

CO₂-knowledge

Capturing CO₂

We use the expression "CO₂ capture" because CO₂ is removed from the fuels or flue gases, and then stored. Several CO₂ capture technologies exist, and additional methods are being developed. All CO₂ capture methods require large investments and so far, the technology has only been tested on a small scale.

THREE IMPORTANT METHODS

CO₂ can be removed in three fundamentally different ways:

- CO₂ is captured after combustion in the power plant (post-combustion)
- CO₂ is captured before combustion in the power plant (pre-combustion)
- Natural gas combustion in a gas turbine with pure oxygen (oxy-fuel)

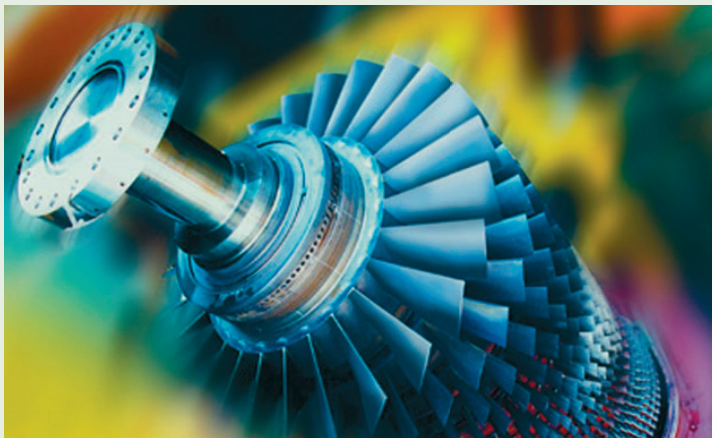


PHOTO: SIMENS

POST-COMBUSTION

This method is easiest to implement because the capture plant can be constructed independently of the power plant. Several gas power plants with post-combustion CO₂ capture are being planned in Norway. The flue gas emitted by a gas power plant only contains 3.5-4 % CO₂. In other words, large volumes of gas need to be treated. The most commonly used capture method is amine scrubbing. When flue gas is passed through a tower filled with amines, CO₂ is 'scrubbed', i.e., reacts with the amines. The remaining flue gas, consisting mainly of air, water vapour and a residual amount of CO₂ (0.6 % of the initial contents are not captured) is discharged into the atmosphere. In a subsequent step, the amine solvent



GASSNOVA

www.gassnova.no | info@gassnova.no

containing the captured CO₂ is heated. This process releases the CO₂ again, which then can be compressed and transported to a storage site. The amines can be re-used. The capture plant requires a lot of space: the absorption tower required for a 420 MW gas power plant would cover an area of about 240 m², and reach a height of more than 50 m. The power plant would annually generate about one million tonnes of CO₂.



PRE-COMBUSTION

In a pre-combustion plant, natural gas or coal is reformed to so-called synthesis gas (syngas), which can consist of carbon monoxide (CO) and hydrogen. CO is then transformed to CO₂ using steam and heat. The CO₂ is then captured, while the hydrogen is fired in the gas turbine. The advantage is that CO₂ capture can be performed under pressure, which requires a smaller and less costly carbon-capture plant than post-combustion. However, the actual power plant based on fuel reformation is more expensive than a conventional gas-fired power plant. The total cost of a gas-fired power plant using pre-combustion carbon capture is thus higher than of a power plant using post-combustion carbon capture. Another disadvantage of pre-combustion is the challenge posed by nitrogen oxide emissions resulting from high-temperature combustion of hydrogen. This model is relevant for operators wishing to produce both power and hydrogen fuel, e.g., for transportation.

OXY-FUEL

In an oxy-fuel plant, oxygen is separated from the air and mixed with the natural gas in gas turbines. This gives a nearly clean combustion, with the flue gas consisting of CO₂ and water. Thus the CO₂ gas can be captured by condensation, a simpler process than conventional post-combustion capture. However, the initial separation of oxygen requires a large energy input.

TECHNOLOGY DEVELOPMENT NEEDED

Both pre-combustion and oxy-fuel technologies require that substantial changes are made to the actual gas or coal power plants. Thus, these technologies will not be commercially available for several years. All capture methods require energy input, which means that the net power yield decreases when CO₂ capture is employed, and more fuel is needed. Fuel consumption per kWh of power generated typically increases by 18-20 %. Norway, the EU and the USA are studying and developing alternative CO₂-capture methods, with the aim of developing technologies that are both more effective and less expensive than today's solutions.

- Published by: Gassnova SF, September 2008
- Written by: Claude Olsen, Teknomedia/Liv Lønne Dille, Gassnova SF
English text by: Karl Kerner, Agro Lingua
- Layout: RLF
- Print: Erik Tanche Nilssen AS, Skien