carbon capture and storage: the second competition for Government support, 2017
103 National Audit Office, Carbon capture and storage: the second competition for Government support, 2017
104 Department for Business, Energy and Industrial Strategy, Clean Growth Strategy, October 2017
4. CCUS policy developments 2017-20

4.1 Clean Growth Strategy

The 2017 Clean Growth Strategy – the Conservative Government’s plan for decarbonising all sectors of the UK economy through the 2020s – set out the Government’s commitment to Carbon Capture Storage, which it reframed as CCUS to recognise the role of CCU in facilitating progress in the 2020s. CCUS was to become a policy priority again because of the need to invest in technologies that would help meet climate change targets. The Committee on Climate Change had called for the Government to implement a new CCS strategy since the cancellation of CCS commercialisation projects (see Section 3.2).

The Strategy set out the Government’s approach to CCUS:

- The approach is designed to enable the UK to become a global technology leader for CCUS and ensure that Government has the option of deploying CCUS at scale during the 2030s, subject to costs coming down sufficiently.
- To progress this ambition, the Government has set out action under 3 themes:
  - re-affirming our commitment to deploying CCUS in the UK subject to cost reduction;
  - international collaboration on CCUS;
  - CCUS innovation.

The Strategy established the CCUS Cost Challenge Taskforce, which reported in July 2018. This led to the November 2018 CCUS Deployment Pathway: An Action Plan which sets out a pathway for CCUS for the 2030s. More information on both these reports are set out below.

4.2 CCUS Cost Challenge Taskforce

The CCUS Cost Challenge Taskforce was formed in 2017 by the then Minister for Energy and Clean Growth. Its task was to provide a strategic plan to develop CCUS in the UK and, specifically, “provide advice on the steps needed to reduce the cost of deploying CCUS in the UK”. Its membership was made up of CCUS stakeholders, Government representatives, industry experts, academics, NGOs and global organisations.

The Taskforce published its Delivering Clean Growth report in July 2018. It concluded:

1. CCUS can support cost-effective decarbonisation across a wide range of sectors, while simultaneously supporting clean growth across the economy.
2. Cost-effective CCUS can be achieved through industry and Government working together to:
   a) Unlock early investment – creating a policy environment to unlock the development of at least two CCUS clusters to be operational from the mid-2020s, anchored by “catalyst” projects to innovate and reduce cost of capital, meaning future projects cost less;
   b) Establish viable business models and an agreed risk allocation for CCUS; and

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105 Committee on Climate Change, Independent Assessment of the UK’s Clean Growth Strategy, 2018
106 Department for Business, Energy and Industrial Strategy, Clean Growth Strategy, October 2017
107 Committee on Climate Change, Letter to Amber Rudd on Carbon Capture and Storage, July 2016
108 Department for Business, Energy and Industrial Strategy, Clean Growth Strategy, October 2017
109 Gov.uk, CCUS Cost Challenge Taskforce [accessed 9 March 2020]
c) Create **CCUS clusters**, regional groupings where several CCUS facilities share infrastructure and knowledge, which could be foundations for **Clean Growth Regeneration (CGR) Zones** to drive lower costs, unlock value for local economies and speed up technical innovation. More information on clusters in Section 4.4 below.

3. By acting now, the UK will be able to make the most of its current engineering, geological and commercial advantages to build a strategic supply chain and use the opportunity to develop a **large export market share** of a potential globally significant sector.\(^{110}\)

The Taskforce’s view was that the deployment of CCUS at scale is key for driving cost reductions (see Section 1.3 on the cost of CCUS). It recommended that Government worked with industry to set out, by the end of 2018, a CCUS roadmap to support its commitment to deploying CCUS in the UK.\(^ {111}\) As a result, the CCUS Deployment Pathway: An Action Plan was as published in November 2018.

### 4.3 CCUS Deployment Pathway: An Action Plan

In November 2018, the Government launched its **CCUS Deployment Pathway: An Action Plan**. Focused on industrial applications, rather than the formally favoured power-sector model, the Action Plan aimed to enable the development of the first CCUS facility in the UK commissioned from the mid-2020s, which would give the option of deploying at scale in the following decade.

The Action Plan sets out a “staged approach” to progressing CCUS in the UK, “allowing Government, and industry, to develop and test commercial and regulatory concepts incrementally through the 2020s […] The aim of this approach is to allow lessons to be learned and applied, to identify, test and secure initial cost reductions with the ultimate goal of enabling commercial deployment of CCUS […].”\(^ {112}\)

The House of Commons Business Energy and Industrial Strategy (BEIS) Committee criticised this approach:

> Whilst we strongly support cost minimisation, we disagree with the CCUS Action Plan’s stipulation that deployment ‘at scale’ should be supported only if ‘sufficient’ cost reductions are achieved. Such vague terminology gives no certainty to investors and does little to ensure that CCUS can contribute to meeting the UK’s overarching climate change targets at least cost, given its existing status as the cheapest—or only—decarbonisation option in many industrial applications.

The Committee recommended:

> Rather than seeking unspecified cost reductions, the Government should set out plans to ensure that projects are brought forwards at least cost.\(^ {113}\)

In August 2019, the new Johnson Government responded to the Committee’s recommendation by highlighting its intention, reiterating what was set out in the 2018 CCUS Action Plan, to undertake a review of CCUS Delivery and Investment Frameworks. It also highlighted the funding support it was providing to specific CCUS projects (see Section 4.4 and 4.5).\(^ {114}\)

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110 Adapted from CCUS Cost Challenge Taskforce, *Delivering Clean Growth*, July 2018
111 CCUS Cost Challenge Taskforce, *Delivering Clean Growth*, July 2018
113 House of Commons Business, Energy and Industrial Strategy Committee, *Carbon capture usage and storage: third time lucky?*, April 2019
The CCUS industry
The Action Plan emphasises the potential value CCUS could bring to the UK economy through growing the CCUS industry:

We see an opportunity for the UK to be a global technology leader in CCUS […] We are already well placed: innovative companies across the UK are developing cutting edge CCUS technologies; we have world leading academic institutions focused on solving key questions to reduce the costs of CCUS deployment; we have one of the largest potential carbon dioxide storage capacities in Europe; our existing industries have the skills and capability required to deploy CCUS at scale; and we are exploring investable commercial models to ensure a supportive business environment for those wishing to develop CCUS. 115

The UK’s existing oil and gas industry is central to the UK’s potential competitive advantage with CCUS:

• It has existing supply chains and skills bases that “could transition to service a growing CCUS industry, allowing the retention and creation of further high value jobs”. 116

• Internationally, existing expertise, skills and resources could be marketed to other countries.

• Oil and gas infrastructure could be re-used. The CCUS Cost Challenge Taskforce estimated that “the cumulative benefits of reusing assets may exceed £500m of entry costs into CCUS regional clusters”. 117 However, there is additional pressure with re-using oil and gas infrastructure because it is in the process of being decommissioned. The Government said it would work with the Oil and Gas Authority, industry and the Crown Estates to identify existing oil and gas infrastructure that could be repurposed for CCUS during 2019. 118

CO₂ transport and storage infrastructure
In order to deploy CCUS at scale, appropriate infrastructure is needed to transport and permanently store the CO₂. The development of a transport and storage network for CO₂ will require large upfront capital expenditure – particularly for offshore and online pipelines, and storage sites and wells. While initial construction costs are believed to be high, operating costs would be relatively low. 119

There is potential to reduce the costs of deploying CCUS by re-using existing oil and gas infrastructure. The UK has a substantial network of offshore oil and gas infrastructure in the North and East Irish seas: 300 platforms and 1000 pipelines. This infrastructure is starting to be decommissioned as assets reach the end of their useful economic lives. The OGA estimate that total decommissioning costs could be between £40-67bn. 120

Re-use for CCUS would involve re-purposing offshore oil and gas assets that have reached the end of their commercial life to be part of a CO₂ transport and storage network.

In the CCUS Action Plan, the Government committed to a) completing a processing to identify existing oil and gas infrastructure that has the potential for re-use for CCUS and b) developing a

117 CCUS Cost Challenge Taskforce, Delivering Clean Growth, July 2018
118 DBEIS, The UK Carbon Capture Usage and Storage deployment pathway: An Action Plan, November 2018
119 As above
120 As above
policy on the re-use of oil and gas infrastructure for the purposes of transport and/or storing carbon dioxide.\textsuperscript{121}

In July 2019, the Government launched a consultation on \textit{Carbon capture, usage and storage (CCUS) projects: re-use of oil and gas assets}. The consultation closed in September 2019 and the outcome is yet to be published.

The Government also committed to examining possible new business models for CO\textsubscript{2} transport and storage in the Action Plan. It promised to explore whether splitting the CCUS chain and establishing a separate, investable business model for the transport and storage element of the CCUS chain would reduce risk and support a sustainable commercial model.\textsuperscript{122} There is more information on CCUS business models in Section 4.5 below.

\begin{center}
\textbf{Box 4: Cross-sector impact of CCUS}
\end{center}

A key theme that emerges from recent Government policy is CCUS’ potential to cut emissions \textit{across sectors}: as a technology, it can be applied across many sectors like industry and power, and it can also drive clean growth across sectors by \textit{using} the captured CO\textsubscript{2} to generate low-carbon power, aid a variety of industrial processes and make new products. The CCUS Cost Challenge Task Force summarised CCUS’ cross-sector role:

\begin{itemize}
\item CCUS can unlock value across the economy to enable low carbon industrial products, decarbonised electricity and gas, a hydrogen economy, greenhouse gas removal, and new industries based around utilising CO\textsubscript{2}.\textsuperscript{123}
\end{itemize}

\textbf{Decarbonisation}

BEIS has said that it expects CCUS to contribute to the decarbonising of the power, industrial, transport and heating sectors. For example:

\begin{itemize}
\item \textbf{Industrial emissions} can be the hardest to abate because processes cannot be electrified due to the continuous, high grades of heat needed.\textsuperscript{124} Industrial processes accounted for around 2\% of greenhouse gas emissions in 2017.\textsuperscript{125} CCS can be applied directly to industrial waste streams; the Clean Growth Strategy identified that around half of the current emission reduction opportunities in industry are from CCS.\textsuperscript{126}
\item \textbf{Power sector emissions}. The energy supply sector is estimated to have been responsible for 24\% of UK greenhouse gas emissions in 2017; the main source of emissions from this sector is the use of natural gas and coal in electricity generation for power stations. Between 1990 and 2017, there was a 60\% reduction in greenhouse gas emissions.\textsuperscript{128} The Committee on Climate Change (CCC) has said that it expects CCUS to play an important role in the power sector, for example by playing a “baseload” role – providing consistent clean electricity when renewables and nuclear do not meet demand.\textsuperscript{129}
\end{itemize}

\textbf{Low carbon power}

CCUS can also be used to decarbonise sectors by enabling the production of other forms of low-carbon energy. For example:

\begin{itemize}
\item \textsuperscript{121} HM Government, \textit{Clean Growth}, \textit{The UK Carbon Capture Usage and Storage deployment pathway: An Action Plan}, November 2018
\item \textsuperscript{122} HM Government, \textit{Clean Growth}, \textit{The UK Carbon Capture Usage and Storage deployment pathway: An Action Plan}, November 2018
\item \textsuperscript{123} CCUS Cost Challenge Taskforce, \textit{Delivering Clean Growth}, July 2018
\item \textsuperscript{124} International Energy Agency, \textit{Transforming Industry through CCUS}, May 2019
\item \textsuperscript{125} Department for Business, Energy & Industrial Strategy, \textit{2017 UK Greenhouse Gas Emissions}, February 2019
\item \textsuperscript{126} Committee on Climate Change, \textit{2019 Progress Report to Parliament}, July 2019
\item \textsuperscript{127} Committee on Climate Change, \textit{Reducing UK emissions 2018 Progress Report to Parliament}, June 2018, and Cornwall Insight, \textit{Market based frameworks for CCUS in the power sector}, April 2019
\item \textsuperscript{128} Department for Business, Energy & Industrial Strategy, \textit{2017 UK Greenhouse Gas Emissions, Final Figures}, February 2019
\item \textsuperscript{129} Committee on Climate Change, \textit{Reducing UK emissions 2018 Progress Report to Parliament}, June 2018
\end{itemize}
• **Hydrogen** is a credible option to help decarbonise the UK energy system because it is a low-carbon energy source. In industry, hydrogen can be a fuel to replace fossil fuels and for industrial heat; in heat, it can replace heating systems; and in transport, it can fuel vehicles. CCUS can help enable the production of hydrogen at scale. The CCC has said that “the lowest-cost means of producing large volumes of low-carbon hydrogen is via natural gas reforming with CCS, requiring extensive capture of the carbon emissions in the process.”

• **Biofuels** – fuels derived from biomass – are expected to play a vital role in the future energy system because they can replace fossil fuels. For example, the CCC has suggested that biofuels could replace 5-10% of UK jet fuel use by 2050. Carbon Capture and Storage (CCS) can be applied to biofuel production to make it more sustainable by potentially achieving negative emissions. There is more information on this technology in Section 1.3 on GGRs. The Parliamentary Office of Science and Technology also published a paper on Low-Carbon Aviation Fuels in February 2020.

### 4.4 Funding for CCUS development and deployment

**Carbon Capture and Storage Infrastructure Fund (Budget 2020)**

Budget 2020 announced a new £800 million Carbon Capture and Storage Infrastructure Fund to establish CCS in at least two UK sites, one by the mid-2020s, a second by 2030, noting that budgets would be finalised at the Comprehensive Spending Review. It also announced that, using consumer subsidies, the Government will also support the construction of the UK’s first privately financed gas CCS power plant.

**Industrial decarbonisation funds**

The Department for Business, Energy and Industrial Strategy announced two decarbonisation funds for capital expenditure in 2018/19, both of which included funding for CCUS development:

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131 National Geographic, [Biofuels, explained](https://www.nationalgeographic.com/science/2019/07/biofuels-explained/), 15 July 2019
<table>
<thead>
<tr>
<th><strong>Overview</strong></th>
<th><strong>Industrial Strategy Challenge Fund (ISCF)</strong></th>
<th><strong>International Energy Transformation Fund (IETF)</strong></th>
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<td></td>
<td>The ISCF provides funding and support to businesses and researchers to develop technologies related to the aims of the May Government's 2017 Industrial Strategy. More information is available in the Library briefing paper on <em>Industrial Strategy (8 August 2019)</em>.</td>
<td>The IETF will provide funding for capital investment in energy efficiency and decarbonisation project. It is aimed at businesses with high energy use to support them to cut energy bills and carbon emissions through investing in energy efficiency and low-carbon technology.</td>
</tr>
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</table>

| **CCUS** | Clean Growth is one of the grand challenges that the Industrial Strategy seeks to address. CCUS is included because it is considered a low-carbon technology. | The IETF aims to promote investment in decarbonisation technologies, which includes those “that are strategically important to long-term emissions reductions such as hydrogen and CCUS”. It is designed to make technologies like CCUS ready for commercial deployment by “funding demonstration and early deployment” in order make it operational on a large scale. |

| **Overall funding** | £725m[^138] (£170m for Industrial Clusters Mission – see below.) | £315m (to 2023-24).[^139] |

| **Timeline** | Launched in 2016. In December 2018, up to £170m of ISCF funding was allocated to “kick-start” the delivery of the Industrial Clusters mission, the targets of which rely on CCUS.[^140] See the Industrial Clusters section below for more information. | Announced in Autumn Budget 2018. Due to launch in spring 2020 and open for applications in summer 2020.[^141] |

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[^134]: Department for Business, Energy and Industrial Strategy, *The Industrial Energy Transformation Fund*, October 2019
[^139]: Department for Business, Energy and Industrial Strategy, *The Industrial Energy Transformation Fund*, October 2019
[^140]: Department of Business, Energy and Industrial Strategy press release, *World-first carbon ‘net-zero’ hub of heavy industry to help UK seize global economic opportunities of clean growth*, December 2018
[^141]: Department for Business, Energy and Industrial Strategy, *The Industrial Energy Transformation Fund*, October 2019
Industrial Clusters

Industrial Clusters are areas with a number of industrial sites. In 2017, industrial processes accounted for around 2% of greenhouse gas emissions.\(^{142}\) The **Industrial Clusters mission** is part of the Industrial Strategy launched by the May Government in 2017:

- The **aim** of this mission is to: “establish the world’s first net-zero carbon industrial cluster by 2040 and at least one low-carbon cluster by 2030”.

- It is **funded** through the ICSF – the IETF will “look to complement the Mission by supporting short-term projects across the UK, while the Clusters will be more longer-term and place-based”.\(^ {143}\)

**CCUS cluster sites**

CCUS is seen as a crucial technology in reducing industry emissions from industrial cluster sites alongside low-carbon fuels such as hydrogen and bioenergy.\(^{144}\)

The CCUS Cost Challenge Task Force and Parliamentary Advisory Group on CCS recommended the deployment of CCUS in industrial centres:

Deploying CCUS in industrial centres has the potential to allow a number of carbon capture applications – from industry, to hydrogen, to low carbon gas in power – to connect to shared carbon dioxide infrastructure, improving resilience of carbon dioxide supply, availability of carbon dioxide storage (if multiple pipelines and stores are used), and mitigating potential cross-chain risk. […]

Deploying CCUS in industrial centres is considered to have the added benefit of helping protect existing industry, increase productivity and encourage inward investment.\(^ {145}\)

This was adopted by the Government in its CCUS Action Plan (more information in Section 4.3).

There are industrial clusters in: Grangemouth, South Wales, Merseyside, Teesside, Humberside and Southampton. Although there are currently no operating CCUS facilities in the UK, there are a number of potential locations for the UK’s first CCUS clusters and CO\(_2\) storage sites, which are based around the UK’s major industrial clusters. The CCUS Cost Challenge Taskforce’s 2018 report [Delivering Clean Growth](https://www.gov.uk/government/publications/delivering-clean-growth) contains more information about these sites.

There are three CCUS projects in the UK which are at a more developed stage:

1. **Pale Blue Dot’s Acorn CCS project**, which is located in the St Fergus Gas Terminal on the north east coast of Scotland – an active industrial site where around 35% of all the natural gas used in the UK comes onshore. It is being built here to “take advantage of existing oil and gas infrastructure and a well understood offshore CO\(_2\) storage site.”\(^ {146}\)

2. The **Teesside Collective** aims to establish Teesside as a CCS network to help decarbonise the region’s industrial sites. The project includes construction of a series of piping networks and shipping facilities designed to move and store large amounts of CO\(_2\) from across Europe. Teesside can access suitable CO\(_2\) storage sites in the Southern North Sea.\(^ {147}\)

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\(^ {143}\) Department for Business, Energy and Industrial Strategy, The Industrial Energy Transformation Fund, October 2019

\(^ {144}\) Department for Business, Energy and Industrial Strategy, What is the Industrial Clusters mission? [accessed 9 March 2020]

\(^ {145}\) HM Government, Clean Growth, The UK Carbon Capture Usage and Storage deployment pathway: An Action Plan, November 2018

\(^ {146}\) Carbon Capture & Storage Association, CCS projects and proposals [accessed 9 March 2020]

\(^ {147}\) Teesside Collective, Teesside Carbon Capture And Storage (CCS) Transport Infrastructure Backed By European Commission
3 The **Caledonia Clean Energy Project** aims to generate low carbon power by using natural gas as a fuel. It would be located at Grangemouth in Scotland, where the majority of Scottish CO₂ emissions come from.¹⁴⁸

In July 2019, the Committee on Climate Change said:

Both schemes [ICSF and IEFT] will have a significant challenge deploying large-scale fuel switching or carbon capture and storage (CCS) in industry unless ongoing support for operational expenditure is provided to complement the schemes, which Government is currently considering.¹⁴⁹

However, in the November 2019 IETF consultation document the Government said that it will provide funding for capital expenditure, not operational expenditure.¹⁵⁰ In the competition details for the ISCF-funded industrial decarbonisation programme, it says that “we do not expect construction and operation of technology to be feasible within the available funding but welcome your proposal if you believe it is strong.”¹⁵¹

**CCUS Innovation programmes**

During 2017-18, the Government announced that it would be launching two grant funding programmes for CCUS projects: the **CCUS Innovation Programme** and the **Carbon Capture, Usage and Demonstration programme**. These aim to increase the scale of CCUS deployment by reducing the costs and improving technology through innovation. More details on both are below.

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<thead>
<tr>
<th>CCUS Innovation programme</th>
<th>Carbon Capture, Usage and Demonstration (CCUD) innovation programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview</strong></td>
<td><strong>Overview</strong></td>
</tr>
<tr>
<td>The <strong>CCUS Innovation programme</strong> was launched in July 2018, offering “grant funding for world-leading research and innovation projects” that contributed to:</td>
<td>The <strong>Carbon Capture, Usage and Demonstration (CCUD) innovation programme</strong> was launched in 2017 to “encourage industrial sites to capture carbon dioxide which could then be used industrial applications.” It aims to:</td>
</tr>
<tr>
<td>a significant reduction in the cost of capturing CO₂; and/or</td>
<td>demonstrate carbon capture and utilisation at a number of key industrial sites in the UK;</td>
</tr>
<tr>
<td>a quicker, more widespread deployment of CCUS in the UK and internationally.¹⁵²</td>
<td>to demonstrate and accelerate cost reductions; and</td>
</tr>
<tr>
<td></td>
<td>to encourage a “project pipeline of follow-on CCUS projects” that will help less mature, but more novel</td>
</tr>
</tbody>
</table>

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¹⁴⁸ CCUS Cost Challenge Taskforce, *Delivering Clean Growth*, July 2018
Overall funding

Up to £24m of grant funding was made available (increased from £15m in January 2019) to support projects for up to 24 months – with projects finishing by 31 March 2021.  

DBEIS allocated up to £20m to design and construct projects.  

Project allocation

In June 2019, the Government announced it had allocated £21m to six projects.  

More information on the individual projects in the Government announcement.  

In June 2019, the Government announced it had allocated nearly £5m to three projects.  

More information on the individual projects in the Government announcement.  

Example project

The University of Sheffield was awarded £7m for a new £21m Translational Energy Research Centre. It aims to provide UK companies with experimental research facilities to develop CCUS. It also aims to drive international collaboration by engaging with the International Test Centre Network and European CCS Experimental Laboratories.  

Tata Chemicals Europe was awarded £4.2m towards a £17m project to build the largest carbon capture in the UK. The company’s plant in Cheshire is the UK’s only manufacturer of soda ash and sodium bicarbonate. By 2021, it will construct a demonstration facility to capture and utilise 40,000t of CO₂ per year, which is 11% of the plant’s total emissions.  

4.5 Business models for CCUS

Business models are fundamental to the delivery of a CCUS industry because they will determine the nature of Government support and industry investment. In the context of deploying CCUS in the UK, “business model” refers to the “commercial, legal, regulatory,

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154 Department for Business, Energy & Industrial Strategy, Press release: UK’s largest carbon capture project to prevent equivalent of 22,000 cars’ emissions from polluting the atmosphere from 2021, June 2019, see Notes section
155 As above
156 Department for Business, Energy & Industrial Strategy, Press release: UK’s largest carbon capture project to prevent equivalent of 22,000 cars’ emissions from polluting the atmosphere from 2021, June 2019, see Notes section
158 Financial Times [subscription required], Tata to build UK’s biggest carbon capture project, June 2019 [accessed 9 March 2020]
financial and risk structures that the Government and investors in CCUS projects will agree on”. It incorporates:

1. Commercial models – the commercial structures used by CCUS projects including ownership, financing and regulatory features;
2. Source of funding – the source and mechanisms by which revenue support will be delivered; and

Business Models Review

The CCUS Cost Challenge Taskforce identified “the need for a long-term supportive policy environment and viable business models to support the delivery of CCUS”. In the CCUS Action Plan, the Government committed to undertaking a review of CCUS Delivery and Investment Frameworks “to identify the parameters for investable commercial models and establish market-based frameworks for bringing forward CCUS”.

In 2019, DBEIS asked the CCUS Advisory Group (CAG) to “develop business models that could be deployed in the UK to support the growth of CCUS – for transportation and storage, power, industrial capture, hydrogen and BECCS in particular – as well as to consider the role of competition and collaboration in the market to drive down costs and reduce risks.”

The CAG considered 13 high-level business models for CCUS, called “Variants”. These are detailed in the CAG’s final report *Investment Frameworks for Development of CCUS in the UK*, which was published in July 2019. Overall, the report recommends a model which would comprise: a private sector owned, regulated CO₂ Transport and Storage business, privately-owned electricity projects with CO₂ capture with revenue support (ultimately funded by electricity consumers), and industrial CCUS projects with CO₂ capture supported by an “Industrial CCUS Contract” between industrial producers and the Government. The CAG also endorsed six models as suitable alternatives.

The CAG report was published alongside DBEIS’ *Consultation on business models for CCUS* in July 2019. The consultation, which closed in September 2019, requested views from stakeholders on potential business models to inform the Government’s Review of CCUS Delivery and Investment Frameworks. The Government’s consultation response has not yet been published.

Risk

CCUS has a number of specific risks attached to it because it is a first-of-a-kind technology. For example, the potential risks with CO₂ transport and storage are: unfixed costs (for example offshore operations), unknown liabilities (such as a CO₂ leak at a storage site), which are difficult to price and share across the full CCUS supply chain, and cross-chain risks (for instance the impact on the wider chain when one component is not working).

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160 CCUS Advisory Group, *Investment Frameworks for Development of CCUS in the UK*, July 2019
161 CCUS Advisory Group, *Investment Frameworks for Development of CCUS in the UK*, July 2019
164 CCUS Advisory Group, *Investment Frameworks for Development of CCUS in the UK*, July 2019
165 As above
166 CCUS Advisory Group, *Investment Frameworks for Development of CCUS in the UK*, July 2019
In the previous CCS competitions in 2007 and 2012, the Government were criticised for not handling the risks appropriately. Developers were expected to carry risks associated with business as usual operations, which included requiring them to bear the full chain risk – i.e. capture, transport and storage. Each of these stages could have a different investor, so if one part stopped working, the investors in other parts could lose income.\(^{168}\) A number of reports concluded that this model failed because it could not absorb the “different risk appetites of organisations in the full chain… the result was an increase in cost of the CCUS project.”\(^{169}\)

The Business Models Review (see above) suggested splitting the CCUS chain and establishing a separate business model for CO\(_2\) transport and storage.\(^{170}\) The Government also requested more information about whether a Regulated Asset Based (RAB) type model would be appropriate for a CO\(_2\) transport and storage network. There is more information on the RAB model in the consultation document.\(^{171}\)

### 4.6 Ensuring CCUS is safe

CCUS has some safety risks, which are predominantly related to the risk of CO\(_2\) escaping during the transport and storage stages\(^{172}\). This has contributed to some public concern about CCUS, although research has shown that the likelihood of leakage is low.

CO\(_2\) leakage poses potential risks to the environment and human safety. For information on environmental risks see Section 1.3 on Storing CO\(_2\). In its 2011 *Assessment of the major hazard potential of CO\(_2\)*, the Health and Safety Executive said that “CCS scale of CO\(_2\) operation has the potential to introduce a major accident hazard where one does not exist”. However, it also highlighted that if the risks are properly controlled the likelihood of a major hazard incident is expected to be very low, as in similar processes in the energy, chemical and pipeline industries.\(^{173}\)

In 2014, the then Department for Energy and Climate Change commissioned a report from CCS experts on CO\(_2\) Storage Liabilities in the North Sea. It identified two categories for leakage risk: (i) those related to engineered structures which penetrate the storage site (operating and abandoned wells) and (ii) those associated with the geological features of the storage site. The report concluded:

> Overall, the risk of experiencing a leak over the anticipated lifetime of a storage site is considered to be very low and the magnitude of any associated CO\(_2\) loss is estimated to be low and manageable through existing and proven corrective measures.\(^{174}\)

The report also highlighted that in the UK, “CO\(_2\) geological storage will take place in offshore areas, where public safety risks are further reduced and environmental exposures are low.”\(^{175}\)

### Regulation

Since June 2009, the main piece of regulation for CCS across the EU has been the **European Union CCS Directive on Geological Storage of Carbon Dioxide (Directive 2009/31/EC)**. This Directive has been implemented in the UK mainly through the *Energy Act 2008*, which

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\(^{168}\) House of Commons Public Accounts Committee, *Carbon Capture and Storage*, 2017


\(^{173}\) Health and Safety Executive, *Assessment of the major hazard potential of carbon dioxide (CO\(_2\))*, 2011

\(^{174}\) AGR Petroleum Services Ltd and Senior CCS Solutions Ltd, *CO\(_2\) Storage Liabilities in the North Sea*, 2014

\(^{175}\) As above
introduced a new regulatory framework to facilitate the offshore storage of carbon dioxide as well as a number of pieces of secondary legislation.\textsuperscript{177}

The Storage of Carbon Dioxide (Amendment and Power to Modify) (EU Exit) Regulations 2019 amends retained EU law to ensure it operates effectively at the end of the implementation period. It will come into force on the day before the implementation period completion day (currently expected to be 31 December 2020).\textsuperscript{178}

On its website, the Health and Safety Executive highlights that although CCUS is not specifically addressed by UK health and safety legislation because it is an emerging process, existing legislation can be used to effectively regulate the safety of the process chain:

- The Health and Safety at Work etc. Act 1974 applies to CCS processes onshore and, from April 2013, offshore – it requires employers to ensure the health and safety of workers and members of the public.
- Although CCUS does not currently attract duties under major accident hazard legislation in the UK, the general duties under the existing legislation means that operators are required to take a proportionate approach to managing risks.
- The Pipelines Safety Regulations 1996 cover safe design and operation of onshore and offshore pipelines – including CO\textsubscript{2} pipelines.
- The Offshore Installations (Safety Case) Regulations 1995 apply where Enhanced Oil Recovery (EOR) is undertaken at an offshore installation as part of the CO\textsubscript{2} storage process. Operators are required to submit an offshore safety case to the Health and Safety Executive.\textsuperscript{179}

### 4.7 2019 General Election party manifestos

The Conservative Party, Labour Party, Liberal Democrats and Green Party all included specific commitments on carbon capture in their 2019 General Election manifestos. Further information is included in the table below.

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\textsuperscript{176} Carbon Capture and Storage Association, CCS Policy and Regulation [accessed 9 March 2020]

\textsuperscript{177} The Storage of Carbon Dioxide (Licensing etc) Regulations 2010; the Storage of Carbon Dioxide (Termination of Licences) Regulations 2011; and the Storage of Carbon Dioxide (Access to Infrastructure) Regulations 2011

\textsuperscript{178} UK Parliament, Statutory Instruments, Storage of Carbon Dioxide (Amendment and Power to Modify) (EU Exit) Regulations 2018, 6 March 2019

\textsuperscript{179} Health and Safety Executive, Regulating CCS [accessed 9 March 2020]
<table>
<thead>
<tr>
<th>Party</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conservative</strong></td>
<td>“We will invest £800m to build the first fully deployed carbon capture storage <strong>clusters</strong> by the mid-2020s.” ¹⁸⁰</td>
</tr>
<tr>
<td>Labour</td>
<td>“We will establish a <strong>Foundation Industries Sector Council</strong> to provide a clean and long-term future for our existing heavy industries like steel and glass and <strong>fund R&amp;D</strong> into newer technologies like hydrogen and carbon capture and storage.” ¹⁸¹</td>
</tr>
<tr>
<td>Scottish National Party</td>
<td>“We want Scotland to be a leader in the development of Carbon Capture and Storage (CCS) technology, which has the potential to create thousands of jobs while helping to fight climate change. Too often the UK has held this ambition back – not least when they reneged on their commitment to a £1 billion project set to benefit Peterhead Power Station. SNP MPs will press the UK Government to <strong>accelerate deployment of fully operational carbon capture utilisation and storage facilities</strong> in Scotland to ensure we are not denied this opportunity again.” ¹⁸²</td>
</tr>
<tr>
<td>Liberal Democrats</td>
<td>“We will reduce emissions from industrial processes by <strong>supporting</strong> carbon capture and storage and new low-carbon processes for cement and steel production”. ¹⁸³</td>
</tr>
<tr>
<td>Plaid Cymru</td>
<td>No specific mention of carbon capture. ¹⁸⁴</td>
</tr>
<tr>
<td>Democratic Unionist Party</td>
<td>No specific mention of carbon capture. ¹⁸⁵</td>
</tr>
<tr>
<td>Sinn Fein</td>
<td>No specific mention of carbon capture. ¹⁸⁶</td>
</tr>
<tr>
<td>SDLP</td>
<td>“SDLP MPs will work with farming organisations to explore alternative methods of subsidy which prioritise public goods including <strong>carbon sequestration</strong>, forest management and flood plain development.” ¹⁸⁷</td>
</tr>
<tr>
<td>Green Party</td>
<td>For industry: “Start deployment of a Carbon Capture and Storage (CCS) system that can deal with CO₂ emissions from manufacture of iron, steel and cement.”</td>
</tr>
<tr>
<td>Research and development:</td>
<td>“Research into carbon capture technologies: £0.8 billion”. ¹⁸⁸</td>
</tr>
<tr>
<td>Alliance Party</td>
<td>“Alliance will seek to work with industry to introduce circular economy models and provide funding to accelerate the introduction of industrial <strong>carbon capture and storage</strong>.” ¹⁸⁹</td>
</tr>
</tbody>
</table>

5. Recent parliamentary scrutiny of Government approach to CCUS

5.1 Business, Energy and Industrial Strategy Committee

The House of Commons Business, Energy and Industrial Strategy Committee published a report on Carbon capture usage and storage in April 2019 which concluded that while “the current Government has made good progress in reinvigorating CCUS interest with a new Action Plan that focuses on industrial applications”. However, the Committee were particularly concerned by the lack of specific targets in the Government’s promise to “deploy CCUS at scale during the 2030s subject to costs coming down sufficiently”: 191

 […] formal targets for CCUS remain ambiguous, with no clarity on the ‘scale’ of deployment that Government plans to bring forwards, nor a definitive answer on the apparent precondition that this essential technology must become cheaper before it is widely deployed. 192

Key recommendations in the Committee’s report included:

- The Government […] should prioritise the development of clear ambitions that will bolster its renewed efforts to kick-start CCUS; […]
- That the timetable for policy delivery is accelerated to enable CCUS commissioning from 2023 – to avoid additional cost of recommissioning disused oil and gas pipelines; […]
- The Government should prioritise the development of CCUS to benefit from growing international demand for low carbon products and services; […]
- That funding models for carbon capture are separated from those for carbon transport and storage; and […]
- That the development and commissioning of first CCUS projects should take place in at least three clusters by 2025 to minimise the risk of a third major delay to the technology’s development and to ensure that its benefits for productivity accrue to industries across the UK. 193

In response to its report, in April 2019 the Committee received an interim letter from then DBEIS Energy and Clean Growth Minister welcoming the report in which she said that the “recommendations will be an important input to the work we are delivering throughout 2019, in partnership with industry to progress CCUS in the UK”. 194 The Committee then received the formal Government response in August 2019, in response to which it wrote to the new Business, Energy and Clean Growth Minister Kwasi Kwarteng MP in September 2019 stating its disappointment with the response’s content:

 […] it barely engages with the arguments made in our report, but instead appears largely to repeat previous policy statements […] We were disappointed to note that the response

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190 House of Commons Business, Energy and Industrial Strategy Committee, Carbon capture usage and storage: third time lucky?, April 2019
192 House of Commons Business, Energy and Industrial Strategy Committee, Carbon capture usage and storage: third time lucky?, April 2019
193 House of Commons Business, Energy and Industrial Strategy Committee, Carbon capture usage and storage: third time lucky?, April 2019
194 Department for Business, Energy and Industrial Strategy, Letter from Claire Perry to Chair re CCUS report, 25 April 2019
appears to row back from statements made by former Ministers during the course of the inquiry […] 195

The Minister responded to the Committee in October 2019, in which he offered reassurance that the “Committee’s CCUS report has already influenced the development of our CCUS business models work”. It also set out detail on specific recommendations. 196

5.2 Scottish Affairs Committee

On 30 January 2019, the Scottish Affairs Committee published its report into The future of the oil and gas industry, in which it considered how CCUS technology could be useful to the oil and gas sector. The Committee’s key conclusions included:

- CCUS technology has an essential role to play in enabling continued use of gas as a power source in a way that is consistent with the UK’s climate change goals; […]
- The Committee welcomes the Government’s ambition to support the development of CCUS clusters, which should drive up value for local economies and encourage ongoing technological innovation; […]
- Creating a market for using stored CO2 can make a contribution to the commercial deployment of CCUS by creating an income stream from some of the captured gas […] As there is likely to be limited demand to use captured CO2 the Government must ensure that the lessons learned from projects supported by the CCU Demonstration Fund are shared with facilities focused on the long-term storage of captured CO2; […]
- Oil and gas infrastructure has the potential to be re-used for CCUS and it would be regrettable if this potential was lost due to a relatively short gap between infrastructure being decommissioned and CCUS becoming commercially viable; — To address this the Committee recommends that “the Government considers underwriting the liability for this infrastructure for a fixed time while options for re-use are explored. This would ensure that the original owners are not at risk from additional liability for keeping this infrastructure in place for an extended length of time […]”

The Government responded positively to the Committee recommendations for increased support on CCUS, highlighting the funding it was allocating through DBEIS for feasibility studies, industrial research and experimental development. 197

5.3 Science and Technology Committee

The House of Commons Science and Technology Committee published its report into Clean Growth: Technologies for meeting the UK’s emissions reduction targets on 22 August 2019, considering carbon capture usage and storage technology and Government support for its development and deployment.

The Committee “commended the Government for recapturing lost momentum in the development of carbon capture and storage” but stressed that it had concerns that its CCUS Action Plan “lacks clarity and ambition”. It therefore recommended that the Government

195 BEIS Committee, Letter from the Chair to the Minister of State for Business, Energy and Clean Growth, 9 September 2019
196 Department for Business, Energy and Industrial Strategy, Letter from Minister of State for Business, Energy and Clean Growth to Chair of the BEIS Committee, 26 September 2019
197 Scottish Affairs Committee, Government sidesteps Committee’s call for Scottish oil and gas sector deal, 9 May 2019
provide “greater clarity on the details of its action plan”.  The information the Committee requested is set out below, with the Government response alongside it – which was published on 1 November 2019. The responses highlight the links between developing the technology at scale and what the Government calls the “business model”.

<table>
<thead>
<tr>
<th>Government should define</th>
<th>Government response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deployment “at scale”</strong></td>
<td>• Large-scale facility is defined as “involving the capture, transport and storage of CO₂ at scale of at least 400,000 tonnes of CO₂ annually”&lt;br&gt;• “At scale” deployment definition varies, but the CCC has advised that between 75-175 CO₂/year may be required to meet net zero by 2050.</td>
</tr>
<tr>
<td><strong>What constitutes “sufficient cost-reduction”</strong></td>
<td>• CCUS will be progressed through a “staged approach”: 2020s will be used to test and develop CCUS in the UK context, supported by the development of business models.&lt;br&gt;• This will “allow lessons to be learnt and applied […] testing and then securing initial cost reductions with the ultimate goal of enabling commercial deployment.”</td>
</tr>
<tr>
<td><strong>How it expects to share costs with industry</strong></td>
<td>• As part of the testing and developing in the 2020s, the Government will set out its approach to sharing costs with industry;&lt;br&gt;• Consultation on CCUS business models has been launched – includes parameters to guide the commercial development of CCUS business models to keep costs low.</td>
</tr>
<tr>
<td><strong>Major milestones and deadlines</strong></td>
<td>• Responses to business model consultation and re-use of oil and gas infrastructure for CCUS expected by end of 2019;&lt;br&gt;• Consultation on Industrial Energy Transformation Fund design launched by end of 2019;&lt;br&gt;• £26m of innovation funding (out of £50m) announced in June 2019. Continuing to work with UKRI on CCUS innovation.</td>
</tr>
</tbody>
</table>

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198 Science and Technology Committee, Clean Growth: Technologies for meeting the UK’s emissions reduction targets, 22 August 2019
199 Science and Technology Committee, First Special Report of Session, Clean Growth: Technologies for meeting the UK’s emissions reduction targets: Government and Ofgem Responses to the Committee’s Twentieth Report of Session 2017–19, 1 November 2019
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