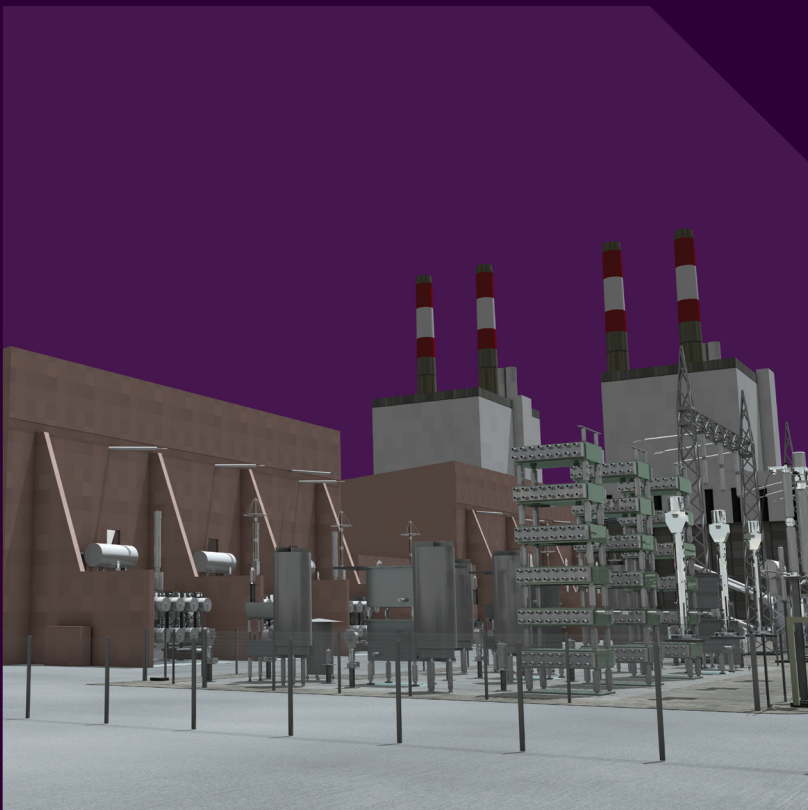


## Carbon Capture and Storage

CCS could clear a path to the  
UK's carbon reduction targets

An ETI technology programme highlights report



## Carbon Capture & Storage

Capturing and sealing away carbon dioxide released from industrial processes and electricity generation is acknowledged internationally to be potentially a winning intervention in the battle against climate change

### Contact details



Andrew Green  
Programme Manager  
Email: [andrew.green@eti.co.uk](mailto:andrew.green@eti.co.uk)  
Phone: 01509 20 20 54



Dennis Gammer  
Strategy Manager  
Email: [dennis.gammer@eti.co.uk](mailto:dennis.gammer@eti.co.uk)  
Phone: 01509 20 20 10

## Carbon Capture & Storage

### A low carbon future becomes affordable

#### Overview

Capturing and sealing away carbon dioxide released from industrial processes and electricity generation is acknowledged internationally to be potentially a winning intervention in the battle against climate change. The collected technologies that make up Carbon Capture and Storage (CCS) could remove more than 90% of the carbon emissions from energy intensive industries and electricity production. In power generation, CCS not only provides low-carbon output but it also preserves capacity in fossil fuel-fired plant to respond to shifts in demand. This is a near-unique combination that could mitigate the different shortcomings of harnessing the wind, the sun or nuclear fission.

CCS could clear a path to the UK's carbon reduction targets; secure its energy supplies; and reduce the cost of those achievements. With CCS in play a low-carbon future with secure energy supplies becomes affordable. However, without, our research has found that the costs of meeting the UK's low-carbon targets could double to £60bn a year by 2050 at today's prices.

However, CCS has to be honed technically and commercially before it can become a reality. ETI, supported by its partners, has made important progress and continues to do so.

## Key Advantages

### Key Advances

Key advances in the ETI CCS programme include:

- Small-scale generation test projects
- Storage site appraisal and development
- A commercially operating storage site database
- Software to model every stage of a CCS project from design to operation
- Using carbon emissions to produce solid-state storage and building materials
- Increasing the understanding of what both the public and private sector need to overcome to help develop the industry; and optimising the location of CCS in the UK

### Global potential

The potential of CCS is global. According to the executive director of the International Energy Agency, Maria van der Hoeven: "Without CCS, the world will have to abandon its reliance on fossil fuels much sooner – and that will come at a cost." The UK has taken a leadership position in developing CCS technologies for its electricity generation and heavy industrial energy users, while creating a market in which CCS can flourish. We are playing a leading role in that work, supporting often-groundbreaking projects to develop CCS commercially and technically.

## Removing the carbon

### CCS could eliminate the climate changing emissions that are generated within our current best fuels for power production

CCS could all but eliminate the climate-changing emissions that are generated within our current best fuels for power production. Gas and coal-fired power stations can generate electricity to meet reliably all-day, every-day demand – so-called baseload – while having the flexibility to ramp up and down during peak usage. These are qualities that wind and nuclear plant cannot match.

CCS would enable coal and gas-fired generation to offset the intermittency of wind power and other renewables as well as the rigidity of nuclear. Equally important is CCS's promise as a means to remove the emissions from energy intensive industrial processes.

Furthermore a combination of CCS and biomass-fuelled generation and heat could extract carbon dioxide from the environment - a step beyond simple carbon abatement. CCS can also include the production of hydrogen – a carbon-free, storable energy source with enormous potential.

## Success and Potential

### £55m of projects

We have delivered significant CCS advances and have important developments in the pipeline. Our CCS investments in completed and ongoing projects currently total more than £55m. These include -

### The next generation

We have committed more than £20m in a project to realise a proposed 5MW demonstration gas-fired CCS power plant scheduled to be generating in 2016. A small-scale test project completed last year has confirmed the anticipated benefits of the demonstrator. In parallel we have held a competitive tender to ensure the best technologies go into this three-year project to design, build and test the demonstrator plant.

The development of CCS has implications down the line for existing plant used in energy production. By 2030 hydrogen from CCS could be a significant fuel in generation and industrial processes. Hydrogen is the key product in pre-combustion CCS technology that is the focus of the ETI's work in the capture stage of CCS. An ETI project completed last year identified the potential for the use of hydrogen in flexible power production – generation that is needed to compensate for intermittency in other plant and to respond to peak demand. The project deployed the intermediate-term storage of hydrogen in salt caverns for subsequent use in generation.

### Mine of information

Research by the ETI has produced the world's first carbon dioxide storage site database – CO2 Stored. [www.CO2stored.co.uk](http://www.CO2stored.co.uk) This online database holds geological data, storage estimates, risk assessments and economic appraisals of some 600 potential storage sites around the UK including depleted oil and gas reservoirs and saline aquifers. Access to the database is available commercially through The Crown Estate and the British Geological Survey.

### In depth

We helped National Grid to identify the site and fund its now completed project to drill into a saline aquifer (sub-seabed reservoir) 70km off the Yorkshire coast to appraise it as a carbon dioxide store. The undersea store – which emerged as having the capacity to hold some 200m tonnes of carbon dioxide – has been earmarked for use by the White Rose CCS generation project. The project is one of two preferred bidders in the government's competition for £1bn in funding towards the establishment of full-scale, commercially operational CCS. Furthermore National Grid has identified the store as a potential hub for other CCS facilities.

### Knowledge building

There have been a number of reports developed to help build knowledge for the industry. Working with the Ecofin Research Foundation we have explored the challenges that both the public and private sector needs to overcome to help build CCS into a viable low carbon industry that is economically competitive. There have also been further detailed reports produced to help increase the understanding of what both the public and private sector need to overcome to help develop the industry; and an additional report on optimising the location of CCS in the UK.

### System Modelling

Modelling software that simulates the operation of every stage of CCS has been developed with our support to streamline the design of CCS projects as well as their operation and eventual roll out. This software toolkit is developed by PSE, the leading supplier of advanced process modelling software and has been launched to market under the gCCS brand.

## Success and Potential (continued)

### Solid prospects

Carbon dioxide can be combined with various readily available minerals to produce solid carbonates that could be stored or even used productively. We have engaged in a project to investigate the economics of mineralisation of carbon dioxide to make solids that can be stored safely and permanently or used as aggregate and other building materials. This project demonstrated that, whilst technically feasible, the high costs of mineralisation make it economically unattractive.

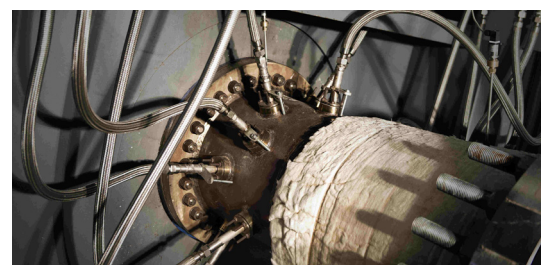
### Huge opportunities, great challenges

Widespread deployment of CCS has the potential to reduce climate-changing emissions, and it could reduce the cost of doing so. There are however challenges to overcome. The exploration risk associated with appraising the first carbon dioxide storage sites will mean it will be costly, and it could take up to nine years. The UK will need to find capacity to store some two billion tonnes of carbon dioxide by 2025 and five billion tonnes-worth in some 20 offshore sites by 2050. At the same time, the greatest opportunities to reduce the costs of CCS are in its transport and storage elements. Our research has showed this is obtainable with the UK's available storage potential.

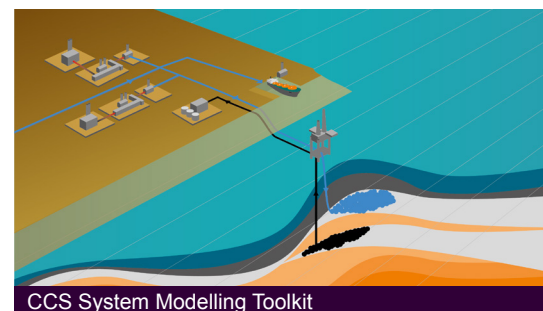
A task force of industry and government – which included the ETI – found that more than half of the anticipated £47/MWh drop in costs of electricity production for a CCS power plant to £114/MWh in 2020 would come from savings in transport and storage costs. These savings would arise from using the best sites and the best infrastructure. The report forecast that CCS could be cost competitive with other forms of low-carbon power generation by the early 2020s. This would be a timely arrival of a flexible, low-carbon source of electricity to replace redundant fossil-fuelled plant and provide the UK with secure, sustainable and economically competitive energy supplies.



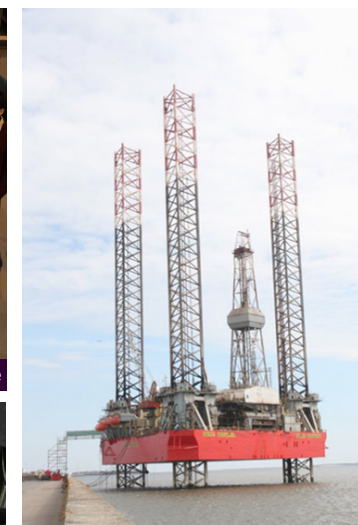
Measurement, Modelling and Verification of CO<sub>2</sub> Storage



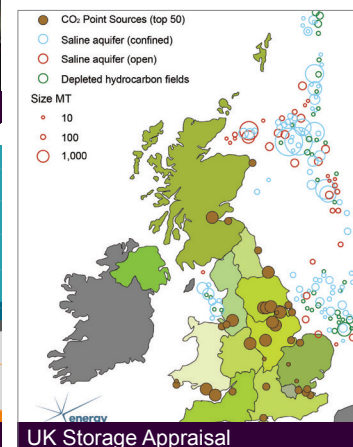
High Hydrogen



CCS System Modelling Toolkit



Saline Aquifer Drilling Project



UK Storage Appraisal



## Contact information:

---

Energy Technologies Institute  
Holywell Building  
Holywell Way  
Loughborough  
LE11 3UZ

[www.eti.co.uk](http://www.eti.co.uk)

©2014 Energy Technologies Institute LLP