SECURING A LOW CARBON FUTURE

Carbon Capture and Storage: an introduction

The Peak Cluster is an innovative collaboration to capture, transport and permanently store carbon dioxide (CO_2) emissions from the cement and lime industry in Derbyshire and Staffordshire, as well as neighbouring industries in Cheshire.

Five cement and lime plants across Derbyshire, Staffordshire, owned by Tarmac, Breedon, Lhoist and Aggregate Industries, together with Lostock Sustainable Energy Plant in Cheshire, known locally as LSEP, have come together with Progressive Energy to form Peak Cluster.

Carbon dioxide (CO_2) released into the atmosphere is a major cause of climate change. Reducing CO2 emissions is an essential part of managing our climate emergency. The UK Government has therefore established a net zero emissions target. This means that by 2050, any CO_2 emissions to the atmosphere must be offset by equivalent emissions removal.

Industrial processes produce a huge amount of CO_2 that is released to the atmosphere. To meet our targets, we need to significantly reduce these emissions. For production of cement and lime this can be achieved by directly capturing the emissions via a process known as Carbon Capture and Storage (CCS).

Why do we need to capture carbon dioxide?

Carbon dioxide (CO_2) released into the atmosphere is a major cause of climate change. To tackle the climate emergency, we must rapidly reduce our CO_2 emissions. The UK Government has therefore established a legally binding net zero emissions target of 2050.

This means every part of the UK's economy must decarbonise to continue operating in the future. Nearly 70% of the UK's local authorities have set even earlier target dates to reach net zero, including Derbyshire County Council, Cheshire West and Chester Council, Cheshire East Council, and Staffordshire County Council.

Industry is vital to the UK economy. It employs hundreds of thousands of people, supports a large supply chain, attracts investment from overseas and produces products that we use in our everyday lives and that we export across the world. However, industrial processes also emit a significant amount of CO_2 that is released to the atmosphere. In order to tackle climate change and maintain industry in the UK, we need to act now to reduce CO_2 emissions and put the UK on track to net zero by 2050.

There are a variety of ways in which this can be achieved – for example, by switching to low carbon fuels, renewable energy and by directly capturing the emissions via a process known as Carbon Capture and Storage (also known as CCS).

For cement and lime production, approximately two thirds of the CO_2 comes from the raw material, limestone. The generation of CO_2 cannot be changed or reduced by electrification or using different fuels, and so capturing the carbon and locking it away is the only option to decarbonise production of these vital materials. Likewise, Energy from Waste facilities which use our household waste to create heat and electricity for industry and the grid, require CCS to enable them to decarbonise.

Carbon capture and storage supports industry as the UK transitions to a net zero economy, facilitating their operation in a global low-carbon market and help to retain employment. These industries will unlock significant economic benefits – in the UK alone, CCS exports could support 48,000 direct high-skilled jobs and £4.3 billion in GVA per year by 2050 (BEIS, 2019).

As Peak Cluster, We are considering storage in either the HyNet store being developed by Eni in Liverpool Bay, or the much larger Morecambe Net Zero store being developed by Spirit Energy. Both have been awarded Storage & Appraisal licences by the North Sea Transition Authority.

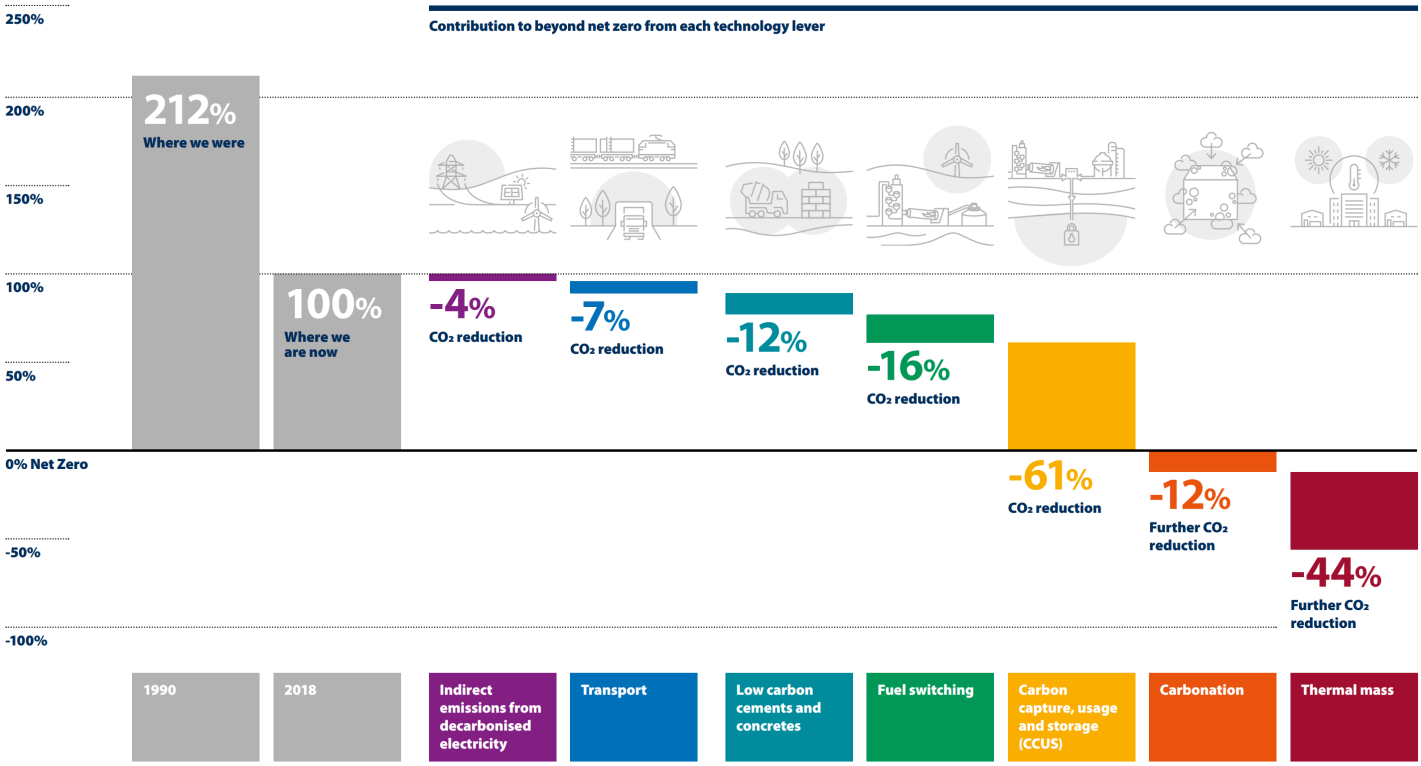
Why Carbon Capture and Storage?

Peak Cluster will use Carbon Capture and Storage (CCS). This process locks away carbon dioxide emissions before transporting it to secure storage sites.

The Climate Change Committee has confirmed that CCS is an essential technology to reach Net Zero. CCS technology is vital in enabling us to decarbonise certain types of industry which emit carbon dioxide (CO_2) as an unavoidable part of their processes.

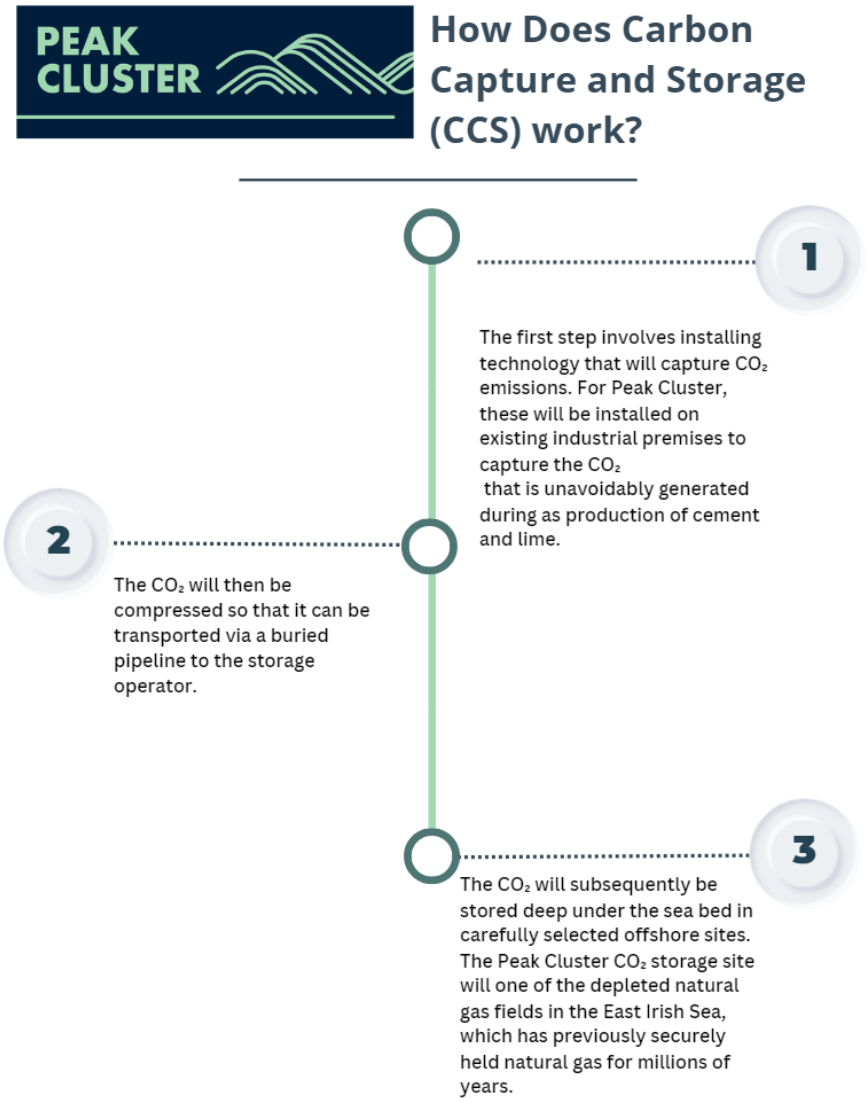
To produce cement and lime, the raw material, limestone (calcium carbonate) must be converted into calcium oxide in the process. This releases CO_2 which accounts for more than 60% of the emissions from this industry. The chemical process cannot be changed and thus, currently, there is no technology other than CCS in which emissions can be cut from cement and lime production.

The Mineral Products Association (MPA) have estimated that 61% of required emissions reductions to achieve net zero across the sector will come from CCS.



Courtesy of the MPA

How does it work?



CCS is a mature technology that can capture up to 95% of CO_2 emissions produced in industrial processes. We will capture CO_2 on site from existing cement and lime plants in the Peak District and other industry sites along the pipeline route.

The CO_2 is then compressed so that it can be transported safely by underground pipeline, to be stored in carefully selected depleted gas reservoirs underneath the sea. These have, until recently, safely and securely held natural gas under high pressure for millions of years, before extraction over the course of the last few decades.

How are we capturing and storing carbon as part of Peak Cluster?

CCS is an essential part of Peak Cluster.

We will be capturing CO_2 from existing cement and lime production plants in Derbyshire and Staffordshire, as well as CO_2 that is produced from the new Energy from Waste plant at

Lostock in Cheshire. The CO_2 will then be transported safely by underground pipeline to depleted gas reservoirs in the East Irish Sea.

Natural gas has been safely extracted through production wells for over 25 years in the East Irish Sea. Extraction of the gas has progressively left space within the sandstone reservoirs that can be used for CO_2 storage.

The reservoirs have capacity to store many decades of carbon emissions to support our transition to net zero.

How can we ensure safe CCS?

CCS is an established technology. The longest established project is the Sleipner project in Norway. According to the Global CCS Institute, in 2022 there were 30 CCS projects in operation, 11 under construction and 153 in development.

The onshore carbon capture and pipeline transport will be regulated by the Health and Safety Executive (HSE), exactly as is done for industrial sites and pipelines today.

Offshore, CO_2 storage infrastructure and operations will be strictly regulated by the UK Government's North Sea Transition Authority (NSTA) and Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). In addition, companies that operate this type of infrastructure are used to ensuring the highest safety standards in their operations.

Throughout all the phases of operation, CO_2 transportation, injection and its safe containment within the reservoir will be carefully monitored using state of the art techniques approved by the regulators (including but not limited to geophysical surveys, pressure sensors, seabed surveys and dedicated monitoring wells).

Here is a paper produced on storage integrity from The Department of Energy Security and Net Zero.

Can we be sure the CO_2 won't escape?

Gas has remained safely trapped in geological structures deep below the surface of the seabed, such as sandstone reservoirs, for millions of years. Hundreds of metres of shale, mudstones, and halite(salt) lie over the top of these sandstone reservoirs, making an impermeable layer which traps the gas in place. The CO_2 will be stored in the same way as the original natural gas. It will remain safely contained in the sandstone reservoirs.

Prior to licencing of a storage site, the regulator will require the operating company to demonstrate a full assessment of the integrity of the store, and will then monitor this

integrity throughout the filling and long-term storage phases. The Royal Society recently published a report which concluded that well-regulated wells would retain 98% of their CO_2 over 10,000 years. Measures to ensure CO_2 is injected safely include:

- Using an injection rate suitable for the site-specific geology to avoid fracturing seal rocks.
- Using pressure relief wells to reduce sub-surface pressure.
- Continuous monitoring to detect and rectify leaks.

You can read more about this in The Royal Society's policy briefing paper here.

How much CO_2 storage is there?

The capacity within the identified stores will allow us to store CO_2 captured for decades to come. There are significant CO_2 storage opportunities in the East Irish Sea, within geological formations in Liverpool Bay (around 190 million tonnes) and in the Morecambe gas fields (estimated to be close to 1 billion tonnes).

CO_2 Storage

Peak Cluster Peak Cluster expects to connect to Morecambe Net Zero for CO_2 storage, although we also have the potential to connect to the HyNet Liverpool Bay stores to be operated by Eni.

MNZ Cluster

Morecambe Net Zero

Spirit Energy have owned and operated the South Morecambe and North Morecambe gas fields since 1974. They made a material contribution to UK energy security, providing roughly

10% of the UK’s annual natural gas requirements through the late 1980’s and the 1990’s.

The reservoirs are in the eastern Irish Sea (EIS), 25 km Southeast of Barrow-in-Furness. The natural gas fields are now almost empty with natural gas extraction anticipated to be decommissioned by the late 2020's.

The South Morecambe and North Morecambe gas fields have a theoretical CO_2 storage capacity of 1,074 million tonnes, or roughly 1 gigatonne.

The South Morecambe and North Morecambe depleted gas fields have a theoretical CO2 storage capacity of 1,074 million tonnes, or roughly 1 gigatonne (1 x 109 tonnes).

- 81% of the capacity, 875 million tonnes, is in South Morecambe.
- The remaining 19%, 199 million tonnes, is in North Morecambe.

The reservoirs are in the East Irish Sea, 25 km Southeast of Barrow-in-Furness, and cover an area approximately 23 km long by 7 km wide.

- The carbon stores have effectively trapped hydrocarbons (predominantly methane) and CO2 over geological time.
- The high-quality sandstone reservoirs are overlain with 800m of interbedded halite (salt) and mudstone which is an extremely reliable impermeable seal.
- The North Morecambe reservoir contains 6 mol% CO2. This naturally occurring CO2 content gives confidence in the integrity of the sandstone formations as long-term CO2 storage sites.

In 2023 Spirit Energy secured the carbon storage licence from the North Sea Transition Authority for an area covering the South Morecambe and North Morecambe reservoirs.

- Spirit Energy has commenced delivery of the licence work programme which includes a seismic survey in 2024 over an area of at least 475 km2.
- In the success case, and if no major impediments are identified, the licence term will conclude with submission and award of a carbon storage permit by the end of 2027.

Spirit Energy has a unique understanding of the South Morecambe and North Morecambe fields having acquired a wealth of subsurface data during 50 years of natural gas exploration and production.

We want to hear from you

If you have any questions, queries or comments on Peak Cluster, please do chat to us. You can find the ways to contact us on our website: www.peakcluster.co.uk.