OIL AND GAS CLIMATE INITIATIVE

The Potential Value of CCUS to the UK Economy

A synopsis of the substantial body of independent studies both global and UK-specific which indicate that when compared with alternatives, CCUS has potential to deliver value across many sectors and make an economic contribution in the strive for deep decarbonization.

07 November 2018

CCUS in a low carbon economy: value versus price

The cost of introducing CCUS to assist with the transition to a low-carbon economy has been described as high and uncertain and it has been suggested that this makes CCUS a risky commercial proposition[1]. The CCUS debate has focused on the multi-billion-pound upfront capital cost to deploy CCUS rather than the underlying value delivered as a result of its contribution to a decarbonized economy.

The price of new technologies is often high initially, this is the case for CCUS as current plants are still first-of-a-kind. Yet a single CCUS project such as Shell's Quest project (storing up to 1.2 Mtpa) delivers about twice the abatement of the world's largest offshore windfarm (i.e. London Array with a CO_2 avoided of approximately 0.6 Mtpa) or twice the abatement of all the Tesla vehicles produced to date. It is expected that cost savings will come as additional plants are built[2]. SaskPower, owner of the Boundary Dam CCUS facility anticipates a 30% cost saving when a second facility is built[3]. The joint UK industry, government and academia CCUS Cost Reduction Task Force has identified a potential to nearly half first-of-a-kind costs with further deployment. Reduced costs are attributable to the shared used of infrastructure, reduced capital costs as risks are better understood and the deployment of new technologies[4]. Cost reduction potential is encouraging but an improved ability to compare costs is also needed. At present for instance, intermittent electricity from a windfarm is compared to firm power (power available at all times) from a gas with CCUS powerplant. As CCUS is deployed, the costs will come down and the value of firm power will become more apparent. However, even without expected cost reduction CCU creates value in the UK. The joint industry / government backed Energy Technologies Institute (ETI) has shown that even if projected cost savings are not achieved, the societal value of CCUS to the UK would erode by just a third from c. £30 billion to c. £20 billion per annum.

This note describes the value derived from CCUS, to place costs in context. Value results not only from simple project economics, but includes greater societal value realised through the preservation and creation of high-waged jobs, the growth of domestic industry, regional regeneration and a positive contribution to the balance of trade. In collaboration with other actors in CCUS, OGCI seeks to engage stakeholders in this conversation about value.

How can the UK deliver on its climate goals?

The UK has enshrined in law a commitment to an 80% reduction in GHG emissions relative to 1990 levels by 2050 and has made enormous progress toward achieving this through efficiency measures, fuel switching and deployment of renewables. The UK now faces the challenge of

[1] UK Government's Clean Growth Strategy states, "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."
[2] Reducing the Cost of CCS Deployment in Capture Plant Technology, Energy Technologies Institute, 2016
[3] The future of carbon capture will focus on cost reduction, Global CCS Institute, 2014
[4] CCS Cost Reduction Taskforce Final Report, 2013.

further decarbonizing the economy. The UK Committee on Climate Change (CCC), an independent body established under the UK Climate Change Act, emphasizes that CCUS is vital for the UK to meet the 2050 target. It also notes that CCUS can impact targets as early as 2030 if urgent action is taken, with the first CCUS project contracts in place by 2020. In the recently released UK Clean Growth Strategy, the government's response to the CCC acknowledges the 'broad international consensus that CCUS has a vital future role in reducing emissions'. The government has put in place initial steps to address costs and consider deployment but has not yet committed to take any concrete action. The OGCI believes the presentation of a strong value proposition will support the government's ambition to deploy CCUS at scale in the UK.

Value from CCUS is potentially significant, particularly for the UK

The ETI and the CCC both conclude that CCUS is required and required at scale. The ETI, a public-private partnership between global energy and engineering companies and the UK Government whose role is to act as a conduit between academia, industry, and the government to accelerate the development of low carbon technologies, makes clear that the UK would be £30 billion per annum (approximately 1% of GDP) better off in 2050 and beyond if CCUS is fully integrated into the power and industrial sectors[5]. Looked at the other way, the UK without CCUS will be at least £30 billion less competitive in a decarbonized world in 2050. The UK CCC, in its role advising the UK Government and devolved administrations on emissions targets advocates that by 2035, there should be 19Mtpa of CO_2 being captured and stored using CCUS in different industries if the UK is to meet the 2050 80% reduction targets. CCC also states that failure to deploy CCUS could double the cost of meeting the 2050 target. While 2035 and 2050 may seem distant, in virtually every energy technology, supply chain development and wide scale deployment takes decades. Mobile phones, solar and wind technologies may appear to have developed at an extraordinary pace, but they too have required decades to scale-up. To maximize the economic value of CCUS for the UK, deployment must start soon.

CCUS generates economic value as a result of job retention and creation. The use of CCUS by industry would allow them to become sustainable over the long term in a low carbon economy. The Trades Union Congress (TUC), representing 50-member unions and more than 5.6 million working people, is strongly supportive of CCUS. The TUC's focus is on jobs. In its 2014 report[6], the TUC, referring to the UK's energy intensive industries, says that 'CCUS will play a significant role in safeguarding the 160,000 direct employees, 800,000 indirect employees and combined GVA of over £14 billion contained within these industries'. Securing and growing the existing industrial workforce is a first step. Growing a new CCUS industry, with a workforce which could be deployed globally along with the necessary technology would further enhance employment. The world class skills in engineering developed in the oil & gas sectors over the past half century can contribute to CCUS. The TUC estimates that total annual employment in CCUS of 30,000 by 2030 is possible if

[5] Carbon capture and storage Building the UK carbon capture and storage sector by 2030 – Scenarios and actions, ETI, 2015
[6] The Economic Benefits of CCS in the UK, CCSA / TUC, 2014

the equivalent of 20GW of abated power generation capacity is installed (approximately 20% of current generation capacity).

CCUS can also lower energy bills. The TUC estimates widescale deployment of CCUS could result in energy bills that are £82 per year lower per household by 2030. The continued supply of clean hydrocarbon energy could also support energy supply diversity and could limit energy price increases associated with supply limitations.

The geology of the UK is yet another factor that can help the UK extract maximum value from CCUS. The Global Carbon Capture & Storage Institute (GCCSI) has assessed each nation's suitability and preparedness for CCUS deployment[7]. It attributes the top ranking to the USA, Canada, and the UK. The GCCSI has considered that the UK has a valuable resource in its significant CO_2 storage capability. Combined with leading policy, legal and regulatory indicators, the UK has the basis to flourish at home and compete favourably abroad.

The Power Sector – Rich with Decarbonization Options

Alongside renewables and nuclear, gas power with CCUS offers a solution for decarbonization in the power sector. The present-day UK power grid is stable and reliable, largely reliant upon a strong nuclear, coal and gas baseload generation capacity. As aging nuclear and coal plants are being retired, new intermittent renewables (solar and offshore wind) are replacing them at an ever decreasing levelized cost of electricity (LCOE). However, LCOE fails to take account of full system costs which include grid stability and balancing intermittency costs typically supplied by the flexible operation of gas-fired power stations. Government policies have supported the widespread deployment of renewables resulting in their electricity becoming increasingly cost competitive on an LCOE basis with the incumbent unabated gas and nuclear. The long-term outcome required is a stable, reliable grid capable of satisfying today's demands and capable of supplying demand growth driven by the electrification of transport and a growing share of domestic and industrial heat load. At present in the UK, lower cost intermittent renewables dominate the growth in capacity. But large power providers like nuclear and gas provide more than just electricity. They provide firm power and grid stability, and gas in particular is better able to respond to fluctuating consumer demand, both on a daily and seasonal basis. The highest value power sector results from a combination of renewables, storage, nuclear and gas with CCUS and not simply the pursuit of the cheapest available electricity bids. Lord Deben, Chairman of the CCC advises 4-7GW of power with CCUS be installed by 2035[8], enabled by decisions on CCUS locations no later than 2018. The current trajectory could leave the future role of gas power to one of unabated balancing of intermittent renewables, implying lower utilization, poorer returns, under-investment and higher risk of not meeting decarbonisation goals. Shifting the power narrative from LCOE to the value of a stable, reliable grid will expose the full value of CCUS.

[7] Carbon Capture and Storage Readiness Index, GCCSI, 2016
[8] The infrastructure needs of a low-carbon economy prepared for climate change, CCC, 2017

Where very few if any alternatives currently exist – net-zero emissions in the industrial sector

As mentioned previously, CCUS, if deployed at scale, could safeguard 160,000 direct jobs and 800,000 indirect jobs in the industrial sector. Unlike power, there are very few alternative low carbon products capable of replacing cement and steel or significantly redefining the processes required to manufacture these commodities. There are virtually no alternatives to CCUS for many CO_2 emitting industries to achieve their full decarbonization. This is mainly due to CO_2 emissions being inherent in their processes.

Even small and distributed CO_2 emissions like those from automobiles, shipping and domestic heating can be reduced through electrification and distributed hydrogen. Hydrogen can play a decarbonisation role reusing the extensive UK gas grid, initially comingling with natural gas and potentially replacing it. The challenge will fall to industry to deliver more hydrogen at scale. Without CCUS, industries like cement, steel, chemicals and hydrogen production could be driven to close and relocate outside the UK. This could lead to increased importation of goods from other countries with potentially higher embodied carbon if low carbon production processes are also not available in the exporting countries. Mechanisms to address this potential carbon leakage are not established yet for the UK, however, border adjustments are often discussed and most recently advocated in the UK Cost of Electricity study from Dieter Helm.

Act now or delay?

It is sometimes argued that the urgency to act on CCUS deployment is overplayed resulting in a number of unhelpful behaviours. The first is the hope that a new and unforeseen technology will emerge. The second is the deceptive belief that the pursuit of numerous incremental low-cost investments will ultimately deliver a coherent system meeting decarbonisation targets. The third is the assumption that carbon offsets could counterbalance failure to decarbonize industry. However, internationally accredited offsets are unlikely to be available for purchase. Modelling work by the EU's Zero Emissions Platform (ZEP) shows that without CCUS roll out at scale, not one of the 10 nations modelled will reach an 80% reduction target and that without CCUS there will be no 'excess' reductions available on the market for purchase as offsets. The corollary of this is that a CCUS first-mover nation that exceeds targets could become a supplier of global offsets, allowing it to set off part of the costs through sale of such offsets.

The unavoidable truth about delay is that each molecule emitted via whichever process (power or industry) will be more difficult to capture once it is in the atmosphere.

Net Negative Emissions – CCUS & BECCS

Even after 2050, the UK will likely continue to emit CO_2 from certain processes that are hard to decarbonize such as agriculture and aviation, and from sources in remote communities where capture costs would be very high. There will likely be a need for negative emissions from other sectors to compensate like BECCS (BioEnergyCCS which combines CO2 capture from the atmosphere with CCS). The ETI, CCC and ZEP studies all emphasise the requirement for net-negative emissions. The UK is well placed to use this technology once it is available as it has large point source emissions, such as the current Drax bio-mass boilers, which could be combined with CCUS[9]. Well-established CCUS infrastructure will facilitate the deployment of this process but would be much more costly without it.

Governing for value –supporting local and central government

Governments and elected officials often need to plan in accordance with time horizons which are significantly shorter than those required for decarbonization and must work within cost and budgetary constraints. The OGCI understands this and seeks to work with government to devise policy mechanisms that will be both acceptable to the electorate and deliver a long term, high value, decarbonized economy. Following the launch of the Clean Growth Strategy, the OGCI welcomes the invitation from the UK Department for Business, Energy and Industrial Strategy (BEIS) to work together on the development of policy and deployment pathways for CCUS.

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This document contains certain forward-looking statements – that is, statements related to future, not past events and circumstances – which may relate to the ambitions, aims, targets, plans and objectives of OGCI and/or its member companies – as well as statements related to the future energy mix. Forward-looking statements involve risk and uncertainty because they relate to events and depend on circumstances that will or may occur in the future and are outside of the control of OGCI and/or its member companies. Actual results or outcomes may differ from those expressed in such statements, depending on a variety of factors.

[9] The evidence for deploying bioenergy with CCS (BECCS) in the UK, ETI, 2016

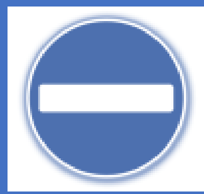
VALUE OF CCUS TO THE UK

£30 Billion p.a. value add to the UK economy in 2050 with CCUS based decarbonisation

(Energy Technologies Institute)

CCUS, safeguarding industrial heartlands, 160,000 direct employees and 800,000 indirect employees

(Trades Union Congress)

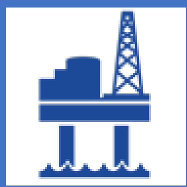


CCUS, the only way to meet the legally binding 80% decarbonisation target

(Zero Emissions Platform)

CCUS will result in energy bills that are £82/yr. lower in 2030 per family

(Trades Union Congress)



World leading CO_2 storage reservoirs

(Global CCS Institute)

CCUS, working with renewables to deliver reliable, stable power

(Zero Emissions Platform)

References

2017	ZEP	5th annual Market Economics report "CCS and Europe's Contribution to the Paris Agreement - Modelling least-cost CO_2 reduction pathways".
2017	CCEP/Summit Power	Clean Air - Clean Industry – Clean Growth How Carbon Capture Will Boost the UK Economy East Coast UK Carbon Capture and Storage Investment Study
2017	CCC	2017 Report to Parliament – Meeting Carbon Budgets: Closing the policy gap
2014	CCSA/TUC	Joint CCSA/TUC CCS Report, 3 February 2014 Joint CCSA/TUC The Economic Benefits of CCS in the UK
2014	CCSA/TUC	A UK Vision for Carbon Capture and Storage
2015	ETI	Carbon capture and storage Building the UK carbon capture and storage sector by 2030 – Scenarios and actions
2017	NAO	Carbon capture and storage: the second competition for government support
2016	CCC/Poyry	A strategic approach to Carbon Capture and Storage (Report)
2016	ETI	ETI analysis of the UK energy system design implications of delay to deployment of carbon capture and storage (CCS) in the UK (Letter)
2016	CCC	A strategic approach to Carbon Capture and Storage (Letter)
2017	Parliamentary Advisory Group on CCS	PAG Report "Lowest Cost Decarbonisation For The UK: The Critical Role of CCS".
2016	CCSA	CCSA Report: Lessons Learned - Lessons and Evidence Derived from UK CCS Programmes, 2008 – 2015
2016	CCSA	CCSA Policy Brief: Retention of Opportunities to Develop CO2 Transport and Storage Infrastructure
2015	CCSA	Delivering CCS - Essential infrastructure for a competitive, low-carbon economy, June 2015
2011	CCSA	CCSA Report, 8 September 2011 'A Strategy for CCS in the UK and Beyond'

2016	ETI	ETI Publishes Report on Reducing the Cost of CCS
2016	Crown Estate	Crown Estate Report on Commercial Models for CO2 Storage
	Energy & CC Committee	Energy and Climate Change Committee Report on CCS
2015	ZEP	Report on CCS and the Electricity Market· Report on CCS for industry: Lowest-cost route to decarbonising Europe
2015	ZEP	Executable Plan for enabling CCS in Europe
2014	Element	CCS Hub Study for Scotland and the Central North Sea
2014	Energy and Climate Change Committee	Inquiry into CCS
	DECC/BEIS	techno-economic study into Industrial CCS
2013	Cost reduction Taskforce	The Potential for Reducing the Costs of CCS in the UK
2011	UKERC	UKERC report "Carbon Capture and Storage. Realising the potential?"
2005	NAO	report on the UK's first CCS Demonstration Competition
2015	CCC/Poyry	Potential Carbon Capture and Storage Cost Reduction Mechanisms (by Pöyry and Element Energy)