CO₂ Capture in Power Generation

Technology that has been used in the oil industry for many years could be used to capture CO₂ from power plant. This information sheet describes the technology, its current use and the potential for improvement.

Why capture CO₂ from power plant?

Modern power plant operate at high efficiency generating electricity reliably and at low cost. Use of CO₂ capture technology with such a plant would reduce CO₂ emissions by more than 80% whilst still providing reliable and relatively low cost power.

How would CO₂ be captured?

Solvent absorption technology has been used for many years in the oil industry to remove CO₂ from mixtures of gases. There are several installations where CO₂ is captured from the flue gases of power plants; these are used to supply CO₂ to the food industry and other industrial users. This process is based on a reversible chemical reaction between CO₂ and a solvent, typically an amine compound.

Thus the technology to ‘decarbonise’ electricity generation is already available. It could be done using either pre- or post-combustion techniques.

What is post-combustion capture?

This method could be used on the flue gas stream of any fossil fuel-fired power station and would capture most of the CO₂ in the flue gas. However, due to the large amount of flue gases to be processed, the equipment would be very large. Such plants would have a large demand for steam, reducing the overall generation efficiency.

Developments in post-combustion capture of CO₂ are focussed on cost reduction by improved energy efficiency, better liquid-gas contacting and improved solvents. Two recent developments are the use of sterically-hindered amine solvents, and a combination of membrane technology and solvent absorption.

CO₂ capture at AES’ Warrior Run power station (Cumberland, USA). The captured CO₂ is supplied to the food industry.
What is pre-combustion decarbonisation?

A major part of the chemical industry is based on producing “synthesis gas”, which is a mixture of hydrogen and carbon monoxide. This technology could be adapted for power generation, improving the conditions for capture by separating the CO₂ before combustion.

The carbon monoxide (CO) in the synthesis gas can be converted to CO₂ very easily, which is then captured using a solvent. A hydrogen-rich fuel is produced which can be burnt in a gas turbine with minimal CO₂ emissions.

Other ways of capturing CO₂

There are a number of other processes for capturing CO₂. Membranes are being developed which may be used on their own or in combination with solvents. Oxyfuel combustion, in which the fossil fuel is burnt in oxygen, may be favoured in some applications. This produces water and CO₂ which can be readily separated. Cryogenic cooling of the gas is another way of separating CO₂ if its concentration is high.

What would CO₂ capture cost?

The penalties for capturing CO₂ would be similar for pre-combustion decarbonisation and post-combustion CO₂ capture. The cost of electricity is increased by at least 1.5 US cents/kWh and the process efficiency is reduced by about 10 to 15 percentage points. The cost of avoiding CO₂ emissions is $30-50/tonne for capturing CO₂. To this, must be added the cost of transmission and storing of CO₂ (which is relatively small).