



The future of the oil and gas industry

SCCS evidence to the Scottish Affairs Committee

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1 Key points

1. The oil and gas industry will need to change as part of a just transition to a low carbon economy.
2. Carbon dioxide enhanced oil recovery (CO₂-EOR) is a key way to make this transition, while maximising economic recovery
3. The UK's oil and gas industry has the skills, experience, knowledge and assets to develop a profitable carbon capture and storage (CCS) industry in the UK.
4. The future of the oil and gas industry is inextricably linked to CCS.

2 What challenges does Scotland's oil and gas industry face, and how can they be addressed?

One of the most significant challenges faced by the oil and gas industry is finding its role in a low-carbon future. Greenhouse gas emissions targets under the Climate Change Act, and the ambition of the Paris Agreement, require a move away from the use of unabated fossil fuels. The oil and gas industry needs to plan for its future, in order to avoid a similar situation to the collapse of open cast coal mining in Scotland, and its subsequent job losses, environmental damage and cost to the public purse.¹

Other challenges – identified in the call for submissions for this inquiry – include the long-term decline in production levels, reduced levels of investment, continued low oil prices and declining tax revenues.

Fortunately, deployment of carbon capture and storage, and carbon dioxide-enhanced oil recovery (CO₂EOR) offer a solution to these challenges, which will not only retain North Sea jobs, but will take the offshore industry from being a greenhouse gas emitter to actively reducing carbon dioxide (CO₂) emissions, providing a subsurface CO₂ storage service for industry and power in the UK and, potentially, in other countries.

Carbon capture and storage is the process of separating and capturing CO₂ either from industrial flue gases or directly from the air (although this latter is a less efficient and more costly approach); cleaning and compressing it; and transporting it to a site where it can be permanently stored and kept out of the atmosphere. The transport and capture parts of the process are where the oil and gas industry will prove essential: transport is likely to be by pipeline out to storage sites deep below the seabed, in depleted oil and gas fields or in saline aquifers. CCS will also help the oil and gas industry retain a market for their products, as it can be used to capture CO₂ emissions resulting from the use of fossil fuels.

¹ See RSPB & Friends of the Earth Scotland briefing on *Opencast coal mining: liability for restoration works*. Available at http://ww2.rspb.org.uk/Images/opencast-coal-mining_tcm9-353523.pdf

The oil and gas industry's transition to a low carbon future is therefore inextricably linked to carbon capture and storage:

- The continuing use of fossil fuels in industry can only happen if CO₂ emissions are not released to the atmosphere;
- The continuing use of fossil fuels for heating and transport will only be compatible with greenhouse gas emissions targets if the natural gas is used to produce hydrogen, and the emissions from this methane reforming process are captured and stored;
- Much of the UK's potential for storing captured CO₂ is in depleted oil and gas fields

Furthermore,

- The oil and gas industry's imperative to maximise economic recovery can be met using CO₂-EOR
- Re-use of gas pipelines to transport CO₂ will reduce the cost of CCS deployment
- The knowledge of the UK Continental Shelf subsurface that has been amassed by the oil and gas industry means that the UK is especially well-placed to develop CCS

2.1 The UK's unique opportunity

The UK is uniquely well placed to develop CCS with its high-volume and well-understood CO₂ storage resources; an established subsurface industry, existing infrastructure that can be reused to reduce initial costs, and the right skills and experience needed to develop this new industry serving our own, and potentially European, CO₂ storage needs. Skilled offshore and subsurface jobs are at risk as the oil and gas industry reduces production: the skills and experience from the industry will be crucial in developing CCS, and the growth of a CCS industry will enable a just transition from oil and gas. Likewise, the existing offshore infrastructure, including pipes, boreholes and subsurface geological data is extremely valuable.

The UK CCS Storage Appraisal² found that the UK has offshore geological storage potential for over 78 gigatonnes of CO₂ and collated data for nearly 600 potential storage sites in the CO₂Stored database. This is an asset that very few countries have, and so gives the UK a competitive advantage over the rest of the EU in deploying CCS. Furthermore, the leasing rights to offshore subsurface CO₂ storage and leasing for pipelines on the seabed are part of the Crown Estate and the Scottish Crown Estate, so there is the potential for significant additional public revenue from development of CO₂ transport and storage.

Oil and gas pipelines are strategic national assets; they should be retained and preserved as a low-cost route to storage in the future for Scotland's large industrial emitters. In this way the value of large public investments already made in this infrastructure can continue to be realised through re-purposing. It could be argued, therefore, that the UK Government has a responsibility to develop CO₂ storage in order to make the best use of the natural and other assets available to it.

A number of projects have explored and confirmed the potential for CCS in Scotland:

- Scottish Carbon Capture & Storage works on development of a Scottish CO₂ hub³, which concludes that:

² Energy Technologies Institute (2016) *UK CCS Storage Appraisal*. <http://www.eti.co.uk/programmes/carbon-capture-storage/strategic-uk-ccs-storage-appraisal>

³ Scottish Carbon Capture & Storage (2016) *Scottish CO₂ Hub – A unique opportunity for the United Kingdom*. http://www.sccs.org.uk/images/expertise/reports/working-papers/WP_SCCS_2016_01_Scottish_CO2_hub.pdf

- CO₂ storage in the Central North Sea is the best understood in Europe following decades of oil and gas activity as well as specific assessments of CO₂ storage requirements.
- Existing pipelines can access storage sites from the Scottish mainland.
- CO₂ utilisation for enhanced oil recovery can create significant value, extending the productive life of oilfields with a range of benefits – such as maintaining jobs and deferring decommissioning expenses for the public purse - as well as providing long-term CO₂ storage.
- CO₂ import hubs could be developed at existing ports, so of which already handle refrigerated gases: the Firth of Forth (Scotland); Peterhead (Scotland); Teesport (England).
- A high proportion of European emissions would be within range of this CO₂ storage system via ports such as Rotterdam, Le Havre, Antwerp and Hamburg.
- Collection of CO₂ from industrial sources, including that already separated at European ammonia plants, could enable early stage implementation of transport and injection infrastructure.
- The ACT Acorn Project, which aims to deliver a low-cost CCS system in north east Scotland by 2023. The project builds upon existing research, such as an appraisal of potential CO₂ storage sites and options to re-use oil and gas assets, to move the Acorn Project from proof-of-concept towards design studies.⁴
- The Caledonia Clean Energy Project, which suggests that gas-fired power generation with CCS could be developed in Grangemouth, using existing onshore and offshore pipelines to transport CO₂ to offshore storage, and that the project could be in operation by 2025.⁵
 - *Clean Air, Clean Industry, Clean Growth*⁶, a report by the project, found that there are benefits to early deployment of CCS, and a significant opportunity cost of slow, or no, deployment.

2.2 Hydrogen

Heat and transport are hard to decarbonise because they comprise millions of point-sources of emissions which cannot be efficiently separated and captured. One option is replacing fossil fuels with hydrogen, which produces no carbon dioxide at the point of use. This is being explored by projects such as HyNet⁷, HyDeploy⁸, the Leeds H21⁹ project, the Liverpool-Manchester Hydrogen Clusters Project¹⁰ and the SGN Hydrogen 100 Project¹¹ as well as by the Scottish Hydrogen and Fuel Cell Association¹². The roll-out of hydrogen would mean a continuing role for the oil and gas industry, since the most effective way to produce hydrogen is currently from methane using steam methane reforming, which produces CO₂ as a by-product.

⁴ <http://www.actacorn.eu/about-act-acorn>

⁵ <http://www.ccsassociation.org/news-and-events/reports-and-publications/caledonia-clean-energy-project-feasibility-report/>

⁶ <http://www.ccsassociation.org/news-and-events/reports-and-publications/clean-air-clean-industry-clean-growth/>

⁷ www.hynet.co.uk

⁸ <https://hydeploy.co.uk/about/>

⁹ <https://www.northerngasnetworks.co.uk/wp-content/uploads/2017/04/H21-Report-Interactive-PDF-July-2016.compressed.pdf>

¹⁰ <https://cadentgas.com/about-us/innovation/projects/liverpool-manchester-hydrogen-cluster>

¹¹ <https://www.sgn.co.uk/Hydrogen-100/>

¹² <http://www.shfca.org.uk>

3 How can the economic return from Scotland's oil and gas reserves be maximised?

CO₂-EOR involves injecting CO₂ into partially depleted oilfields deep beneath the seabed to force out additional volumes of oil, with the majority of the injected CO₂ remaining permanently stored deep underground. It is the only enhanced oil recovery technique that allows concurrent storage of CO₂ and can help kick-start the development of CO₂ storage in the North Sea basin.

Residual Oil Zones in the North Sea are not currently viewed by the oil industry as producible, so this oil is not declared as a resource. However, the use of CO₂ to flood these zones can both maximise production in mature oil fields and store large volumes of CO₂.

The SCCS CO₂-EOR Joint Industry Project (JIP)¹³ was a collaborative programme of work to develop an understanding of CO₂-EOR, with the aim of creating a commercial use for CO₂ captured from power plants and industry. It concluded that CO₂-EOR would have the following impacts:

- Gives significant benefits to the wider UK economy - extending the producing life of the North Sea, reducing imports of oil, maintaining employment, developing new capability to drive exports, and additional direct and indirect taxation revenues.
- A business demand is created, which drives sequential construction of CO₂ capture, which develops learning and reduces costs of CO₂ supply.
- Additional oil production using CO₂-EOR, can provide the commercial finance, equipment infrastructure, and project management experience needed to develop lower cost CO₂ capture and secure storage
- CO₂-EOR strengthens the case for Government to invest in CCS, and reduces the level of investment required by providing part of the offshore transport storage capacity and storage certainty as an intrinsic part of EOR. Moving forward with CCS will reduce the cost of future implementation through learning-by-doing and accelerate the journey to a low carbon future for the UK.

4 What action is the UK Government taking to support the long-term future of the oil and gas industry in Scotland, and how effective has this been?

Two key public sector players in the development of CCS are the Oil and Gas Authority (OGA), and the Department for Business, Energy & Industrial Strategy (BEIS).

The Oil and Gas Authority's purpose is to maximise the recovery of oil and gas, and its Corporate Plan¹⁴ states that "The OGA regulates offshore carbon storage, approving and issuing permits and providing technical, commercial and financial assurance on carbon storage projects to the UK Government. The OGA will work with industry and other relevant stakeholders to identify synergies and promote opportunities where development of carbon storage can contribute to MER UK."

¹³ <http://www.sccs.org.uk/expertise/reports/co2eor-joint-industry-project#co2-eor-summary-report>

¹⁴ Available at <https://www.ogauthority.co.uk/news-publications/publications/2016/oil-and-gas-authority-corporate-plan-2016-2021/>

SCCS is concerned that despite the statements in its corporate plan, the OGA is not taking a proactive role in enabling the development of CCS. We are concerned that the division of responsibilities in relation to CCS between BEIS and the OGA is not clear, and that this is putting CCS cost reductions at risk by allowing premature decommissioning of pipelines that could be reused. We are also concerned that the OGA is not giving sufficient priority to CO₂-EOR.

4.1 Re-use of existing infrastructure

The *Maximising Economic Recovery UK Strategy*¹⁵ states that “before commencing the planning of decommissioning of any infrastructure in relevant UK waters, owners of such infrastructure must ensure that all viable options for their continued use have been suitably explored, including those which are not directly relevant to the recovery of petroleum such as the transport and storage of carbon dioxide”. Anecdotal evidence suggests that this requirement is being interpreted in a way which allows the decommissioning of pipelines that have been identified as being suitable for CO₂ transport – by projects such as ACT Acorn and the Caledonia Clean Energy Project - but which do not have a firm project plan attached to them.

It is clear from informal discussions with OGA and BEIS that neither party feels they have responsibility for this aspect of decommissioning planning, so the UK Government needs to take urgent action to close this gap to ensure that infrastructure is retained and maintained, and CCS projects are not lost due to poor regulation.

We recommend that the Government takes a strategic approach to decommissioning which includes a strategic assessment of the oil and gas assets in the UKCS and their suitability for reuse – for CCS, but also for other potential uses such as renewable energy or nature conservation. There are immediate cost-cutting options available through the reuse of existing infrastructure, but only if near-term decommissioning of pipelines is replaced by their preservation for future use.

The Government should also consider what support and/or regulation it should put in place where there is a gap between cessation of production and the likely repurposing of a pipeline for CCS to ensure that the pipeline is maintained in a suitable condition.

4.2 CO₂-Enhanced oil recovery

Production of oil from a North Sea oil field typically leaves 55% of the oil underground.¹⁶ Enhanced oil recovery from existing fields is therefore crucial to the UK’s strategy to maximise economic recovery. The OGA has produced an *Enhanced Oil Recovery Strategy*¹⁷ which characterises CO₂-EOR as a ‘future opportunity’ and includes an action to “Develop a CO₂ EOR strategy and five-year plan”. SCCS considers that the need to develop CO₂-EOR should be treated with greater urgency, since deployment of CO₂-EOR has been shown to lead to the development of CO₂ storage, with the end result that more CO₂ can be stored than is released through the production, transport, refining and combustion of the produced crude.¹⁸ However, email correspondence between SCCS staff and the OGA suggests that the OGA takes the opposite view, and may not now produce a CO₂-EOR strategy at all:

¹⁵ Available at <https://www.ogauthority.co.uk/news-publications/publications/2016/maximising-economic-recovery-of-uk-petroleum-the-mer-uk-strategy/>

¹⁶ SCCS (2015) *CO₂ Storage and Enhanced Oil Recovery in the North Sea: Securing a low-carbon future for the UK*. Available at <http://www.sccs.org.uk/images/expertise/reports/co2-eor-jip/SCCS-CO2-EOR-JIP-Report-SUMMARY.pdf>

¹⁷ Available at <https://www.ogauthority.co.uk/news-publications/publications/2016/enhanced-oil-recovery-strategy/>

¹⁸ Stewart R.J., Johnson G., Heinemann N., Wilkinson M., Haszeldine RS, *Low Carbon oil production: Enhanced oil recovery with CO₂ from North Sea residual oil zone*. Available at <https://www.sciencedirect.com/science/article/pii/S1750583618301154#!>

“The OGA will review its overall EOR strategy through 2018 and will undertake an Industry EOR workshop late 2018. Pending the outcome of that workshop a decision will be made to move forward on a CO₂ specific strategy, which, if at all, would be completed late 2019.”¹⁹

5 How well do the different stakeholders (UK Government, Scottish Government, companies) work together? Does the current devolution settlement enable all stakeholders to support the sector?

As stated in our answer to the previous question, it seems that there is a gap between the remits of BEIS and the OGA in relation to oil and gas decommissioning and CCS, and this is already leading to difficulty for projects that hope to re-use gas pipelines.

As the urgency of deploying CCS increases, an Innovation Centre to bring together researchers and industry is needed to take technologies from research and development to full deployment. This would complement the work that the Oil and Gas Technology Centre is taking forward on decommissioning and support the oil and gas industry to transition to low carbon applications.

6 How can Scotland maximise its expertise, technology and infrastructure in oil and gas industry to secure the industry’s future as reserves decline? What support is needed from Government to maximise these opportunities?

Scotland’s oil and gas industry expertise, technology and infrastructure all have a crucial role to play in the development of CCS, which will in turn help the industry to transition to a profitable role in the low-carbon economy. However, there needs to be a strong steer from government – both HMG and the Scottish Government - to drive this, with appropriate regulation and incentives, as well as strategic work such as an assessment of the suitability of oil and gas infrastructure for re-use.

Recommendations of how to develop CCS in the UK are made in the Lord Oxburgh report, *Lowest cost decarbonisation for the UK: the critical role of CCS*, and further recommendations are expected to be published shortly by the Carbon Capture, Utilisation and Storage Cost Challenge Task Force. In addition to these recommendations, it is crucial that all of government is aligned towards delivering CCS: this includes BEIS, OGA and the Treasury.

Specific recommendations that SCCS has made in the past include:

- Retain the National Transmission System No.10 Feeder onshore pipeline, and appropriate North Sea pipelines including the Goldeneye pipeline and borehole infrastructure and the Atlantic pipeline, avoiding their decommissioning and maintaining them in suitable condition to enable conversion for CO₂ re-use;
- Assess opportunities for small-scale CO₂ capture of emissions from biomass, biogas, fermentation, waste and small combined heat and power (CHP) energy processes to give a

¹⁹ Email from OGA, 29/05/2018

low-carbon impact multiplier, together with appropriately scaled options for transport and use or permanent storage;

- Assess opportunities for pilot trials of low-carbon heating using hydrogen for conversion of district-scale gas networks, with hydrogen produced by steam methane reforming coupled with CCS;
- Support investigation and development of seed projects for medium-scale CO₂ storage opportunities.
- Support actions leading towards development and commercialisation of larger-scale CO₂ storage operations, including projects involving cooperation with other states around the North Sea.

7 Further information

Scottish Carbon Capture & Storage (SCCS) is a research partnership of the British Geological Survey, Heriot-Watt University, University of Aberdeen, the University of Edinburgh and the University of Strathclyde with associate member the University of St Andrews. SCCS researchers are engaged in innovative applied research and joint projects with industry and government to support the development and commercialisation of carbon capture and storage as a climate change mitigation technology.

Scottish Carbon Capture & Storage would be happy to answer any questions or provide further information. We have a wealth of research – produced by our partner research institutions and by the SCCS team – that we would be happy to share.²⁰ Please contact Rebecca Bell, SCCS Policy and Research Officer, on rebecca.bell@sccs.org.uk.

²⁰ See <http://www.sccs.org.uk/expertise/reports> , <http://www.sccs.org.uk/expertise/reports/working-papers> , <http://www.sccs.org.uk/expertise/publications>