



A BUSINESS CASE FOR A UK INDUSTRIAL CCS SUPPORT MECHANISM

A Pöyry report on behalf of and in partnership
with Teesside Collective

Executive summary

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EXECUTIVE SUMMARY

- **Carbon Capture and Storage (CCS) is a technically proven technology for application to industrial emissions currently operating at sites worldwide, and the only option for deep emissions cuts for many UK industries.**
- **Total lifetime cost for capture, transport and storage for an industrial CCS hub is £60/tCO₂ – appears good value in comparison to cost of carbon used for policy development which stands at £78/tCO₂ by 2030, and other contracts aimed at decarbonising the energy system.**
- **Building on Lord Oxburgh report recommendations, a commercially feasible industrial CCS business model has been identified and tested through broad stakeholder input that potentially meets needs of both industry and Government.**

Introduction

Large manufacturing industry is a major contributor to the British economy: in 2015, for example, nationally it accounted for 2.6 million jobs, £160 billion Gross Value Added and contributed around half of UK exports. However, it also has around 70 million tonnes (mt) annual direct CO₂ emissions. As the UK Government formulates its industrial strategy, it is inevitable that the impact of legally binding carbon budgets form part of that consideration – including the provision of necessary infrastructure to reduce industrial emissions. Beyond further energy efficiency, deep emissions reduction for many industries is only possible through Carbon Capture and Storage (CCS) technology.

During the most recent UK competition for CCS on power, modest funding was provided by Government to scope CCS for industry, as represented by Teesside Collective. Following the cancellation of the CCS Commercialisation Programme in 2015, and an evident need to gain industry confidence after a number of failed competitions, there is a need to revitalise this effort in a more structured approach.

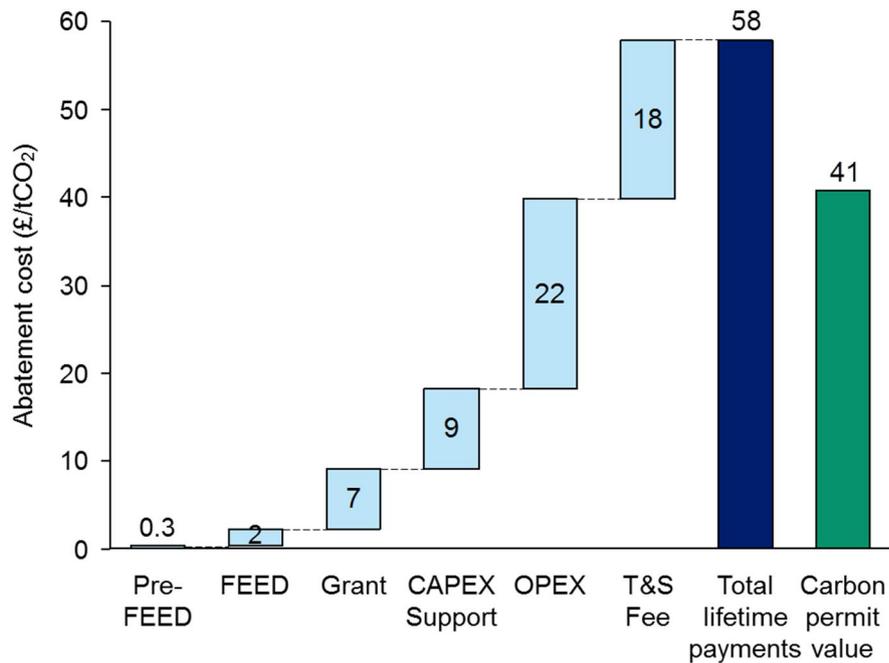
This report proposes a business model that could make cost-effective, near-term investment in CCS attractive to the Government and to Energy Intensive Industries (EIs) and so form a basis to enable the Government and industry to jointly to take forward delivery of Industrial CCS.

Costs of industrial CCS

A comprehensive analysis of the costs and benefits of supporting industrial CCS would take a number of factors into account, including the value of jobs created, future value of infrastructure and learnings developed, and the value of supporting the retention of EI industry in the UK. Here, we address only one part of the cost-benefit analysis: investigating the abatement cost purely from the perspective of direct cost-to-government per tonne of CO₂.

Figure 1 presents the cost per tonne of CO₂ abated by supporting three sample projects from Teesside Collective – CF Fertilisers, BOC Linde and Lotte – comprising a total potential CO₂ volume of 0.73 million tons per annum (mtpa) permanently stored. These three projects sum to a total cost, including payment for accessing a shared T&S network, of £58 per tonne of CO₂ (tCO₂). The blue bars represent different cost elements of the business model proposed in this report. The projected monetary carbon value from captured carbon is £41/tCO₂ based on Government EU ETS price projections, some of which will be netted off on-going capital and operational support cost commitments for Government under the proposed business model.

Figure 1 – Lifetime CCS costs (£/tCO₂): CF Fertilisers, BOC Linde and Lotte



Source: Pöyry Analysis, from cost estimates by Ryder Hunt International, Teesside Collective Blueprint work, 2015
 2015 money, 3.5% real discount rate. CO₂ permit value - DECC 2015 Reference scenario (£47/tCO₂ by 2030). Cost estimates +50%/-30%, additional sensitivity to e.g. electricity prices. Abatement assumes additional electricity is low/zero CO₂.

These costs, totalling around £17m of pre-FID costs, £110m for construction and £16m per year of operational costs (excluding T&S), would reduce emissions by 11 million tons of CO₂ over a 15 year support lifetime.

We emphasise that the three sample projects are a limited subset of the industrial CCS opportunity on Teesside, particularly when accounting for new potential investments. For example, further work completed in 2010 for an additional three pre-existing sites on Teesside, delivers very similar cost estimates per tonne of CO₂ for capturing an additional 1.7mtpa (2.4mtpa total when combined with the three sample Teesside Collective projects). Additional existing and new opportunities at the Teesside hub alone may capture a further 5-10mtpa.

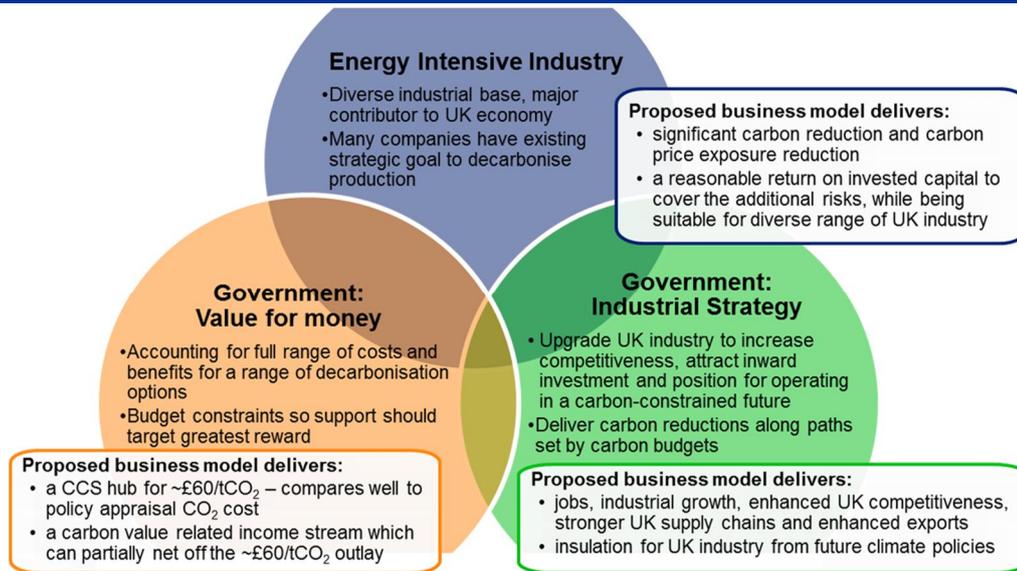
It is likely that many more sites around the UK could capture carbon at similar cost to these first projects shown on Teesside where developed through a hub approach. While some sources will undoubtedly require more expensive engineering solutions, total non-electricity related industrial emissions in the UK are around 70mtpa, so the potential for emissions reduction, based only on existing industry, is significant.

Developing a successful business model for Industrial CCS

Aligning perspectives on industrial CCS

A model which drives industrial CCS must create an attractive proposition to many stakeholders with different outlooks and success criteria. We group these into three principal ‘perspectives’, shown in Figure 2 below.

Figure 2 – Aligning perspectives on industrial CCS



- **EIIs – building a compelling investment case:**
 - Decarbonisation is a strategic goal for many EIIs, but the realities of international competition need to be accounted for. The key target must be to create a compelling business case for the national or international management in comparison to other investment opportunities. From an EII perspective the model embraces the underlying commercial realities of industry by providing a reasonable rate of return and carbon exposure benefit for the first movers.
- **Government – aligning with industrial strategy:**
 - From a Government strategic perspective, upgrading UK industry to help it increase competitiveness and position for operating in a carbon-constrained future aligns well with the developing industrial strategy and Emissions Reduction Plan in the UK. This ICCS Business Model protects and generates jobs, attracts inward investment, grows GVA, provides a competitive advantage to UK operations, and develops UK supply chains. Industrial CCS also delivers decarbonised UK industry in line with wider objectives such as the Climate Change Act carbon budgets, while the need for provision of explicit support for CCS is recognised by EU state aid rules.
- **Government – providing value-for-money decarbonisation:**
 - From a Government value-for-money perspective, effective industrial CCS support can be judged to deliver cost-effective decarbonisation through:
 - generating growth in industrial regions and significant decarbonisation at a potential cost that is much lower than other decarbonisation options, including current subsidies in the energy sector; and
 - minimising the overall cost of support for industrial CCS to the public by avoiding the risk of over-reward of the EII undertaking the capture.

Transport and Storage

Building on previous work for developing CCS in the UK – most notably the 2015 Teesside Collective Blueprint work and the 2016 Lord Oxburgh Parliamentary Advisory Group report – this report supports the necessity of the separation of the business of CO₂

capture from that of CO₂ Transport and Storage (T&S). The risks, drivers and required expertise for offshore T&S are very different from those of capture sites; whose primary business is the production of goods. Where the business case for capture and T&S has been strongly linked, **cross-chain risk between the parties is a very real deal breaker** and creates an unacceptably high risk of failure.

The business model in this report therefore focuses on driving the adoption of industrial CCS, while linking in to a CO₂ transport and storage network that is developed and backed separately by the UK Government. A process for developing the transport and storage network hub and carbon capture will need to ensure the transport infrastructure can be brought online before, or concurrently with, the first capture project(s). Pursuing a model that also works alongside support for power based CCS will maximise the opportunity to access economies of scale from a large well utilised transport and storage network.

Proposed industrial CCS business model

Five main challenges need to be addressed in any industrial CCS contract:

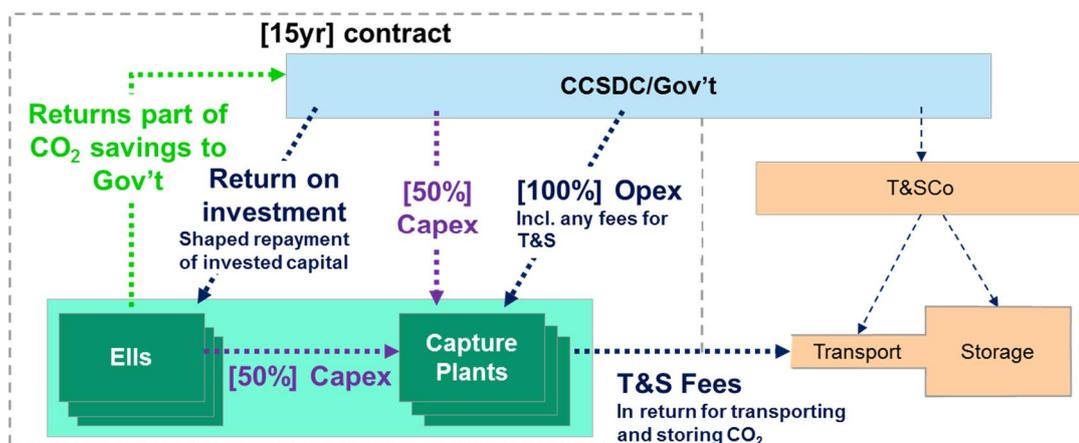
1. Upfront capital investment for CO₂ capture.
2. On-going costs for operating the CO₂ capture plant.
3. Benefits of dramatically reduced CO₂ emissions.
4. Technical performance risks of the capture plant.
5. A clear solution for the CO₂ once it leaves the boundary of the capture site.

Fundamentally the proposal is a fixed-term contract between the EII and Government which supports development of CO₂ capture at the industrial site.

A Government owned company would be responsible for CO₂ T&S – and the EII will have a contractual relationship governing the transfer of CO₂, including the transfer of all storage long-term liabilities, and any associated payment of transport and storage fees.

Figure 3 summarises the business model structure, the main money flows within the contract and the key parties: the EII company capturing CO₂ at the site; the Government body assumed as tasked with delivering CCS (the CCS Delivery Company or CCSDC); and T&SCo – the company developing CO₂ transport and storage.

Figure 3 – Overview of proposed ICCS Business Model



Note: We assume here that CCSDC is the responsible body within Government for delivery of UK CCS including contracting of Industrial CCS. Figures in brackets are parameters to be negotiated between parties and are subject to change.

This proposed model needs to be an attractive proposition to both EIs and Government. In the following sections we describe the proposed model from each party's viewpoint. **Given the current stage of UK CCS development, we focus on the business model features required to establish the first industrial CCS projects at a new hub in the UK. The level of support provided to the EIs may decrease between the initial contracts developed before the hub is operational and those developed later, as the risks of developing CCS change. Early adopters will particularly need to see enhanced benefits within this framework to encourage them to participate.**

Energy Intensive Industries:

- EII makes a capital investment in the capture plant. It then receives repayment of that capex from Government with an agreed return on their investment. This payment stream from Government is shaped such that the majority of the original capital outlay is recovered by the EII in the first few years of operation to fit with EII restrictions on investment return periods. Payments from Government relating to capital are much lower in the later years of the contract, but ensure that the EII will only earn a higher return on capital if it continues to operate the plant up to the full contract term.
- Full capture plant operational costs, including payment for use of the T&S network are covered by Government. Payments may be made against a combination of actual and forecast costs to provide an incentive for the EII to minimise on-going operational costs over time. This would be balanced against the need to ensure the scheme's attractiveness by managing risk to EIs and any disincentives to run the capture plant.
- Some carbon value is retained by EIs, such that their carbon price exposure is lower after the introduction of CCS. This helps to create a compelling business case for the Board of the EII, which can be set against the risks of developing CCS. After the support period, the EIs have a CCS system for their long-term use, albeit covering the operating costs themselves.

Government:

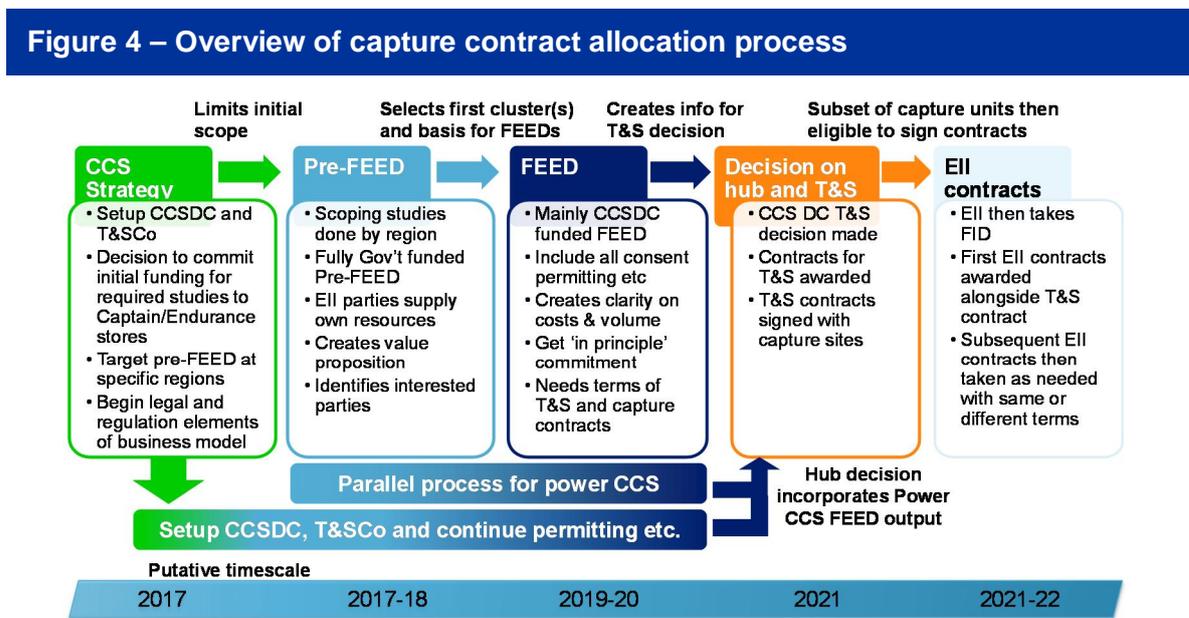
- Government, through the CCSDC, provides partial upfront capital to support the investment in CO₂ capture equipment, in the form of a grant.
- Government provides capex repayment, with an agreed return for the proportion of the capex funded by EIs, plus opex support during the [15year] life of the contract. On-going support costs are reduced for Government as they receive a proportion of the value of CO₂ savings from the CCS.
- Payments made to the T&S provider by the EII are covered on a full pass-through basis by the CCSDC. These T&S payments are assumed to be sufficient to cover the fair proportion of the costs of developing and operating a large and well-utilised T&S network.
- The scheme aligns with Government perspectives on industrial CCS in two ways:
 - Value for money carbon reduction in line with Carbon Budgets with wider economic advantages arising from providing low carbon industrial infrastructure. This model is a powerful incentive for industry retention in the UK, job creation, and the attraction of new industries to industrial clusters with CCS, including companies that use CO₂ as feedstock.
 - When compared to alternative approaches, the support structure lessens tax payer contributions to the scheme by lowering the need to provide large returns to the EII to compensate for investments outside of their usual scope (such as T&S).

Although various parameters have to be agreed between the parties, feedback on this model indicates it could be sufficiently attractive to encourage EIs to participate, while aligning well with a range of Government investment and domestic policy objectives. We therefore present this proposed model as a solution for Government to use to deliver the infrastructure for UK based industrial Carbon Capture and Storage.

Allocating CCS support to CO₂ emitting industries

As noted above, overcoming cross-chain risk, where the performance of one investment is highly dependent on the performance of other parts of the CCS chain, has proved to be one of the biggest challenges for full chain CCS projects. This model, as in the Lord Oxburgh report, advises separation of the capture from the T&S. Accessing the well-recognised benefits of hubs – reducing emissions from large and multiple emitters to capture economies of scale and reduce risks for follow on projects – makes it worth overcoming the challenge of coordinating several projects.

The process for allocating contracts therefore needs to sufficiently de-link the capture investment process from the decision on T&S, while allowing for the development of multiple capture sites. Our proposal for the process of allocating CCS support to emitting industries and power, and the link to the T&S development is summarised in Figure 4.



The first step in the process is for Government: to define a clear strategy for CCS – this will include the decision to target support to particular storage sites and industrial and power CCS, as well as taking the necessary legal and regulatory steps to establish the CCS delivery bodies. A strong strategy is essential upfront to attract potential EII and regional participants to invest the significant resource required. The process steps are designed to allow for the decision on the T&S hub to be taken with key information in-hand from potential capture projects and vice-versa. We envisage that the final investment decisions (FID) on proceeding with construction of T&S and the signing of the initial capture contracts would be targeted to happen concurrently.

Our proposal should enable simultaneous development of industrial CCS with power based CCS. This alignment gives a strong message of Government commitment, although it is quite possible that EII projects would actually be the first to use the store.

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