



Commercialising CCS

INVESTOR PERSPECTIVES

Executive Summary

Over the last 10 years the UK government has encouraged the development of Carbon Capture and Storage (CCS) in the UK. The offer of capital grants and the expectation of Contracts for Difference for appropriate projects resulted in strong interest from project developers and private sector capital providers, and a wealth of CCS knowledge has been built-up in the UK.

The cancellation of the £1bn capital grant for up to two CCS projects at the November 2015 Spending Review sent a very negative message to private sector investors and undermined their enthusiasm to invest in the UK energy sector. Some investors (both debt and equity) have already decided to abandon their plans to invest in CCS in the UK though others remain committed to developing a technology that has been consistently shown to be the most cost effective way to reach the UK's legally-binding CO₂ targets whilst keeping the lights on. Research from the Energy Technologies Institute (ETI), the Committee on Climate Change (CCC), the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) continues to show that CCS is essential.

Following last November's decision, the government announced that it will set out an alternative plan for developing CCS by the end of 2016 and it is expected that this will be done in close collaboration with equity and debt investors.

In order to maintain the interest and commitment of these investors it is crucial that the government sets out its alternative plan in a timely way or risk losing expertise and interest that will be very difficult to replace.

We recommend that the government addresses the following issues in its new CCS strategy:

1. Establish a new CCS delivery model in collaboration with CCS investors

To get the UK's first commercial CCS projects off the ground, it is vital that the government, project developers and private sector capital providers work together (through working groups, workshops and bilateral discussions) to develop a bankable investment mechanism for CCS on power and industry.

2. Make the business case for government and industry co-investment

It is positive news that the government is continuing to provide some level of support to remaining projects. It is important that funding to existing and future projects is provided not as an isolated initiative but as part of an overall business plan and policy to deliver CCS.

In this brief note, we set out:

- Existing CCS projects globally, and how the UK can be a fast follower
- Why CCS is strategically so important for the UK
- Why further delay is not an option in the UK from the investors' perspective
- Specific issues that need to be addressed in the government's new CCS strategy

Background

- The Ecofin Research Foundation worked with Sandbag and Element Energy to identify what is required in the Government's new CCS strategy (due to be published by the end of 2016) to re-establish the momentum to commercialise CCS. Decisions taken by the government this year will determine whether development of a CCS industry continues or the opportunity is squandered. If the new strategy does not demonstrate a commitment to CCS the cost for the UK to reach its legally binding 2050 CO₂ reduction targets will significantly increase accompanied by a major loss of international investment and risks to energy security.
- The recommendations in this briefing document draw on extensive published research and are informed by the UK CCS Commercial Development Group (CDG) members including project developers and private sector capital providers (see Appendix for full list). The Ecofin Foundation leads the CDG with the support of the Energy Technologies Institute.

CCS is real and it works: Existing Projects

- Carbon capture and storage (CCS) is the only way to achieve 90% emissions reductions from the energy intensive industries, it is also essential for the continued use of natural gas for power or heat.
- Globally, there are 15 large-scale CCS projects in operation (June 2016), with a further seven under construction. The number of CCS projects in operation or under construction has doubled since 2010 and the total CO₂ capture rate of these 22 projects is around 40 million tonnes of CO₂ per year.¹
- In Norway – the Sleipner and Snøhvit storage projects have for two decades sequestered and stored around 20 million tonnes of CO₂ cumulatively. The Quest project in Canada now stores around 1 million tonnes of CO₂ annually in a deep saline formation. Other CCS projects use CO₂ for enhanced oil recovery (EOR, sometimes referred to as a CO₂ usage before storage, CCUS), where the stored CO₂ forces up extra supplies of oil or gas (of interest in the declining North Sea).
- In the power sector, Boundary Dam, the world's first large-scale power CCS project, is now operational in Canada. Later this year, a new-build 582 megawatt (MW) power plant at the Kemper County Energy Facility in the US will become operational. Important industrial CCS projects are also expected to be formally commissioned this year including the already operational Abu Dhabi CCS Project in the United Arab Emirates (UAE), the world's first large-scale CCS project in the iron and steel sector.
- In the UK the two Commercialisation Programme projects made significant progress on developing strategically important CO₂ transport and storage infrastructure by appraising the 5/42 site in the Southern North Sea; this was in addition to the already appraised, developed and depleted Goldeneye gas field in the Central North Sea.
- Three remaining potential CCS projects in the UK are progressing their projects:
 - Caledonia Clean Energy Project, a new coal & CCS plant planned for Grangemouth received £4.2 million funding from the UK and Scottish Governments to carry out a feasibility study.
 - Teesside Collective, a major industrial cluster, published a blueprint for growth in the North-East through Industrial CCS in Teesside ² and received an additional tranche of funding in April 2016.
 - The Don Valley Power Project, planned in Yorkshire, is at an advanced stage of development, and was recently acquired by Sargas Power. It has continuing EU funding but only provided that it can continue to demonstrate the UK's commitment to progressing the project.

¹ <https://www.globalccsinstitute.com/projects/large-scale-ccs-projects>

² <http://www.teessidecollective.co.uk/teesside-collective-blueprint-for-industrial-ccs-in-the-uk/>

Why is CCS strategically so important for the UK?

CCS is essential to meet climate targets

- The Committee on Climate Change (CCC) recently advised the Secretary of State that there needs to be substantial development of CCS by 2030 to enable the technology to contribute fully to the least cost delivery of the 2050 CO₂ reduction targets.³
- ETI's energy system modelling suggests that **without CCS, the cost of reaching UK Climate Change targets will double** from a minimum of around £30bn per year in 2050⁴. Similarly, a recent International Energy Agency (IEA) report⁵ shows that without CCS, the cost of meeting a 50% global CO₂ reduction target by 2050 would increase by 40%. Additionally, the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report found that global decarbonisation would be more than double (138%) as expensive without CCS. The majority of the global models available to the IPCC cannot meet the 2 degrees target if CCS is not incorporated.⁶
- Deploying CCS on dependable fossil fuel power, alongside nuclear and weather dependent renewables, could deliver electricity prices around 15% lower as early as 2030 (and considerably more savings by 2050) compared with decarbonising without CCS⁷.
- CCS-equipped power plants are dependable (can provide baseload) or can be a dispatchable (possessing the ability to be rapidly turned on and off), which is important in complementing increasing amounts of intermittent renewable energy production.
- CCS is recognised as the key option for substantially decarbonising the energy intensive industries, including the process parts of the cement, chemicals, oil refining, and iron and steel sectors which cannot decarbonise through other means.⁸
- The government's decision in the March 2016 Energy Bill debate to aim for a Net Zero emissions reduction target only increases the necessity for CCS in the UK.⁹

CCS has wider economic benefits to the UK and provides value for money

- A commercial CCS industry could be creating 15,000-30,000 new jobs annually by 2030.¹⁰
- Gross Value Added (GVA) benefits from CCS deployment in the UK range between £2bn and £4bn per year by 2030 (with a cumulative UK market value of £15bn–£35bn).
- UK GVA resulting from a share in the global CCS market could increase to between £5bn and £9bn per year by 2030.¹⁰
- Consistent with the government's Northern Powerhouse ambition, CCS could help maintain existing industrial clusters and encourage new investment by companies wishing to have less than 10% of the carbon emissions without CCS. These sectors had a combined turnover of £95bn (i.e. equivalent to three per cent of UK GDP) and directly employed 160,000 people with a further indirect employment of 800,000 people via supply chains.¹⁰
- Aging oil and gas fields in the North Sea, together with low oil prices, are leading to platform and pipeline decommissioning, set to accelerate over the coming decades. The Government could extend the life of some of this infrastructure and create thousands of jobs by adapting parts of the infrastructure for the transport and storage of carbon dioxide. With the combination of Enhanced Oil Recovery and Enhanced Gas Recovery in the Central North Sea, tens of millions of tons of CO₂ could be stored and up to 1 billion additional barrels of oil could be produced;¹¹ it is estimated that

³ <https://documents.theccc.org.uk/wp-content/uploads/2016/01/Paris-Agreement-and-fifth-carbon-budget-CCC-letter-to-Rt-Hon-Amber-Rudd.pdf> - Around 7GW of gas CCS, and 3MtCO₂e stored from industry needed by 2030

⁴ Element Energy and Pöyry for the ETI, 2015, CCS sector development scenarios in the UK

⁵ International Energy Agency Technology Roadmap, Carbon Capture and Storage – 2013 edition

⁶ IPCC AR5, 2014, Summary for Policymakers pp 25

⁷ TUC and CCSA, 2014, The economic benefits of carbon capture and storage in the UK

⁸ Element Energy et al. for BIS and DECC, 2014, Demonstrating CO₂ capture in the UK cement, chemicals, iron and steel and oil refining sectors by 2025: A Techno-economic Study

⁹ Sandbag, 2015, UK targets Net Zero emissions, but carbon accounting flaws remain

¹⁰ TUC and CCSA, 2014, The economic benefits of carbon capture and storage in the UK

¹¹ Element Energy et al. for CO₂-EOR JIP, 2014, CO₂-EOR in the UK: Analysis of fiscal incentives

in this way we could create 44,000 person-years of employment (cumulatively) in Scotland over the period to 2050.¹²

CCS has other potential long-term benefits

- CCS can deliver negative emissions in combination with bio-energy, a crucial factor in light of the government's commitment in the Energy Bill 2016 to a Net Zero target under the Climate Change Act.
- Well known gasification technologies e.g. Steam Methane Reformation (SMR) produce hydrogen and pure CO₂ from natural gas. The hydrogen can be used as a zero-carbon fuel in transport and industrial and domestic heating sectors, whilst the centrally produced CO₂ can be cost effectively stored in depleted gas reservoirs or saline aquifers. For example, the city of Leeds is currently pursuing a pilot project to convert from natural gas domestic heating to low-carbon hydrogen.¹³

Investor Perspective: Further delay is not an option

The ETI and the CCC have already provided compelling evidence on why substantial development of CCS is needed before 2030, and further briefings are to follow throughout 2016.¹⁴ This section explains potential consequences of 'further delay' from the investors'¹⁵ point of view:

- In a recent letter to the Energy and Climate Change Committee the ETI sets out the **cost implications of delaying deployment of CCS**. The ETI estimates that delay adds an estimated £1-2bn per year throughout the 2020s and is likely to add £4-5bn per year compared with the otherwise best achievable cost of reducing carbon emissions in 2040.¹⁶
- Key CCS project developers – Shell and National Grid – have ended ongoing CCS work in the UK. If CCS deployment in the UK is delayed further, the Boards and Investment Committees of the remaining CCS investors in the UK would not be able to justify ongoing investment in the UK CCS sector.
- The Don Valley Project is the only project in the UK to benefit from an EU grant awarded under the European Economic Programme for Recovery (EEPR); the project will lose the €60 million remaining unused funds from the €180 million EU grant if it cannot demonstrate to the European Commission that the UK government intends to support its continuing development.
- The CCS industry can be cost-competitive with other low-carbon technologies by the late 2020s only if deployment begins in 2017/18. Many of the cost-reduction opportunities are a matter of capture scale and sharing transport and storage infrastructure. That is to say, technology cost reductions delivered by CCS investment elsewhere globally will come later and are not required to deliver the required cost reductions in the UK.
- Regional CCS hubs supported by government policy, can provide a bankable long-term foundation for new industrial growth. This would help UK energy intensive industries to become major players in the low-carbon economy. Granting a Development Consent Order (DCO) for the White Rose pipeline, as a matter of urgency, would reduce the possibility of the 'Humber cluster' disappearing.
- There is also a risk that progress in storage development and consenting made through the CCS competition projects might be lost. Starting planning applications again adds, by definition, years of delay. So the converse of all previously quoted research, including that provided by the Government's own Advisors the CCC, is that no decision by the government to develop one or two

¹² Element Energy et al. for Scottish Enterprise, 2014, Scotland and the CNS CCS Hub Study

¹³ H21 Leeds City Gate project, July 2016. <http://connectpa.co.uk/wp-content/uploads/2016/07/H21-Executive-Summary-Interactive-PDF-July-2016.pdf>

¹⁴ See for example:

<https://documents.theccc.org.uk/wp-content/uploads/2016/01/Paris-Agreement-and-fifth-carbon-budget-CCC-letter-to-Rt-Hon-Amber-Rudd.pdf> - there needs to be substantial development of CCS by 2030 to enable the technology to contribute to the least cost delivery of the 2050 CO₂ reduction targets

¹⁵ In this document, investors refer to project developers and private sector capital providers

¹⁶ <https://www.parliament.uk/documents/commons-committees/energy-and-climate-change/ETI-letter-to-Chair-on-Future-of-CCS.pdf>

of the investment ready stores is, in fact, a decision by Government to significantly increase the cost of decarbonising the UK.

Investors (debt and equity) understand that fiscal constraints meant a hard decision needed to be made in last November's Comprehensive Spending review. Collaborating with the CCS industry to develop a new policy strategy for CCS now will help investors and project developers regain interest in the UK, not only for CCS, but also for other major infrastructure projects which stand to benefit from a UK CO₂ transport and storage network.

New government strategy for CCS

Following last November's decision to withdraw all grant funding for one or two CCS projects in the power sector, the government's alternative strategy for developing CCS in the UK is expected to be published by the end of 2016. In delivering this new strategy the government needs to take account of investor's loss of trust following Longannet power CCS cancellation in 2011 as well as the cancellation of funding for CCS competition in 2015.

It's vital that the new strategy demonstrates that the government wants and perceives a need for CCS in the 2020's, likely including industrial CCS (since the alternative is closing down energy intensive industries in the UK), and backs this up with a clear implementation plan to a low carbon future.

The new CCS strategy (no longer constrained by a Competition) can maximise the synergies between the decarbonisation of power, unlocking deep emission reductions for energy intensive industries in the industrial heartlands and supporting the decarbonisation of heat through hydrogen production and heat networks. This could be done whilst still using the skills and assets that are present in the oil and gas sector.

A confident CCS strategy and ambitious leadership alongside strategic partnerships with CCS investors can reignite interest in the UK CCS sector. In order to maintain the interest and commitment of the project developers and private sector capital providers, we recommend the government addresses the following issues in its new CCS strategy in close collaboration with CCS investors:

1) Establishing a new CCS delivery model in collaboration with CCS investors

"For the development of CCS in the UK and the rest of Europe to succeed it is important that the learnings from the competition, enshrined in the 'Lessons Learned' document, form the basis of the continued dialogue with the commercial funding community (both debt and equity) and, more importantly any future CCS policy. Given global concerns around climate change and emissions generally, it is vital that precedent is established in the commercial funding of CCS projects and that will only happen if an appropriate risk allocation can be agreed between key stakeholders in the public and private sectors." (Richard Simon-Lewis, formerly Capture Power)

- The successful development of CCS requires the interests of both the public and private sectors to be well aligned to create a business case that is investable for all parties. To deliver a bankable CCS delivery model, it is vital that the government, project developers and private sector capital providers work together (through working groups, workshops, and bilateral discussions). We recommend that the established delivery model addresses the following issues:
- **The 'Lessons Learned' from the former competition projects need to be fully taken account of in setting future CCS policy.** The private sector providers of capital have been taken to the 'starting line' and it's particularly important that the related learnings form the foundation of a dialogue with funders going forward – 'starting again' would be hugely damaging to investor confidence.

- To re-establish the confidence and trust of equity and debt investors, the government must **present a clear and coherent energy policy** in which the role of CCS is evident. Offering grants without a CCS policy and/or delivery plan is not attractive as it does nothing to manage the risk.
- Establish CCS with at least two parts, onshore capture, transport and offshore storage. **A Transport & Storage business model** can be developed that reduces cross-chain risks for project developers whilst the Government takes the very low, but uncertain, risk of carbon price **liabilities for any costs of CO₂ emissions** for the first CCS projects
- **Ensure sufficient medium term support (including Contracts for Difference)** is available to support power projects.
- Ensure that a **Development Consent Order for the White Rose pipeline** is agreed as soon as possible.
- Ensure the **storage capacity appraised or previously appraised and developed and made investment ready through the CCS competition projects** (i.e. 5/42 in the Southern North Sea and Goldeneye/Captain in the Central North Sea), **is utilised**.
- Consider the opportunity to **prove CCS as part of new-build gas power plant; potentially making use of the synergies by locating alongside industrial CCS plants**.
- Establish **an investment mechanism for industrial CCS**, which is recognised as the key option for substantially decarbonising the energy intensive industries (cement, chemicals, oil refining, gas processing and iron and steel sectors) – initial options were examined by the Teesside Collective¹⁷ and are being further developed.

The government's planned working groups, workshops and bi-lateral discussions in summer/autumn 2016 provide an excellent launch-pad for new collaboration between investors, current and potential projects, and government.

2) Make the business case for government and industry co-investment

The three East Coast regions of Grangemouth, Teesside and Humber are working together to create the building blocks to develop a decarbonised East Coast Network. It's important that government continues to provide funding support for commercial feasibility studies for the first CCS projects. The bridging funds will maintain the interest and commitment of investors and avoid losing expertise that will be very difficult to replace. It would be helpful if this support was extended to detailed engineering and commercial feasibility studies of existing and prospective CCS projects and development of transport and storage infrastructure.

Specific EU funding issues for the government to focus on include:

- At the EU level €360million of previously allocated EU funding for the UK CCS industry remains unspent.
- Exploring the possibility of using unspent €300million of NER300 funds allocated to White Rose for remaining UK CCS projects and/or transport and storage infrastructure.
- Ensuring the Don Valley Project can receive the unspent €60 million EU grant it was previously awarded under the European Economic Programme for Recovery (EEPR).
- Securing **Projects of Common Interest (PCI)** funding for a North Sea transport & storage network, working with other countries around the basin to produce an effective PCI bid

A recent CCC report¹⁸ suggests whilst global CCS roll-out and continued R&D could be important for lowering costs in the UK, more than 70% of the cost reduction is likely to be attributable to sharing of infrastructure and through improvements in the UK support structure for CCS. In spite of withdrawal of funding for the two power CCS projects was withdrawn in 2015, the significant cost reductions available through shared infrastructure implementation of CCS in the 2020s can still be harvested through the Government's Energy Policy Update.

¹⁷ Teesside Collective, Blueprint for industrial CCS in the UK – Investment Mechanism Design (2015)

¹⁸ Pöyry and Element Energy for the CCC, 2015, Potential CCS cost reduction mechanisms

Appendix: Members of the Commercial Development Group

Ecofin Research Foundation, Energy Technologies Institute, Sandbag,

The Carbon Capture and Storage Association (CCSA), The Crown Estate,

Summit Power, Sargas Power, Teesside Collective, Pale Blue Dot, Progressive Energy,

Green Investment Bank, Societe Generale, Lloyds Banking, HSBC, RBS, European Investment Bank, Bayern LB, Bank of Tokyo-Mitsubishi,

Department for Energy & Climate Change (DECC), Department for Business Innovation & Skills (BIS),

Patrick Dixon (previously Expert Chair CCS DECC),

Mervyn Wright (previously White Rose/National Grid), Richard Simon-Lewis (previously Capture Power)

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