CARBON CAPTURE UTILISATION AND STORAGE (CCUS) INSIGHT

October 2024

Offshore Energies UK

Contents

List of Abbreviations

Abbreviations	Definitions
APS	Announced Pledges Scenario
BECCS	Bioenergy Carbon Capture and Storage
BGS	British Geological Survey
CBAM	Carbon Border Adjustment Mechanism
CCUS	Carbon Capture Utilisation and Storage
DAC	Direct Air Capture
ERR	Economic Regulatory Regime
ETS	Emissions Trading Scheme
FID	Final Investment Decision
GGR	Greenhouse Gas Removals
Gt	Billion Tonnes
ICC	Industrial Carbon Capture
IPCC	Intergovernmental Panel on Climate Change
NSTA	North Sea Transition Authority
SAF	Sustainable Aviation Fuels
SPS	Subsea Production Systems
SURF	Subsea Umbilicals, Risers and Flowlines
T&S	Transport and Storage
TRI	Transport and Storage Regulatory Investment

1 Executive Summary

This report highlights the critical role that carbon capture, utilisation, and storage (CCUS) will play in delivering the UK's net zero targets. It shows that by leveraging the UK's strong oil and gas heritage, there is a significant opportunity to repurpose existing infrastructure and capitalise on the expertise of our workforce to build a world leading CCUS industry. The report describes the regulatory and policy frameworks required to kick-start the sector, offering recommendations that will help develop a competitive and robust CCUS market for the UK.

The UK's CCUS sector has experienced a series of false starts over the past decades, however, CCUS remains essential for achieving net zero emissions by 2050 and this report shows that immediate deployment is crucial if we are to meet our climate targets. It explores its end uses and explains that the technologies have matured, and the sector is ready for deployment.

The confirmation of £22bn of funding in October 2024 for Track 1 clusters, Hynet and East Coast Cluster over 25 years which enables them to take final investment decisions is a positive step welcomed by industry. Track 1 and Track 2 clusters will build the foundational infrastructure necessary to kickstart this nascent sector.

Starting work on the first two clusters is only the beginning. The process must accelerate if the UK is to fully maximise the potential of CCUS and meet its 2030 and 2035 deployment targets, 20-30mn tonnes/yr and 50mn tonnes/yr, respectively. Emitters and transport and storage (T&S) system operators outside the cluster sequencing process have no clear route to market. Out of the dozens of emitter projects, only eight within the Track 1 clusters have been selected to negotiate with government about revenue support models. The expansion of Track 1 for Hynet is progressing slowly, and the expansion of East Coast Cluster has not been launched. This means many projects do not know if they are eligible for government support or when to expect it. A clear deployment plan for Track 2 clusters and beyond is essential to provide long-term confidence to the sector and create a consistent pipeline of work for the supply chain. So far, 27 CO_2 storage licences have been awarded, but OEUK expects more than 100 to be needed by 2050. That means the continued and rapid development of the industry will be key.

By scaling up infrastructure, business models, and licensing, the UK could unlock significant economic potential. The CCUS sector could create 50,000 jobs and protect a further 100,000 in industrial regions across the UK, contribute billions to the economy this decade and be worth £100bn to the supply chain by 2050.

The sector will also provide energy security by delivering low-carbon dispatchable power by installing carbon capture in gas-fired power plants. This will be essential for the government's plans to reach clean power by 2030, complementing the intermittency of an electricity system increasingly based on renewables.

This is a once in a lifetime opportunity for the UK to become a global leader in decarbonisation, safeguard energy security, reduce emissions and work with the European Union to create a cross-border market for CO_2 transport and storage, creating jobs and generating revenues.

1.1 Key recommendations

1) **Industry welcomes** the confirmation of £22bn of government support to de-risk early projects and kickstart the sector. The development of business models to make these projects investable is a crucial first step. Going forward, the government must implement clearer, simpler funding mechanisms that go beyond market pricing, which is currently insufficient for the sector's long-term development. With slim profit margins, high upfront costs, and significant commercial risks, especially in the early stages, CCUS cannot yet solely rely on carbon markets and the Emissions Trading Scheme (ETS). A clear timeline for the deployment of the £22bn government support was announced in October 2024 enabling Track 1 FID, the prompt award of FID for Track 2 clusters is also needed to continue developing the sector at pace. Additionally, developing a more predictable, annual competitive allocation process for early projects—not just Track 1 and 2—will attract investors, ensure market stability, and enable the supply chain to prepare for delivery.

2) **The UK must capitalise on its unique position to deliver CCUS by developing policies to retain existing energy supply chains with highly transferable capabilities to CCUS and assist it to service these opportunities.** We have the largest CO_2 storage potential in Europe, sufficient existing oil and gas infrastructure, emission source points concentrated in industrial clusters, and a local supply chain with capabilities that are readily transferable to CCUS. However, these advantages alone are not enough; policies must also support UK supply chains to avoid importing the technologies and skills. Whilst such a process will be selective, it must also have the flexibility to take commercial risks.

3) **Government needs to enable non-pipeline transportation and remove the regulatory barriers for cross border transportation of CO_2.** Our analysis in this report shows the scale of the opportunity and presents the case for action. Access to non-pipeline transportation is crucial for decarbonising emitters in dispersed locations and maximising the volume of CO_2 entering the network. Facilitating a cross-border CO_2 market which allows the UK to make the most of its own storage resources, and sharing costs, could add billions to the UK supply chain and support the decarbonisation of UK and European emitters.

4) **CCUS is the only way to protect heavy industrial activity and the jobs they support in our industrial heartlands.** We need to ensure the UK is able to retain energy intensive heavy industries as part of the fabric of the UK economy, using CCUS as one of the means to support their ongoing evolution to be part of a low carbon economy. CCUS is an indispensable technology, without which we will fail to meet our net zero objectives. CCUS will protect and create a combined 150,000 jobs across our energy and industrial heartlands, adding over £100bn to the economy by 2050.

5) **Carbon pricing and carbon markets have a vital role to play in developing a self-sustaining CCUS market**. Mutual recognition or alignment between the UK and EU emissions trading schemes is needed to facilitate imports of CO_2 and improve liquidity between markets.

6) **Power CCUS will play a key role in delivering the government's clean power 2030 target, providing low-carbon dispatchable power to support the intermittency of renewables.** Accelerating policies to enable the pipeline of power CCUS projects not currently supported by government funding to materialise.

2 Introduction

It is hard to overstate the importance of CCUS and the role it will play in the energy transition. The UK's Climate Change Committee has said that CCUS is a necessity, not an option and without CCUS, it will be impossible to reach net zero. Our oil and gas supply chain, people and infrastructure will be vital for this technology. The UK has all the ingredients to become a global leader in CCUS. OEUK members are already building the early foundations of this sector, capitalising on expertise gained from building and operating national energy infrastructure.

CCUS technologies are technically and commercially ready to be deployed today. Each part of the value chain has been proven to work successfully. For example, CO_2 has been captured from natural gas processing since the 1970s. The US has thousands of kilometres of CO_2 pipelines and CO_2 has been stored safely under the Norwegian North Sea for over 30 years. The challenge today is to deploy these technologies at scale, at an unprecedented pace to meet our net zero targets.

There is no alternative to CCUS for decarbonising many energy intensive sectors such as cement manufacturing, whose emissions make up 7% of the global total CO_2 emissions. To put that into perspective, if global cement production were a country, it would be the third-highest emitter in the world.

CCUS will also support renewables by being installed in gas-fired power plants that will be important when solar and wind generation are unavailable. OEUK's blueprint for net zero power highlights that such modified plants will be crucial in helping the new government meet its 2030 target of a net zero power grid.

CCUS is also an enabler of other deep decarbonisation technologies, particularly low carbon hydrogen. The UK has a strong ambition to scale up low-carbon hydrogen production to 10 GW by 2030, at least 4 GW of which is expected to come from CCUS-enabled projects. Known as "blue hydrogen", this is the fastest way to scale up production.

If this were not enough, CCUS is also critical to enable negative emissions technologies. For example, bioenergy with carbon capture and storage (BECCS) and direct air capture (DAC) technology which works by removing CO_2 from the air. The UK must scale up these technologies to ensure that they are cost competitive enabling the UK to reach net zero by 2050.

2.1 Accelerating CCUS deployment: the urgent need for action

The offshore energy industry has been ready to deploy CCUS in the UK for years, but the withdrawal of government support in the 2010s meant that no CCUS projects have been built in the UK yet. The government has committed to supporting the development of four CCUS clusters by 2030 aiming to capture, transport and store between 20-30mn tonnes/yr. Hynet and the East Coast Cluster have been selected as Track 1 clusters whilst Acorn and Viking CCUS have been chosen as Track 2 projects.

These clusters will provide the infrastructure required for the large-scale transportation and storage of 20-30mn tonnes/yr by the end of the decade, the government target. The inaugural carbon storage licensing round organised by the North Sea Transition Authority (NSTA) offered 21 licences to 12 companies last summer, bringing the total number to 27. This is a positive start, but more licences will be needed. OEUK expect over 100 to be required by 2050 if we are to meet the required 90-170mn tonnes/yr capacity set out by the CCUS vision.

The government is also working to finalise business models to provide financial support to early projects across the value chain: in industry, the power sector and for the development of early transportation and storage infrastructure.

2.2 A once-in-a-lifetime opportunity for the UK to become a global leader in CCUS

The opportunity for the CCS sector in the UK could be worth around £100bn to the supply chain by 2050 and £20bn in this decade alone. The UK's CCUS sector is expected to contribute to 50,000 jobs by 2030 and protect over 100,000 jobs in existing industries.

The prize is therefore huge and the UK already has the components necessary to make CCUS a great success:

- The largest CO_2 offshore storage potential in Europe with up to 78 billion tonnes (Gt) of CO_2 storage in depleted oil and gas reservoirs and saline aquifers – equivalent to two centuries' worth of UK emissions today.
- Our extensive oil and gas heritage makes the UK in a natural leader. Rystad Energy research (commissioned by OEUK) shows that 84% of the capital expenditure needed can be delivered by the UK's supply chain servicing the current oil and gas sector. We can capitalise on the opportunity to repurpose existing oil and gas infrastructure (eg pipelines, survey vessels, wells, etc).
- Over half the UK's industrial emissions are concentrated in six clusters. Installing shared CCUS infrastructure in these regions would assist the transition to net zero.
- Ideally, by 2050 the UK will have over 100 CO_2 stores in place, capturing over 50mn tonnes/yr. At the centre of this new industry will be our geologists, engineers and other innovators.

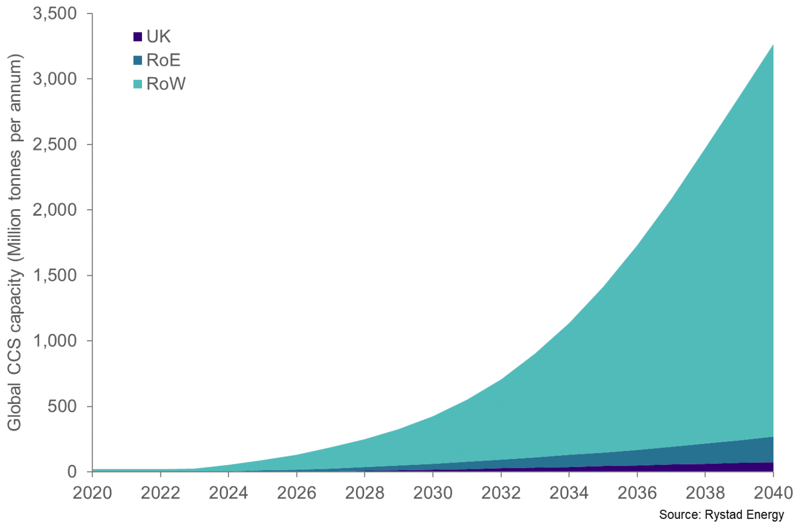
3 CCUS market overview

3.1 Global pipeline of projects and the UK's place in it

CCUS technologies are essential for the global energy transition. By capturing CO_2 emissions at their source and permanently storing them in subsurface sites, CCUS will help decarbonise essential sectors of the economy. These include manufacturing, power generation and residual emissions through the deployment of greenhouse gas removal (GGR) technologies. The UN Intergovernmental Panel on Climate Change (IPCC) has highlighted carbon capture as an essential part of maintaining climate targets. The International Energy Agency's Sustainable Development Scenario expects CCUS to account for nearly 15% of the cumulative reduction in emissions.

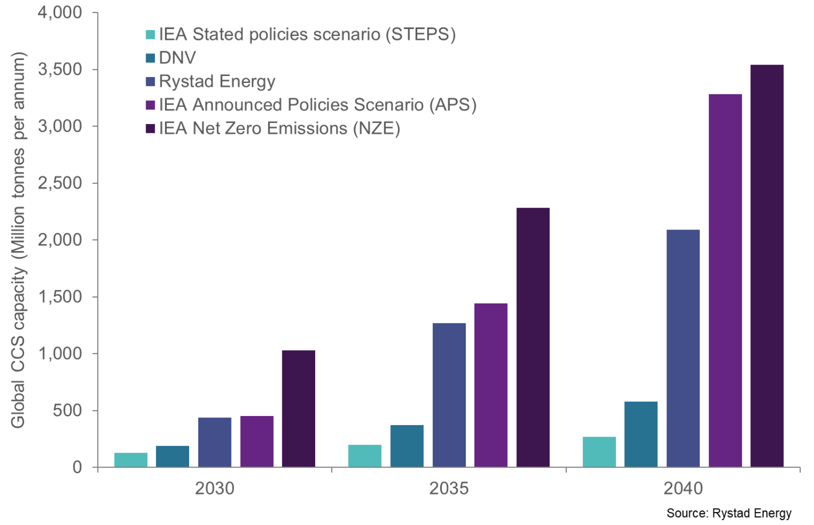
There are 45 commercial capture facilities in operation globally, capturing a total of 50mn tonnes/yr. If we are to meet the 2040 total (Figure 1) of 3-3.5bn tonnes/yr, the installed capture capacity will need to increase 60-70-fold, or around 31%/yr for the next 15 years. Worldwide, projects total 400mn-450mn tonnes/yr: just 14% of what is required by 2040 in the Rystad scenario highlighted.

Figure 1
Global CCUS capacity outlook



Current policies go some of the way to developing CCUS capacity. But global regulatory and policy thinking need to develop faster in order to meet and then exceed the decarbonisation pledges made by individual countries. Figure 2 showcases the scale of the challenge, the IEA Stated Energy Policies Scenarios (STEPS) highlights the progress CCUS will make if it follows the stated national policies. This fails to make a noticeable dent in 1.5 °C ambitions of the Paris Agreement. Even the IEA's Announced Pledges Scenario (APS), which includes net zero ambitions from nations such as the UK, still falls short. This means we will have to move faster if the world is to meet the UN net zero targets.

Figure 2
Global CCUS scenarios



European CCUS projects are gathering speed so OEUK has highlighted some of the more advanced projects in Europe in Table 1. In total these projects have the potential to capture and store almost 70mn tonnes/yr by 2030. Of these, only Porthos (The Netherlands), Greensands (Denmark) and Northern Lights (Norway) have all taken final investment decisions (FID). However, OEUK expects the UK to catch up in this regard with FID for the Track 1 clusters (HyNet and East Coast Cluster) in October 2024 and Track 2 (Viking CCUS and Acorn CCUS) likely following next year.

Table 1
Examples of European CCUS projects

Project	Country	Annual injection capacity (mn tonnes/yr)	Storage Type	Project Stage
East Coast Cluster	United Kingdom	4 - 2027 10 - 2030	Saline Aquifer	Planned
Hynet	United Kingdom	4.5 - 2026 10 - 2030	Depleted gas field	Planned
Acorn CCUS	United Kingdom	5 – 2026	Saline Aquifer	Planned
Viking CCUS	United Kingdom	10 - 2030	Depleted gas field	Planned
Northern Lights	Norway	1.5 - 2025 5.2 - 2026	Saline Aquifer	Under Construction
Greensand	Denmark	1.5 - 2026 8 - 2030	Depleted oil field	Under Construction
Aramis	Netherlands	7.7 - 2029 10.8 - 2030	Depleted gas field	Planned
L10	Netherlands	5 - 2028	Depleted gas field	Planned
Porthos	Netherlands	2.5 - 2026	Depleted gas field	Under Construction

4 The role of CCUS as an enabler of Net Zero

4.1 Industrial carbon capture (ICC) and energy from waste

Hard-to-abate industries will fail to reach net-zero ambitions without the use of CCUS. Cement is particularly challenging, where fuel switching alone is not the answer. Most of the CO_2 associated with its production are attributable to process emissions – those released through the chemical transformation of raw materials. During the calcination process limestone, calcium carbonate ($CaCO_3$), is heated in a cement kiln to form lime (CaCO) releasing CO_2. The only means of reducing process emissions is to capture the CO_2 at source.

$$CaCO_3 \xrightarrow[Heat]{} CaO + CO_2$$

CCUS can also enable significant reductions of emissions in the waste-to-energy sector. By trapping and either storing or repurposing the CO_2, CCUS reduces the overall carbon footprint of waste incineration and energy recovery. These plants in the UK emit around 11mn tonnes/yr, with proposed and under-construction energy facilities potentially adding another 9mn tonnes/yr.

The costs of retrofitting existing industrial sites to incorporate carbon capture technologies can be substantial. Challenges to be overcome include modifications to existing infrastructure, additional energy requirements and hence potentially less efficient plant.

4.2 Power CCUS (decarbonising power generation)

The new UK government has set targets to accelerate the decarbonisation of the power sector by 2030, five years ahead of the previous government. To achieve this ambitious target, the UK will need to rapidly upscale its development of wind, solar PV, and other renewable energy generation capacity and expand the transmission grid at a much faster pace.

Securing access to low-carbon dispatchable power generation will be essential to complement the intermittency of renewables. CCUS offers a solution, making use of our existing strengths in gas power generation. Power CCUS combines the power generation of our domestic gas -fired power plants and decarbonises them through carbon capture technologies.

If the whole known pipeline of Power CCUS projects were to materialise then 9.4GW of capacity would enter the system, this includes projects not currently in negotiation with government for support. Adding 9.4GW of power CCS would require 20 million tonnes of CO_2 capture and storage capacity per year. Independent research commissioned by OEUK shows that this power CCUS pipeline would be critical to achieve the government's clean power 2030 targets. Adding additional carbon capture and storage requirements to an already stretched target for 2030 would need a significant acceleration of the readiness of CO_2 storage capacity.

Net Zero Teesside Power (NZT Power) has already been selected as a power CCUS project supported by the Track 1 process. This project aims to be one of the world's first commercial scale gas-fired power plants with inbuilt carbon capture capacity, offering 860 MW of flexible dispatchable low-carbon power.

4.3 CCUS-enabled low-carbon hydrogen

Low-carbon hydrogen is expected to play an important role in the energy transition as it can be used for industrial fuel switching, power generation, transport fuel and potentially for heat decarbonisation. CCUS-enabled hydrogen, also known as blue hydrogen, is the quickest way to scale up low carbon hydrogen production. The UK has a twin track approach where electrolytic (green) and blue hydrogen production are developed in parallel, enabled by the colour-agnostic low-carbon hydrogen standard. The UK has a target of 10 GW of low-carbon hydrogen capacity by 2030 which includes 4 GW of blue hydrogen. Blue hydrogen production plants being developed in the UK's CCUS cluster sequencing programme include:

- H2NorthEast: 355 MW by 2028, scaling up to 1 GW in the early 2030s;
- H2Teesside: 1.2 GW by 2030; and
- Hynet Hydrogen Production Plant 1 (HPP1): 350 MW by 2027.

4.4 Greenhouse gas removals

GGRs will play a strong role in addressing residual emissions. Technologies such as DAC and BECCS are two of the most prominent forms of engineered GGR. In its simplest form, DAC draws air through a filter, capturing CO_2 molecules directly from the atmosphere. This can be used in conjunction with large scale industrial and power carbon capture projects to reduce residual emissions. However, DAC solutions are expensive as they are not commercially viable yet and have a high-power load. DAC technology trades on the voluntary carbon market at about £1,000/tonne, while the UK ETS price is about a twentieth of that.

A marginally cheaper alternative GGR method is BECCS. BECCS operates in much the same way as CCGTs with CCUS may work, capturing CO_2 at the source post combustion. However, unlike power CCUS, BECCS can be considered a carbon removal technology as the CO_2 is captured by trees that would otherwise naturally release the carbon captured after their lifetime.

4.5 Carbon utilisation and the creation of a low-carbon goods market

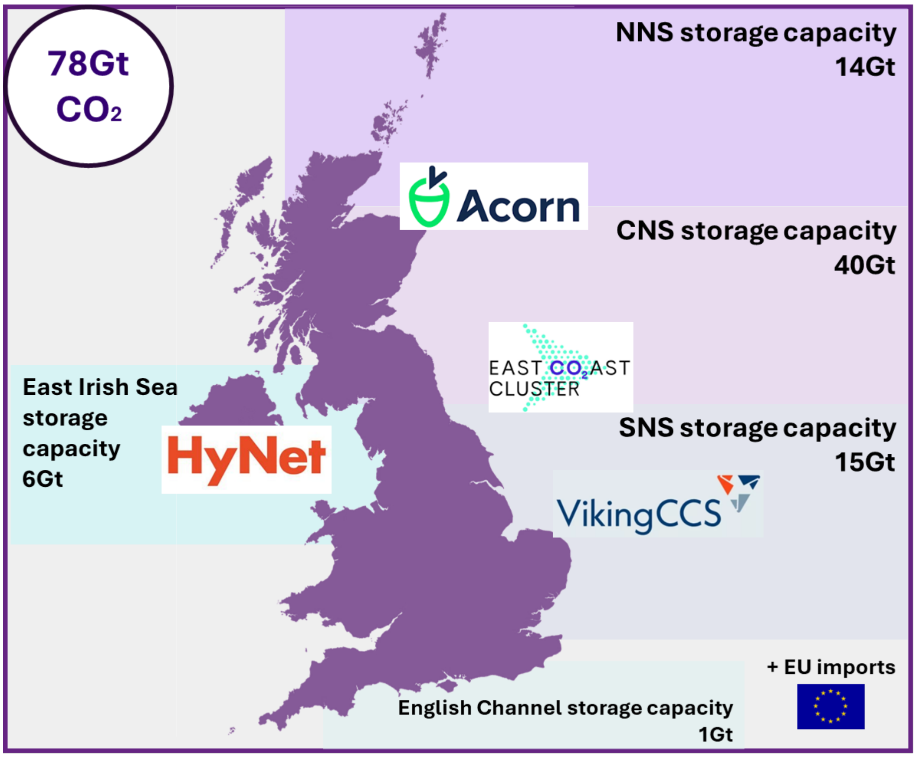
Carbon utilisation, while expected to have a limited overall impact in emissions reductions, is still expected to play a crucial role in specific sectors. It is particularly important to the production of sustainable aviation fuels (SAF) and in energy-intensive industries that can re-use CO_2, such as chemicals and cement.

CCUS will be essential to enable manufacturing to transition to net zero. Sectors such as cement have no viable decarbonisation route without CCUS. Initially this will work by retrofitting industrial plants with carbon capture and connecting them to the CO_2 pipeline network. CCUS will help protect thousands of jobs across our industrial heartlands and will also enable the development of new markets for low-carbon goods such as green cement, green steel, and green glass. The government has an important role to play in developing demand-side policies to increase demand for low carbon goods and develop product standards and policies to protect UK industry from imports that do not have the same environment-friendly input costs.

5 Kick-starting the UK's CCUS sector

The UK has a strong foundation on which to build a robust CCUS sector. The country benefits from an established. world-class supply chain that has honed its skills in the oil and gas industry. A large proportion of our supply chain's skills and expertise are directly transferable to CCUS, with 84% of the capital expenditure required for CCUS already serviceable by the supply chain to the oil and gas sector. The British Geological Survey (BGS) estimates that the UK holds around 78bn tonnes of CO_2 storage potential spread across the UKCS. This represents the largest offshore storage capacity in Europe, surpassing Norway's 70bn tonnes potential[1]. With this immense storage capability, the UK can store at a rate exceeding its current annual emissions for over a century, positioning itself as a hub for both domestic and European CO_2 storage needs.

Figure 3
UKCS storage potential



The government has committed to establishing four key CCUS industrial clusters by 2030, storing 20-30mn tonnes/yr. Track 1 clusters, HyNet and the East Coast Cluster, had confirmation of their funding envelope in October 2024, initiating the construction phase of the UK's CCUS sector. Expectations are that the Track 2 cluster projects will follow suit and achieve FID a year later in 2025. Outside of the track-clusters there are a number of clusters making great strides in developing domestic CCUS opportunities.

Morecambe Net Zero (MNZ) and the Solent Cluster are but two examples of projects outside the cluster sequencing process which need to come online at or around 2030. As the market matures the government hopes the sector will evolve through three market phases, ultimately progressing to a model whereby minimal government support is needed. By this stage the UK government is targeting

[1] https://www.sodir.no/en/whats-new/publications/co2-atlases/co2-storage-atlas-of-the-southern-barents-sea/

50mn tonnes/yr storage capacity. MNZ and the Solent Cluster offer a glimpse of how the market might look as it moves away from state support. As the sector matures, dispersed emitters will begin to gain access to storage sites, utilising non-pipeline transportation methods such as rail and shipping. In total dispersed emitters make up 33mn tonnes/yr.

Relying solely on carbon markets will not be enough for CCUS technologies to succeed, given their high costs. We anticipate that some form of price support or other risk mitigation mechanisms will be necessary, even in the long term, to address the volatility of carbon pricing. The early success of the sector hinges on the seamless coordination between carbon emitters and the infrastructure for transportation and storage. Each component of the value chain relies on the others for effective operation. The market creation phase incorporates government support mechanisms that cover cross-chain risks, such as construction delay, underutilisation of the network and T&S performance/availability. As the sector evolves, CCUS infrastructure will grow, allowing more emitters to connect to the network, in turn reducing risk. At the same time, market signals such as further cost reductions and ETS pricing will allow the sector to become self-sustaining with reduced government intervention and bilateral contracts dividing up risk and reward.

Figure 4
Emissions trading schemes

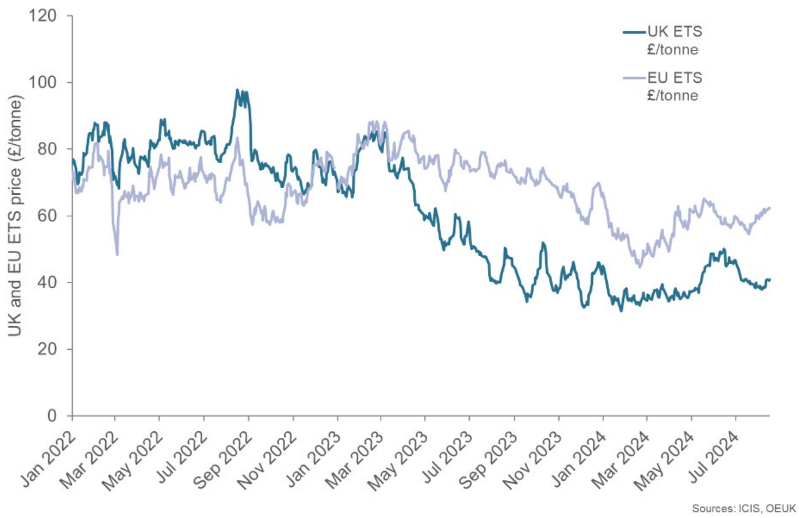
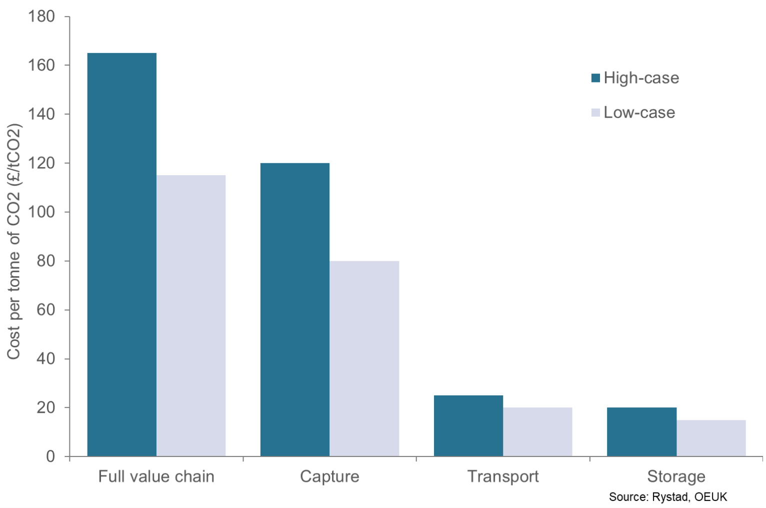


Figure 5 The cost of CCS



OEUK estimates the cost of capturing, transporting and storing CO_2 in the UK today to range between £115 and £165/tonne, dependent largely on the source of CO_2, the transportation method and the distance between emitters and storage sites. Figure 5 shows the range of CO_2 capture costs for the various sources of CO_2. By 2030 OEUK expects the cost of CCUS to fall by between a tenth and a fifth in a more developed market. Although the sector is expected to achieve cost reductions, CCUS technologies might not achieve economies of scale as quickly as renewables like wind, owing to their higher costs, complex infrastructure and less established market. Most of the likely cost reductions will come from the carbon capture portion of the value chain. A future merchant model for a developed CCUS market could see some further reductions in the cost of transporting and storing CO_2 as competition and technical learning enable efficiencies.

As Figures 4 & 5 show, the current UK ETS price does not yet cover the cost of capturing, transporting and storing CO_2. Since formally diverging from the EU's ETS in January 2022, the UK ETS price has fluctuated between £30 and £95/tonne, settling in recent months around £50/tonne. This is under half the current cost of the process of capture, transport and storage.

As we progress to a more developed CCUS market, falling costs and higher ETS prices will mean less state support is needed to float the CCUS market. The sooner CCUS projects get off the ground, the sooner the UK will be able to lower its CCS costs.

5.1 Economic model for the nascent CCUS sector and outlook beyond the track process

Early transportation and storage networks will have monopolistic characteristics similar to other infrastructure networks that require significant upfront capital investment. They are designed to have a long operational life and service many different customers with a single network. Therefore, government designed the Transport and Storage Regulatory Investment (TRI) model to attract investors to a first-of-a-kind infrastructure network, promoting the efficient operation of these networks and protecting their users. The TRI model is underpinned by the economic regulatory regime (ERR) which sets an allowed revenue for network developers and sets a standard of service its users may expect and embedded in a licence. This will determine transportation and storage companies' allowed earnings and their capital and operational expenditures. The Carbon Capture and Storage Network Code defines the commercial, operational, technical, and governance arrangements for CO_2 transport and storage companies and its users, much like the Unified Network Code does for third-party gas shippers.

While it is needed to generate investment in the sector, the track process will not be sustainable in the long-term, given the high levels of government financial support required. The longevity of the UK's CCUS sector will depend on the market becoming self-supporting.

OEUK foresees a merchant-based model developing in the sector post 2035, whereby the market is developed to the extent that there are established storage sites competing for emissions from domestic and international emitters, driving down T&S costs and raising the overall efficiency. The following infographics outline the role of business models in the UK and methods of support given by competing nations/trade regions including the US and EU.

5.2 Examples of Business Models

Regulated asset base model (RAB)

Support for projects transporting and storing CO_2, enabling the permanent sequestration of CO_2 in the UKCS.

- **Regulated Asset** model as T&S networks share similar characteristics to other infrastructure networks (gas, electricity, water): significant upfront capital investment, long operational life, customers connecting to network.
- Government support to provide increased certainty of returns over time, to be reduced as CO_2 flows and T&S fees increase.
- Protection against demand-side risk to revenues (T&S company has no control of CO_2 flows from emission source points).
- Close scrutiny of costs and performance.
- OFGEM as the economic regulator.

Dispatchable power agreement (DPA)

Support for projects capturing CO_2 from gas-fired power stations, offering low-carbon power generation.

- The dispatchable power agreement (DPA) contractual framework aims to enable deployment of flexible low carbon power.
- Adapted from the CfD for AR4 to enable natural gas fired power CCUS facilities.
- DPA propose an availability payment linked to facility performance.
- Incentivising availability of low-carbon power generation.
- DESNZ propose a variable payment that will account for the additional cost of generation for a power CCUS facility compared to an unabated reference point.
- Term length: 10-15 years

Industrial carbon capture (ICC)

Support for projects capturing CO_2 from industry, enabling the development of low-carbon goods

- Industrial carbon capture (ICC) and waste business models aim to de-risk deployment and provide revenue support.
- The model for track-1 emitters utilises a fixed trajectory reference point, offering predictability for first movers.
- DESNZ are minded to transition from a fixed trajectory reference price to an applicable carbon market reference price for later emitter projects.
- Term length: 10-15 years

The UK's approach to supporting early developments of the CCUS industry differs somewhat from competing and comparable regions such as the US, EU and Norway. The UK approach via the track projects supports the entire value chain from emitters to transport and storage companies, whereas Norway tends to support only the transport and storage systems. The US takes the approach of rewarding early movers in the sector: the Inflation Reduction Act (IRA) provides significant tax benefits for every tonne of CO_2.

Table 2
Policy and regulatory priorities

Theme	Policy priorities
Funding and pace of Track 1 and 2	• Industry welcomes the confirmation of a £22bn government support package announced in October 2024 enabling Track 1 clusters (HyNet and East Coast Cluster) to reach FID. The process from Track-1 selection, negotiations and confirmation of funding took 35 months. We must take lessons learned from this process if we are to deliver on our deployment targets. • Prompt award of FID for Track 2 clusters is needed to continue developing the sector at pace. Track 2 clusters need a streamlined process to ensure emitters build on the lessons learned from Track 1. • Power CCS projects need to move faster: OEUK research[2] shows that these plants will play a critical role in realising the government's net zero emissions from power target. • Timely delivery of Track 1 expansion for Hynet and a published timeline for East Coast Cluster expansion. • Track 2: Confirm timelines for the anchor phase of emitters (currently targeting deployment in 2028-2029) and cluster expansion processes.
Long-term certainty for investors	• A regular competitive allocation process for projects is urgently needed to provide a route to market for projects. Emitters and T&S operators outside the Track 1 cluster sequencing process lack this. • Only eight emitter projects in Hynet and ECC have been selected to negotiate revenue support. Track 1 is moving slowly and dozens of emitters do not know when and how they can bid for government support.
Transition from a government-supported sector to a self-sustaining market	• Carbon pricing and CCS costs make projects unviable without government support, but this will be required in the mid-2020s to kickstart the sector and develop early infrastructure (retrofitting emitter plants and building the onshore and offshore pipelines and storage sites). • Transition to a self-sustaining market will require a supporting carbon pricing environment, protection against carbon price volatility alongside further cost reductions and enabling policies such as carbon border adjustment mechanisms (CBAM) and mutual recognition/alignment of UK and EU ETS systems.
Accelerate the development of a competitive UK CO_2 storage market	• The UK must retain critical oil and gas supply chains (drilling, vessels, subsea umbilicals, risers and flowlines systems) which are essential to deliver CCUS. A stable and competitive fiscal environment is a prerequisite for this. • The removal of regulatory barriers for cross-border transportation of CO_2 are urgently needed. The UK supply chain is to earn at least £7bn[3] of work if CO_2 imports are enabled by 2030, and some UK storage sites are only viable if they receive imports. • Non pipeline transportation methods, particularly shipping, are essential for connecting remote emitters to the network. These methods must be enabled now to be ready before 2030, bearing in mind the supply chain lead-times (CO_2 tankers and associated infrastructure).

[2] https://oeuk.org.uk/product/analysis-for-achieving-a-net-zero-power-grid-by-2030/

[3] https://oeuk.org.uk/product/uk-og-supply-chain-opportunities-in-the-energy-transition/

Theme	Policy priorities
Streamline regulation	• The UK has developed a regulated economic model to minimise cross-chain risks in the market creation phase. This approach also leads to limited risk/reward incentives for developers and a bundled T&S model. Leaner models such as the SDE ++ used in The Netherlands should be explored going forward. • Overly complex regulatory landscape with dozens of regulators involved unclear boundaries and linkages between regulatory processes.

6 Cross border opportunities

There is an opportunity for the UK to service the CO_2 storage requirements of other nations. Exporters in Europe are the most obvious customers for UK storage operators owing to their relative proximity and excess demand for storage, as evidenced in the EU Net Zero Industry Act published earlier this year. The Act sets an EU CO_2 injection target of 50mn tonnes/yr by 2030, with an estimated injection demand of 80mn tonnes/yr. This shows that the EU's short to medium-term ability to capture CO_2 is likely to exceed its ability to store CO_2.

As the UK continues to reduce its domestic emissions, gaining access to additional CO_2 imports will be vital for the growth of the UK's carbon storage sector. Allowing a greater number of storage projects to be developed in the UK, increasing competition, driving down costs and ultimately reduce the reliance on the UK government. Delaying the process of accessing imports of CO_2 from the EU could have a significant impact on the UK's ability to capitalise its storage capacity and together with Norway develop a North Sea storage market.

With time, OEUK expects a merchant style model taking over, with CO_2 stores competing with one another for emissions. With non-pipeline transportation methods becoming the primary mode of transportation between emitters and storage sites. In particular, CO_2 shipping will enable the long-distance deployment of CO_2 transportation, connecting UK facilities with isolated regions such as the South Wales Industrial Cluster (SWIC) and the Mediterranean.

6.1 Current regulatory hurdles

Accessing international imports of CO_2 comes with a unique set of regulatory hurdles that need to be passed. OEUK has worked with its members to define five core blockers that need to be addressed. These hurdles are not insurmountable if tackled through a joined-up strategy between the UK government and CCUS industry. The primary hurdles we have identified include the lack of mutual recognition between the UK and EU emissions trading systems, the current London Protocol regulations. The secondary hurdles indicate a need for mutual CO_2 standards, limited cross-border current transportation infrastructure and a lack of clarity on the long-term liabilities of transportation and storage value chains.

Solving the primary hurdles will require a linking agreement or agreement of mutual recognition between UK and EU emissions trading schemes. Until the amendment to Article 6 of the London Protocol has been ratified by two-thirds of the signatory countries the UK should make every effort to set up bilateral agreements with trading nations to allow for the free flow of CO_2. Ongoing dialogue between the UK and the EU is required to ensure CCUS standards remain aligned. Developing infrastructure and long-term liability definitions will follow as the sector evolves and projects begin operating.

Figure 6
Regulatory hurdles

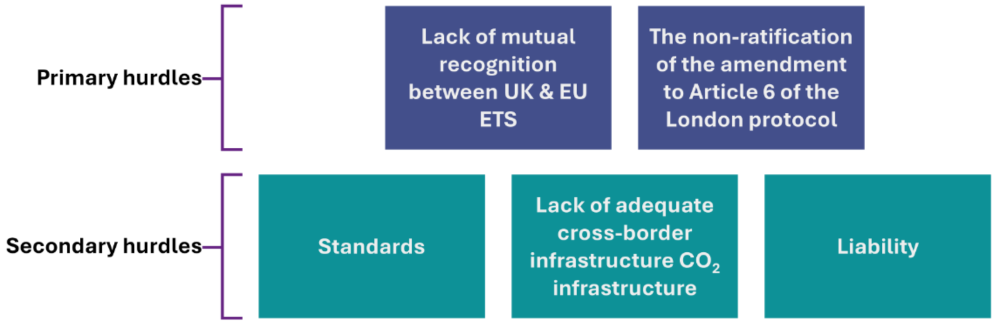


Table 3
Benefits of cross border transportation and storage of CO_2 to the UK and EU

UK	Europe
Expansion of offshore CO_2 storage sector, allowing the development of additional stores.	Greater access to storage sites for emitters with the development of a pan-European CCS transportation and storage network (including the UK and Norway).
Access to greater economies of scale and resulting reductions in the overall cost to supply chain and T&S companies. Increased activity and revenues of at least £7bn for UK supply chain to 2040.	UK CO_2 storage sites at scale are expected to become operational earlier than most of those in other European countries, which could help European emitters meet their carbon reduction goals faster.
Imports reduce domestic projects' reliance on government support	Greater competition for storage, resulting in increased optionality and potential cost reductions for emitters.

Supply chains and project spend profiles[4]

Global CCUS spending to reach £115 billion in 2040, with UK to be a major European player. UK CCUS projects expected to account for 3% of the global spend, with most of the spending in the CCUS industry happening outside of Europe. UK is expected to be a major player in Europe, accounting for roughly 30% of spend throughout 2040.

Capital expenditure accounts for roughly 40% to 50% of the total lifecycle cost of a CCUS project. Most of these costs are related to construction and commissioning of the capture plant along with transport infrastructure.

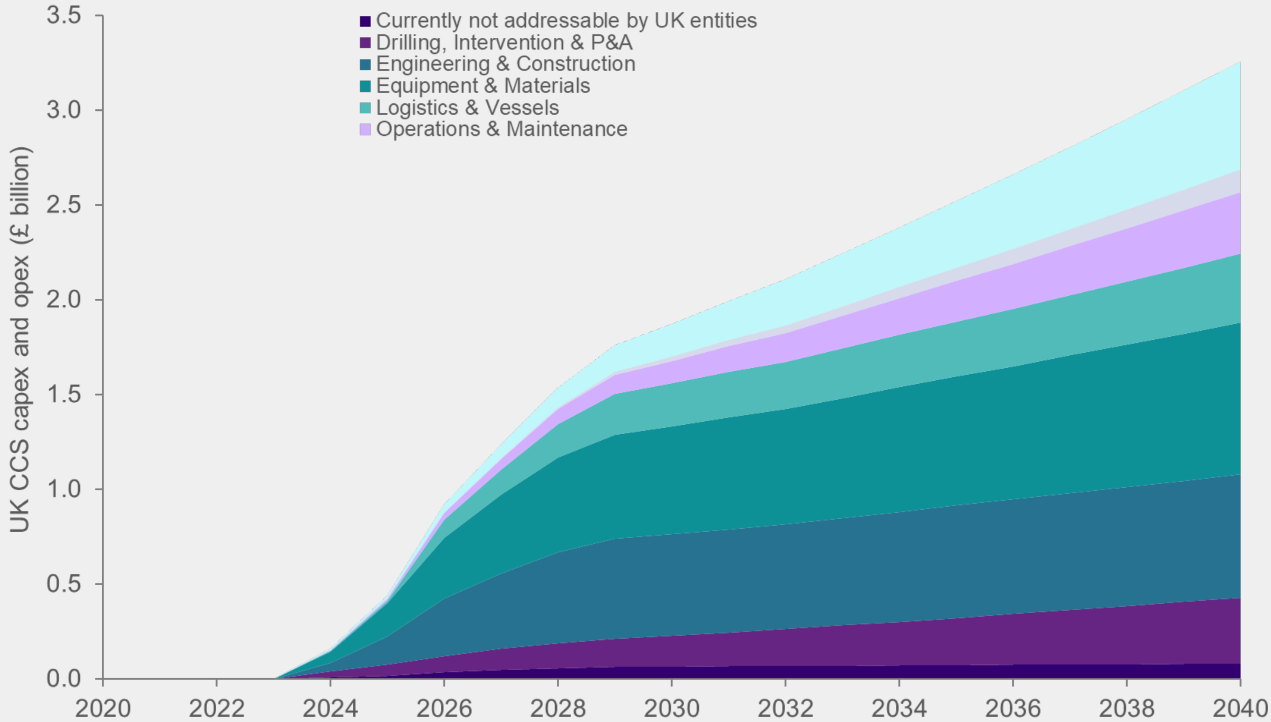
Roughly 40% to 50% of the expenditure for a CCUS project occurs before the start-up of injection of CO_2 for permanent storage. Initial investments encompass manufacturing and installing technologies at carbon capture facilities, as well as substantial investments in transportation infrastructure, which may involve repurposing existing pipelines or greenfield construction.

In the storage segment, drilling services, as well as subsea production systems (SPS) and subsea umbilicals, risers and flowlines (SURF), constitute a significant portion of offshore storage costs.

Once capture, transport and injection commence, operational expenditures come into play. These operational costs involve maintenance, subsurface and reservoir monitoring, as well as logistics and supply base expenses. Opex costs can make up 60% of a CCUS project with onshore capture, and offshore storage and transportation of CO_2 via pipelines and a typical lifetime of 25 years.

Figure 7

UK CCUS capex and opex per year by segment



Source: OEUK, Rystad

[4] https://oeuk.org.uk/product/uk-og-supply-chain-opportunities-in-the-energy-transition/

UK can leverage existing strength in subsea to secure CCS expenditure abroad[5]

The UK has high capability within SPS and SURF, with players winning integrated subsea contracts and significant manufacturing capacities in the UK.

The UK serves as a key hub for many of the most successful subsea contractors worldwide. Subsea7, TechnipFMC and Baker Hughes have the ability to win larger subsea scopes (full SPS or SURF scopes) as well as integrated contracts in the UK and abroad.

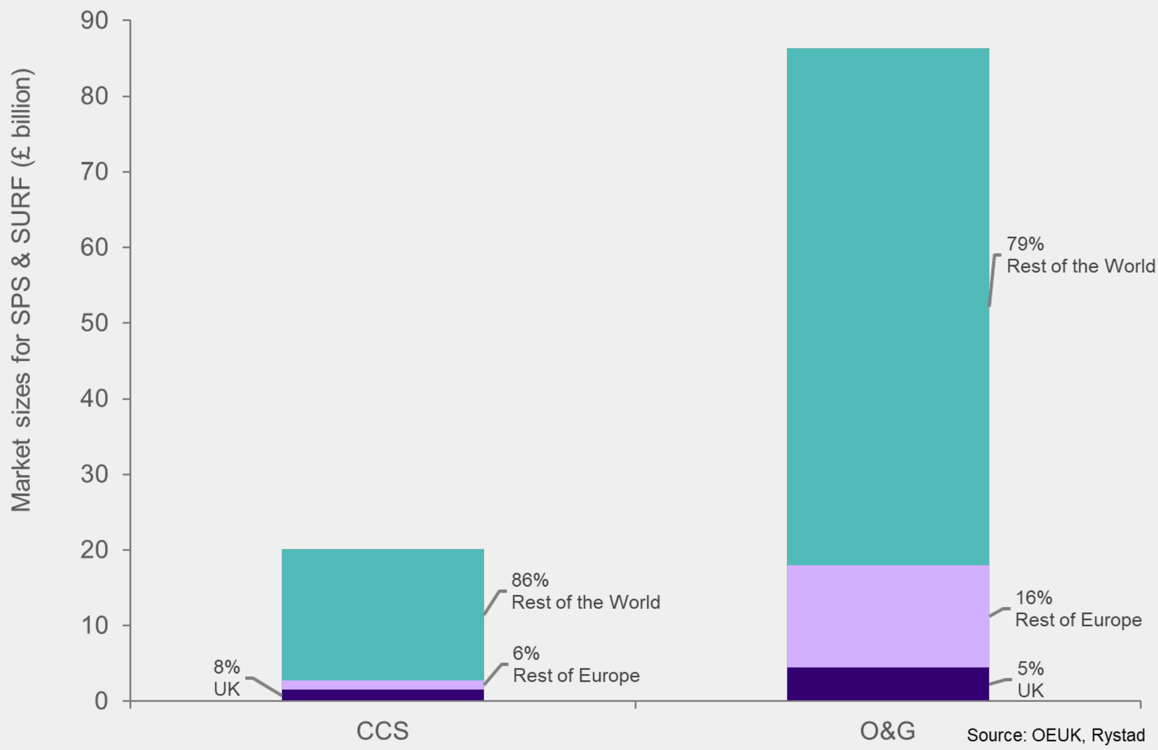
Baker Hughes and TechnipFMC, both prominent contributors to the subsea production systems segment, have manufacturing plants in the UK. TechnipFMC, a global consortium headquartered in the UK, and Baker Hughes, with a UK subsidiary, collectively represent about half of the worldwide supply of subsea trees.

The UK also holds 20% of global umbilical, cables and flexibles manufacturing. Here TechnipFMC has also been present in the UK after acquiring Duco Ltd in 2003. With a plant in Newcastle, Duco has delivered umbilicals to the oil and gas industry since the 1970s.

With corrosive streams, flow assurance challenges and leakage concerns, current subsea systems needs to be tailored to meet the demands from CCS. Export routes for the global subsea market is already well established with UK-located players. As the UK is among the first to scale CCS offshore, there should be significant opportunity in utilising these export routes for subsea CCS technology.

In the chart below, it is evident that the global oil and gas market for SPS and SURF exceeds the market size of the CCS industry. Nevertheless, the total global SPS and SURF market for CCS makes up 20% to 25% of the oil and gas market between 2024 and 2040. The UK is an early mover in the offshore CCS market and its suppliers should be well positioned to take part in the growing industry.

Figure 8
Market sizes for SPS & SURF in different regions for CCS and O&G (2024-2040)



Source: OEUK, Rystad

[5] https://oeuk.org.uk/product/uk-og-supply-chain-opportunities-in-the-energy-transition/

Oil & Gas | Hydrogen | CCUS | Offshore Wind

Enjoy the benefits of membership

OEUK has over 400 members, from oil and gas operators to the offshore energy supply chain and across the lifecycle from production to decommission. We represent an integrating offshore energy industry which provides cleaner fuel, power and products safely to everyone in the UK.

Raise your profile

- Social media welcome on our social platforms. We have over 55,000 followers on LinkedIn alone!
- Share your news on our website.
- Promote your case studies.
- Be in one of our member highlights.

Join forums & workgroups

- Discuss key issues of the industry that draw your interest.
- Over 14 forums to join in on.
- Take pride in contributing to better future working methods within the energy supply chain.

Gain market insights

- Our quarterly Offshore Energies magazine delivered to your office.
- Enjoy member exclusive reports and insights, written in-house by our experts.
- Speak to our market intelligence experts for unique market insights.

Target your networking

- Network with peers that are interested in the same subject.
- Showcase your expertise and business to others in the industry.
- Enhance your business' capabilities by making valuable connections.

Lead the industry

- Contribute to award-winning good practice guidelines.
- Nominate a senior leader to OEUK's Advisory Council.
- Get involved with external key stakeholders of the wider energy industry.

Attend our events

- Gain access to member-exclusive events.
- 35% discount on tickets at any OEUK event.
- Member-exclusive exhibition rates.
- Speaking opportunities relevant to your field of interest.

Join us today membership@OEUK.org.uk +44 (0) 1224 577 250

Other OEUK offerings:

CCUS Forum: 100+ members

OEUK's quarterly CCUS forum brings together over 100 member companies from across the value chain including licensees for all 27 UKCS carbon storage licences. Their operators, the supply chain and legal sectors. The forum provides a regular update on the progress of the UK's CCUS sector, from cluster projects, storage sites, UK & EU policy to people & skills. New members are welcome.

Well decommissioning guidelines for CO_2 storage

OEUK's Guidelines for Decommissioning Wells were produced by the Well Decommissioning workgroup of the OEUK Wells Forum. The guidelines provide industry recommendations and good practice for well decommissioning based on recent North Sea experience. These guidelines have been prepared to support well operators and well engineers on the considerations that are needed for decommissioning a well to retain the integrity of a future CO_2 store. Furthermore, this guideline will also support future CO_2 storage operators on the considerations that are needed to assess the integrity of inherited legacy wells.

Link: https://oeuk.org.uk/product/oeuk-well-decommissioning-guidelines-issue/

OEUK.org.uk

info@OEUK.org.uk

@OEUK_

Offshore Energies UK

Working together, we are a driving force of the UK's energy security and net zero ambitions. Our innovative companies, people and communities add value to the UK economy.

Join us today and help strengthen the UK offshore energy industry and your business.

membership@OEUK.org.uk