Driving down the cost of carbon capture

Post-combustion carbon dioxide capture technologies can already be used under certain conditions and pre-combustion separation uses technologies that are well established in other industrial sectors, such as fertiliser generation and hydrogen production. However, alternative technologies are being explored to further drive down costs and improve overall energy efficiency. New research has demonstrated how some new methods could reduce the cost of carbon capture by 20-30 per cent whilst also producing hydrogen, which could be used to fuel cars.

Globally, power generation is the largest single source of CO₂ and accounts for 24 per cent of total greenhouse gas emissions. However, fitting existing power plants with carbon capture technologies inevitably reduces energy efficiency and it is estimated that existing technologies would cost perhaps 20 -60 Euros for every tonne of CO₂ removed.

New research shows that ‘demonstration’ technologies could reduce the cost of carbon capture by 20-30 per cent¹. For natural gas fuelled power plants, research is underway in the CACHET² project to develop technologies that reduce the cost of CO₂ capture at the same time as producing hydrogen. The authors suggest that the hydrogen, a carbon-free fuel, could then be used as a clean way to power vehicles.

An expensive part of carbon capture is separating the gases. Where air is used as the oxidation source, nitrogen and residual oxygen are mixed with the CO₂, increasing the cost of separation processes and reducing energy efficiency. An alternative approach is to keep the air and the fuel apart using ‘unmixed’ oxidation processes, in which metal oxides react with the fuel instead of air. The research shows that nickel particles can be used to carry oxygen to the fuel and catalyse this reaction, thus avoiding contact with the air and providing a much cheaper and more energy efficient means of separating the gases.

This form of separating gases can be used in two methods explored by the research: chemical looping combustion (CLC) which allows CO₂ separation with essentially no additional energy cost, and chemical looping reforming (CLR) which allows CO₂ separation and hydrogen production at the same time.

According to the Stern report, the cost of adapting to climate change will be greater than the cost of mitigating climate change. Estimates vary, but CCS could be used to achieve 15-55 per cent of the cumulative CO₂ mitigation efforts by 2100. While post-combustion approaches may allow retrofitting carbon capture technologies to existing power stations to meet early mitigation targets, experimental technologies such as CLC and CLR may prove to be effective approaches for future generations of power stations built with capture from the outset, especially when using clean fuels such as natural gas.

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