CARBON DIOXIDE CAPTURE AND STORAGE (CCS) is a technique by which CO2 could be stored underground in order to limit greenhouse gas emissions. How does it work? Could it really help addressing climate change?
Carbon dioxide (CO₂) is a greenhouse gas that occurs naturally in the atmosphere. Human activities, such as the burning of fossil fuels and other processes, are significantly increasing its concentration in the atmosphere, thus contributing to Earth’s global warming.

One technique that could limit CO₂ emissions from human activities into the atmosphere is carbon dioxide capture and storage (CCS). It involves collecting, at its source, the CO₂ that is produced by power plants or industrial facilities and storing it away for a long time in underground geological layers, in the oceans, or in other materials. It should not be confused with carbon sequestration, which is the process of removing carbon from the atmosphere through natural processes such as the growth of forests.

It is expected that fossil fuels will remain a major energy source until at least the middle of this century. Therefore, techniques to capture and store the CO₂ produced, combined with other efforts, could help stabilize greenhouse gas concentrations in the atmosphere and fight climate change.

Carbon dioxide could be captured from power plants or industrial facilities that produce large amounts of carbon dioxide. Technology for CO₂ capture from small or mobile emission sources, such as home heating systems or cars, is not sufficiently developed yet.

A significant proportion of the CO₂ produced by fossil fuel power plants could potentially be captured. By 2050 the amount captured could represent 21 to 45% of all the CO₂ emitted by human activities.

Coal power plants are a good example of a large point source of CO₂ emissions.
How can CO₂ be captured?

To capture carbon dioxide (CO₂) it is first separated from the other gases resulting from combustion or industrial processes. Three systems are available for power plants: post-combustion, pre-combustion, and oxyfuel combustion systems. The captured CO₂ must then be purified and compressed for transport and storage.

It is possible to reduce the CO₂ emissions from new power plants by about 80 to 90%, but this increases the cost of electricity produced by 35 to 85%. For industrial processes where a relatively pure CO₂ stream is produced, the cost per tonne of CO₂ captured is lower.

How can CO₂ be transported once it is captured?

Except when the emission source is located directly over the storage site, the CO₂ needs to be transported. Pipelines have been used for this purpose in the USA since the 1970s. CO₂ could also be transported in liquid form in ships similar to those transporting liquefied petroleum gas (LPG).

For both pipeline and marine transportation of CO₂, costs depend on the distance and the quantity transported. For pipelines, costs are higher when crossing water bodies, heavily congested areas, or mountains.

How can CO₂ be stored underground?

Compressed CO₂ can be injected into porous rock formations below the Earth's surface using many of the same methods already used by the oil and gas industry.

The three main types of geological storage are oil and gas reservoirs, deep saline formations, and un-minable coal beds. CO₂ can for instance be physically trapped under a well-sealed rock layer or in the pore spaces within the rock. It can also be chemically trapped by dissolving in water and reacting with the surrounding rocks. The risk of leakage from these reservoirs is rather small.

Storage in geological formations is the cheapest and most environmentally acceptable storage option for CO₂.

This text is a faithful summary, by GreenFacts, of the IPCC Special Report on Carbon Dioxide Capture and Storage. A longer, more detailed summary can be found on www.greenfacts.org/en/co2-capture-storage/.
Methods are still needed to estimate and report the amounts of greenhouse gas emissions reduced, avoided, or removed from the atmosphere. While one tonne of CO₂ permanently stored brings the same benefit as one tonne of CO₂ not emitted, one tonne of CO₂ temporarily stored brings far less benefit.

The methods currently available for national greenhouse gas emissions inventories can be adapted to accommodate CO₂ capture and storage systems. Some issues remain to be addressed through national and international political processes.

Hydrogen could be used in fuel cells, including in the transport sector. This would centralize CO₂ emissions and facilitate capture.
CO₂ capture and storage is technologically feasible and could play a significant role in reducing greenhouse gas emissions over the course of this century. But many issues still need to be resolved before it can be deployed on a large scale.

Full-scale projects in the electricity sector are needed to build knowledge and experience. More studies are required to analyse and reduce the costs and to evaluate the suitability of potential geological storage sites. Also, pilot scale experiments on mineral carbonation are needed.

An adequate legal and regulatory environment also needs to be created, and barriers to deployment in developing countries need to be addressed.

If knowledge gaps are filled and various conditions are met, CO₂ capture and storage systems could be deployed on a large scale within a few decades, as long as policies substantially limiting greenhouse gas emissions are put into place.

The scientific consensus views carbon capture and storage as one of the important options for reducing CO₂ emissions. If it were deployed, the cost of stabilizing the concentration of greenhouse gases in the atmosphere would be reduced by 30% or more.
This publication presents a faithful summary of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Carbon Dioxide Capture and Storage (2005), a leading scientific consensus reports on the topic. This summary was written by GreenFacts and peer-reviewed by three independent experts.

The IPCC was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). It has produced over the years a number of reports on various aspects of climate change that are widely used references. Its publications can be found on the IPCC website: www.ipcc.ch

A more detailed summary can be found on www.greenfacts.org/en/co2-capture-storage/ in English & French.