Can CCS be an economic lifeline for coal power?

Despite everything, 2020 turned out to be a good year for carbon capture and storage (CCS), with both the UK and Norway committing to spend big on new infrastructure to store CO₂ emissions deep beneath the North Sea. In the US, the climate change mitigation technology received early backing from the President-elect. CCS has previously struggled under half-hearted support, cast by critics as a desperate bid by fossil fuel companies to maintain the status quo. Following an initial wave of political interest in the 2000s, relatively few large projects were realised, and many high-profile initiatives fell through due to rising costs or insufficient backing.

The recent rise of corporate and national net zero carbon targets has been instrumental in putting CCS back in the frame — now a fundamental means of making the numbers add up. Several governments have concluded that carbon capture must finally be cracked, while oil and gas companies — who crucially have the engineering expertise to store the greenhouse gas vision — and sometimes the economics — has shifted in favour of gas or biomass-fuelled plant. The association with coal is seen by some as an embarrassing relic of the technology’s less successful past.

Where does this leave coal power? CCS was once regarded as the salvation of the sector, capable of ushering in a more sustainable future and averting plant closures. The technical feasibility of fitting CO₂ capture to a coal plant has been demonstrated over the last decade by pioneering projects at Boundary Dam 3 in Canada, and Petra Nova in Texas, which both achieved their performance targets after some initial teething problems. Based on this experience and other advances, capture technology manufacturers claim cost reductions of around a third are possible for a next wave of coal plants. But any kind of CCS is still a costly business, which makes little commercial sense unless it can be used to generate some kind of revenue.

In 2018, the US took a major step towards creating just such a business first movers. The US Department of Energy (DOE) has therefore helped fund detailed engineering studies for CCS on nine existing power plants — five coal fired and four gas fired. Located across the country, the projects tend to feature cheap coal and communities with an interest in retaining a vital local industry. Several are also backed by capture technology providers keen to prove their worth on a full-scale plant. Most claim they will achieve a capture cost of around $45 per ton of CO₂ — coming in conveniently below the 45Q level.

Aside from oil recovery projects, a major initial barrier to CCS expansion has been the costly, time-consuming process for characterising and permitting geological storage sites. The DOE’s CarbonSAFE initiative, which is performing this work for several suitable formations around the country, is therefore a huge benefit for coal power plants including Prairie State in Illinois, Project Tundra in North Dakota, and Dry Fork in Wyoming An initiative at San Juan Generating Station in New Mexico, produce over 100 Gt of CO₂ if allowed to see their normal economic life.

Although China has been active in CCS research since the 2000s, even setting up some fairly large-scale facilities, real political support seems to have balked at the idea of burning more coal for less power. However, following President Xi Jinping’s September announcement of a target to reach ‘net zero’ in 2060, many expect this stance to change. With its huge fleet of mostly ‘cookie-cutter’ efficient plants built in the last 15 years, good domestic capture technologies, and favourable geology for CO₂ storage, the stage seems set for mass CCS roll-out.

Prior to the net zero announcement, interest in CCS for the power sector was already growing partly as a result of an average CO₂ emissions intensity target placed on the country’s major power companies. Given China’s highly regulated power market and current excess of coal capacity, awarding CCS-equipped plants with guaranteed operating hours is often proposed as an initial driver. Although

Coal may no longer be leading carbon capture and storage progress but there is a chance the technology could still provide a lifeline for some coal fired power plants, especially in Asia. Toby Lockwood explains.
The recent rise of corporate and national net zero carbon targets has been instrumental in putting CCS back in the frame – now a fundamental means of making the numbers add up. Several governments have concluded that carbon capture must finally be cracked, while oil and gas companies – who crucially have the engineering expertise to store the greenhouse gas - have cemented a business opportunity, which could secure their long-term future. CCS advocates now hope that the technology will feature heavily in post-Covid stimulus packages. But CCS today looks quite different to CCS ten years ago. Where once the technology was practically synonymous with ‘clean coal’, coal power now appears to be the norm. This is perhaps unsurprising, given that in Europe and North America, where interest in CCS is greatest, coal is in sharp decline. The political focus is increasingly on emissions from process industries such as steel and cement, as well as the idea of decarbonising the production of hydrogen from natural gas. While some countries still envisage a role for CCS-equipped power plants in balancing renewable generation, the other advances, capture technology manufacturers claim cost reductions of around a third are possible for a next wave of coal plants. But any kind of CCS is still a costly business, which makes little economic sense unless it can be used to generate some kind of revenue.

In 2018, the US took a major step towards creating just such a business case with the expansion of the existing 45Q tax credit to directly reward CCS – raising it to $55 per ton of captured CO2 used in enhanced oil recovery projects, and up to $50 per ton for storage in saline aquifer formations. A thriving market for CO2 to boost oil well production has long put the US at the forefront of CCS developments, but these revenues are too low to fund capture of the greenhouse gas from relatively dilute, large-scale emitters like power plants. The new credit therefore represents an effective income stream, which could put many more projects in the black.

Even with 45Q, and the slightly perverse ‘advantage’ of producing large amounts of CO2 while CCS-equipped power plants remains a contentious issue. CCS-equipped power plants can be built to capture CO2, but this is still on the brink of profitability, particularly for small and medium-sized plants. The DOE’s ‘CarbonSAFE’ initiative, which is performing this work for several suitable formations around the country, is therefore a huge benefit for the current wave of projects. The initiative will select a site for each project from the existing nearby network of CO2 pipelines and inject it into the oil and gas industry.

With coal power in the US already struggling to compete with cheap gas, CCS seems unlikely to solve the problem. It may well extend the lifetime of some well-located generators with healthy demand and benefit from the existing network of CO2 pipelines, but unless the price of CO2 is reduced, the industry will continue to struggle.

Coal power plants are still in operation, but there is a chance it can be called upon to mitigate climate change. The capital cost of CCS remains high, but as technology continues to mature, the cost of carbon capture and storage decreases. The rise of CCS in the US highlights the potential of this technology to decarbonise the energy sector. While CCS-equipped power plants are still in operation, their future looks uncertain. The technology must be further developed to make it a viable solution for the energy transition.

Levelised cost of CO2 capture for large scale post-combustion facilities at coal-fired power plants, including previously studied facilities.

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