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# Carbon capture: Miracle machine or white elephant?

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Billions have been spent on schemes to deal with CO<sub>2</sub> emissions but expectations have not been met



**T**oday it is just a scrubby field next to the enormous Drax coal and wood pellet power station in the English county of North Yorkshire. But in a matter of months, this could be the spot where the UK finally gives the go-ahead for what has become one of the world's most perplexing tools in the quest to combat climate change: a carbon capture and storage plant.

The stubby ground would make way for a jumble of pipes and tanks that would trap carbon dioxide

from a new coal power station and push it out to be stashed deep below the North Sea before it has a chance to warm the atmosphere.

At least, that is the plan. In practice, no one is holding their breath given the troubled history of carbon capture. Few technologies have had so much money thrown at them for so many years by so many governments and companies, with such feeble results.

Even Peter Emery, the Drax board member chairing the consortium behind the North Yorkshire project, balks at predicting that it will definitely go ahead.

“I think there’s a very good chance it will but it is complicated and it’s difficult and that’s why it has not happened,” he says as he sketches a diagram on a whiteboard in a nearby office to show how the plant would operate.

Yet as the focus on global warming intensifies ahead of the UN climate change accord due to be struck in Paris in December, companies are facing pressure to build hundreds and possibly thousands of carbon capturing plants.

On paper, the concept looks simple enough and scientifically, the case is compelling. But the big question is: who is going to pick up the bill?

## Dirty business

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Power generators contribute more to global warming than any other industry. More than 20 per cent of the world’s electricity comes from natural gas plants and 41 per cent from coal power stations that pump out twice as much carbon dioxide.

CO<sub>2</sub> is the most prevalent long-lasting greenhouse gas. So much of it has built up in the atmosphere since fossil fuel burning began in earnest that those of us alive today are the first homo sapiens to breathe in air with carbon dioxide levels of 400 parts per million — up from 275 ppm before the industrial revolution. Scientists say the increase has been enough to raise global average temperatures by nearly 1°C from pre-industrial times, melting glaciers and pushing up sea levels.

Countries agreed at UN climate talks five years ago that temperatures should not rise by more than 2°C, an aim the Paris climate agreement is supposed to deliver. Warming above that level raises the risk of “severe, pervasive and irreversible” damage, according to the latest report from the UN’s Intergovernmental Panel on Climate Change.



The report also suggested that to have a reasonable chance of meeting the 2°C target, CO<sub>2</sub> emissions from burning fossil fuels, especially coal, should fall dramatically by the 2050s and virtually cease by the end of the century. But those emissions have roughly doubled in the past 40 years, as China and other

countries have industrialised, and are expected to keep growing.

Boundary Dam coal fired power plant, Saskatchewan, Canada

With coal so cheap and abundant, and energy so vital to development, another crop of fast-growing countries, including Vietnam and Indonesia, are driving what one recent study called a “global coal renaissance”.

A coal power plant typically operates for at least 30 years, so countries racing to build them are locking in decades’ worth of emissions. Gas plants are cleaner, but still produce a lot of CO<sub>2</sub>.

Against that background, building power plants with carbon capture and storage, commonly called CCS, has become something of a holy grail since the concept first emerged in the 1990s.

Leaders of the world’s largest fossil fuel companies speak regularly of what Ben van Beurden, chief executive of [Royal Dutch Shell](#), calls the “real game-changer” of power plants with CCS.

Many of the models scientists use to show how the world can avoid climate change are based on the assumption that CCS will be widespread from 2050.

In fact, because countries have been slow to curb their emissions, the models are based on an even more radical use of the technology, says Niklas Höhne, a lead author of the latest IPCC report.

“Instead of adding CCS to a normal coal plant, the models assume the technology will have to be used on a power station burning wood or other plants in order to produce so-called negative carbon emissions,” he says.

In other words, we would need to grow crops that suck CO<sub>2</sub> from the air, then burn them to generate electricity and store the resulting gases so there is less CO<sub>2</sub> in the atmosphere overall.

The Drax project could turn out to be the world’s first such plant. The company has already started converting its existing power station, the UK’s biggest, so it can burn wood pellets as well as coal. And the new CCS plant planned for its neighbouring field has been designed to burn coal but could eventually be reconfigured to burn wood as well.

Whether such use could ever become widespread is far from clear.

## Woeful record

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Setting aside the question of whether the world has enough suitable land to grow crops for electricity as well as food, efforts to get CCS up and running on conventional power plants have been woeful. Over the past 14 years, governments have announced a total of \$24bn in funding commitments for carbon capture and storage projects, according to the Bloomberg New Energy Finance research firm. Companies have spent at least \$9.5bn since 2005, says the International Energy Agency.

Not all that money has gone to power stations. Shell, for example, is building a system to capture

CO<sub>2</sub> from an Alberta oil sands project.

But to date there is just one carbon capture system in commercial operation at a power station, the Boundary Dam coal plant that Canada's SaskPower utility opened last year. Two others in the US are supposed to start next year, including one in Mississippi that was scheduled to begin operating in 2013 and has a \$6.2bn price tag.

At least 33 other power plant CCS ventures have been scrapped or mothballed in the past five years, according to the Australian-based Global Carbon Capture and Storage Institute. They include one in Scotland that was due to open last year, a Canadian scheme scheduled to start this year and a string of others across Europe and the US.

"This is to be expected," says Brad Page, the institute's chief executive. He argues that the industry's failure rate is similar to that of other conventional commercial projects. But it is far from clear if CCS systems actually have a business case. Many of the failed projects died because the government funding for them faded amid economic downturns or because of competing budgetary or political pressures.

President George W Bush was still in the White House when he declared that a CCS project in Illinois called FutureGen would become "the first clean-coal power plant" by 2012. But its federal funding was suspended this year, leaving the project's fate in the balance. More than a dozen schemes in the UK have already been scrapped.

Carbon capturing technology is not regarded as the problem. Equipment to capture CO<sub>2</sub> has been used for decades in the chemical and oil industries, where the gas is sometimes a byproduct.

But figuring out how to adapt it for use with a power station is complicated, and building it costly. A sizeable coal plant, without carbon capture, might cost \$1.4bn to build but adding CCS adds about another \$1bn, according to recent US Department of Energy research.

On top of that, some of the electricity the plant generates, the main source of income for the owner, has to be diverted to run the carbon capture system. The upshot: a lot more money for a less efficient power plant.

This is why government funding has been so important to get CCS to this point. But the fickle nature of this backing makes it hard to imagine a flourishing future for the technology. As recently as 2009, the IEA, which advises governments on energy policy, suggested about 100 CCS projects should be operating worldwide by 2020 and 3,400 by 2050, including big industrial plants that emit large quantities of CO<sub>2</sub>, as well as power stations. It has since scaled back its numbers to 30 projects by 2020.

There are currently 22 large-scale CCS plants operating or under construction, according to the Global CCS Institute, but only three are on power stations. The other 19 are capturing carbon dioxide from plants used for natural gas processing, fertiliser production or other industrial activities.

The Boundary Dam plant in Canada has found a way round the funding problem. It received C\$240m in federal government support but has also signed a 10-year contract to sell its captured CO<sub>2</sub> so the gas can be pumped into nearby ageing oilfields to boost waning recovery rates, a process known as enhanced oil recovery.

But using the captured CO<sub>2</sub> to produce more oil, which then produces more CO<sub>2</sub> when burnt, is hardly the ideal way to tackle climate change. Those that cannot use an oilfield, or the North Sea, to bury CO<sub>2</sub> also face the public opposition early European CCS projects faced from people fearful of living near stores of buried carbon dioxide.

## The \$4tn bill

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As much as \$4tn would be needed for CCS projects to meet the world's 2°C climate goal between now and 2050, according to the IEA. But it estimated the costs could be considerably higher without CCS, because it would mean scrapping many existing power stations and building new low-carbon replacements such as wind farms.

So what are the options? A reasonably high price on CO<sub>2</sub> pollution could make CCS more financially attractive. But that is a distant prospect in many countries. Even in the EU's carbon market, the world's largest, prices have wallowed below €10 a tonne of emitted carbon for most of the past three years.

Since carbon capturing systems are a climate measure that keeps fossil fuel companies in business, some supporters of the technology argue the industry should bear the cost of building them.

“There is a global failure of political arithmetic on this problem,” says Stuart Haszeldine, professor of carbon capture and storage at the University of Edinburgh. “A way through this logjam is to require an amount of carbon storage by carbon extractors. Coal gas and oil companies have to be required to store some fraction of what they produce.”

The coal industry, however, says governments should back CCS as generously as it claims renewable sources of power have been treated.

“In the last 10 years, \$2tn has been spent on renewable technologies and only 1 per cent of this [has been] on CCS,” says Benjamin Sporton, chief executive of the World Coal Association. “What we need is a genuine commitment from government to support all low emission technologies equally . . . that is when we'll begin to see real progress on CCS.”

Others question whether subsidies are the answer.

“As long as CCS plants are built on the ‘Apollo Programme’ principle of unlimited public subsidies,

In the last 10 years, \$2tn has been spent on renewable technologies and only 1 per cent of this has been on CCS

- Benjamin Sporton, chief executive of the World Coal Association



they will remain prohibitively expensive,” says Professor Myles Allen of Oxford university.

He thinks CCS should become a cost of doing business with fossil fuels, like the requirement to use double-hulled tankers to ship oil, and points to the CCS facility that [Chevron](#) is building with [ExxonMobil](#) and Shell in the north of Western Australia.

“It has been built with very little subsidy simply because the WA government made it a licensing requirement for the exploitation of a particularly lucrative gas reserve,” says Prof Allen.

Ultimately, says Mr Emery of Drax, fossil fuels are so cheap and plentiful that it makes sense to keep using them if it is possible to deal with the carbon dioxide problem. “We think CCS could be very low cost,” he says. “And the one thing the world needs is low-cost sources of energy.”

### Letter in response to this article:

*Incentives for carbon capture are top priority / From Dan Reicher*

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