Carbon capture and storage: the debate

What is it?
CCS stands for Carbon Capture and Storage. What this involves can be broken down into three steps:

- **Capture**
  "Capturing carbon dioxide (CO_2) from power plants or industry, and compressing it to a liquid state."[1]
- **Transport**
  "Transporting the CO_2 (usually via pipelines) to deep geological storage points such as depleted oil and gas fields or deep saline aquifers."[1]
- **Storage**
  "CO_2 is injected into deep underground rock formations, often at depths of one kilometre or more."[1] It is then "trapped" beneath seals of low permeability rocks, dissolved in water, converted to solid minerals or by a method known as capillary trapping[3].

Why are we doing it?
"Fossil fuels are presently the dominant source of global primary energy demand and will likely remain so for the foreseeable future."[4]

The reason CCS gets so much attention is because it is seen as a best-of-both-worlds technology. It allows economies to continue growing and developing thanks to the huge range of opportunities that fossil fuels provide but it also allows industry to mitigate the exorbitant impact these opportunities have on the delicate climatic systems we so rely upon.

"Fossil fuels currently supply over 85 per cent of all primary energy globally, and stabilising global temperatures at or near the 2°C warming target will likely require significant contributions from CCS."[4]

Considering this latent potential, there is quite a lot of faith being put into this technology, that, until fairly recently in the UK, had not been commercially developed. There are only 8 operational commercial-scale CCS plants globally[5].

Scale
The International Energy Agency has stated that CCS can provide a fifth of the world's emission reductions needed by 2050[4]. Considering CCS can capture up to 90 per cent of the carbon emissions from the industrial use of fossil fuels for electricity generation, it stands to reason that, if conducted on a large enough scale, this 20 per cent figure could be possible. Some progress needs to be made however; in order for this goal to be achieved by 2050 more than 3,000 CCS projects must be successfully constructed in this time[6].

So what's happening currently?
Whilst fully operational plants may be hard to find, "worldwide up to $40 billion has been committed by governments to support CCS projects".[1] According to the Global CCS Institute's *Global Status of CCS* report for February 2014 there are 21 large-scale projects in operation or construction around the world (including the 8 fully operational)[7].

What are we doing about it?
According to the British Government, the UK has a set of conditions which make it a very suitable place to explore the technology:

- "Extensive storage capacity under the UK seabed, particularly under the North Sea"
- "Existing clusters of power and industrial plants with the potential to share CCS infrastructure"
- "Expertise in the offshore oil and gas industry which can be transferred to the business of CO2 storage."[1]

The Secretary of State for Energy and Climate Change Edward Davey states that he would like Britain to be a leader in the technology:

"As carbon capture and storage is commercialised Britain will be in first place to export this knowledge to a decarbonising global economy."[8]

In order to do this the plan is to help industry to implement an investment strategy that would enable the UK to equip itself throughout the early 2020s[6], a structure that they say is "one of the most comprehensive offered by any country in the world".[1]

The strategy

This strategy is broken down into five parts:

1. "A CCS Commercialisation Programme with £1 billion in capital funding to support commercial-scale CCS".[1]
   Commenced in 2012, this programme found two projects to split the funding. These are:

   - White Rose: The funding for this particular project has continued to grow, most notably with the awarding of the European Commission's New Entrants' Reserve Fund (NER300) 300 million (around £240 million) grant. This fund has been created to assist renewable and low carbon fossil fuel technology development and White Rose is the first CCS plant to receive help.[8]

   - Peterhead: The world's first planned CCS project on a gas power station.[9]

2. "A £125m, 4-year, co-ordinated R&D and innovation programme"[1]
   Funding comes from the Department of Energy and Climate Change (DECC), the Technology Strategy Board (TSB), the Energy Technologies Institute (ETI) and the Research Councils.[9]

3. "Development of a market for low carbon electricity through Electricity Market Reform (EMR)"[1]

4. "Intervention to address key barriers to the deployment of CCS including work to support the CCS supply chain, develop transport and storage networks, prepare for the deployment of CCS on industrial applications and ensure the right regulatory framework is in place"[1]

5. "International engagement focused on sharing the knowledge we have generated through our programme and learning from other projects around the world to help accelerate cost reduction."[1]

The budget

As part of this strategy, HM Treasury announced in the 2014 Budget, a further £60 million that will be made available for CCS innovation[10].

So seemingly there is every reason for jumping headfirst into the world of CCS, but other groups in society hold differing opinions....

				
The issue	**What the Government says**	**What industry says**	**What the campaigners say**	**What the scientists say**
Does it fit in our portfolio?	Carbon Capture and Storage (CCS) is the only set of technologies that can turn high carbon fuels into genuinely low carbon electricity, and crucially it is the only approach available to decarbonise many energy intensive industries such as steel and cement[11]. "Analysis suggests the technology could cut the annual cost of meeting our carbon targets by up to 1% of GDP by 2050."[11]	Carbon Capture and Storage (CCS) is a technology that can capture up to 90% of the carbon dioxide (CO_2) emissions produced from the use of fossil fuels in electricity generation and industrial processes, preventing the carbon dioxide from entering the atmosphere[12].	"If you assume that our economies will only grow through efficiency gains and that resource depletion clearly points towards the need for efficient closed cycle processes, spending over £1bn on CCS makes little sense."[13]	To meet legally binding targets, UK GHG emissions need to be cut by at least 80% of the 1990 levels by 2050. With an increase in future fossil fuel use, Carbon Capture and Storage (CCS) is the only method of meeting these targets[14].
What could it mean?	"Carbon Capture and Storage (CCS) has the potential to be one of the most cost effective technologies for decarbonisation of the UK's power and industrial sectors, as well as those of economies worldwide."[6] "UK gas and coal power stations equipped with carbon capture, transport and storage have clear potential to be cost competitive with other forms of low-carbon power generation, delivering electricity at a levelised cost."[15]	"Carbon capture and storage (CCS) will be a critical component in a portfolio of low-carbon energy technologies if governments undertake ambitious measures to combat climate change."[16] "Given current trends of increasing global energy sector carbon dioxide (CO_2) emissions and the dominant role that fossil fuels continue to play in primary energy consumption, the urgency of CCS deployment is only increasing."[16]	"The energy penalty [energy taken from production and used in capture process itself] is translated into a financial penalty. What that means is that CCS doesn't improve productivity – it simply makes generating power more expensive."[17] "The technology is largely unproven and will not be ready in time to save the climate."[23] "How about decarbonise the power sector now, promote improvements in efficiency, particularly material efficiency, then sort out the border protection for domestic production/consumption of material industries to promote best practice."[18]	"The metaphor that we are using our skies as an open sewer to dump our carbon waste is precisely correct, and CCS is the sewer system."[19] The CO_2 produced from the processing of fossil fuels can actually be used. One of the most desired uses is Enhanced Oil Recovery (EOR). "CO_2-EOR is the injection of supercritical CO_2 into oil fields after the production from conventional drilling has declined to help produce more oil and it is a proven method for permanent carbon sequestration."[19]

The issue	What the Government says	What industry says	What the campaigners say	What the scientists say
Is it dangerous?	"CO_2 is not currently defined as a dangerous substance under the Control of Major Accident Hazards Regulations 1999 (COMAH) or as a dangerous fluid under the Pipelines Safety Regulations 1996 (PSR)."[20] "CO_2, based on the evidence available at that time, has major accident hazard potential if released at, or above, its critical pressure. However, where the risks are properly controlled the likelihood of a major hazard incident is expected to be very low, as in other similar processes in the energy, chemical and pipeline industries."[20]	"In a climate perspective, the alternative to storing captured carbon dioxide is to emit it to the atmosphere."[21] "The CCS Directive (2009/31/EC) provides a legal framework for the safe geological storage of CO_2. . . For geological storage of CO_2 to be allowed at a site, a storage permit must be obtained and it must meet the requirements of the Directive."[14] "Hundreds of thousands of tonnes of carbon dioxide are safely processed, captured and transported every year in the UK under existing UK and European regulatory frameworks and regimes, and have been for many years."[22]	"Risks arise from the large quantities of CO_2 to be injected, the prolonged storage times required for any real climate benefit, and the fact that injection wells, and other infrastructure and geological imperfections, may result in CO_2 leakage."[23] "On a global scale, continuous leakage of CO_2 has the potential to undermine climate change mitigation efforts."[23] "On a local scale, CO_2 leakage from storage sites poses a threat to human health."[23]	"Research and practical experience demonstrate that we have robust safe storage capacity all around the globe to meet the demand for thousands of gigatons of sequestration."[21] "The potential health risks of CCS include asphyxiation of humans and animals, compromise of safe drinking water supplies, in addition to the well-known cardiorespiratory disease and mortality consequences of continued coal combustion."[24] "The medical community ought to support actively non-combustion, clean energy policies as a matter of public health."[24]

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