GLOBAL CCS INSTITUTE

#3

BIO-ENERGY WITH CCS

Bio-energy with carbon capture and storage (BECCS) is the combination of biomass processing or combustion with CCS. It involves capturing the carbon dioxide (CO_2) from biomass point emission sources and then transporting and injecting it into deep underground rock formations for storage. The technologies for transport and storage of CO_2 in BECCS are identical to those applied to more traditional CCS applications.
The additional advantage of BECCS is that it can lead not only to reduced, but to negative emissions.

What is 'negative CO_2 emissions'?

Through bio-sequestration, atmospheric CO_2 is captured and stored in biomass as plants grow, this being a normal part of the natural carbon cycle. When these plants are used in industry for combustion or are processed the CO_2 is normally released back to atmosphere. They are often accounted for as being 'carbon-neutral'. With BECCS, the CO_2 is recaptured and permanently stored deep underground in geological formations.

By permanently storing the CO_2 from the biomass, BECCS can often deliver a net removal of CO_2 from the atmosphere, or negative CO_2 emissions (Figure 1). Therefore, it is able to mitigate emissions that have already occurred.

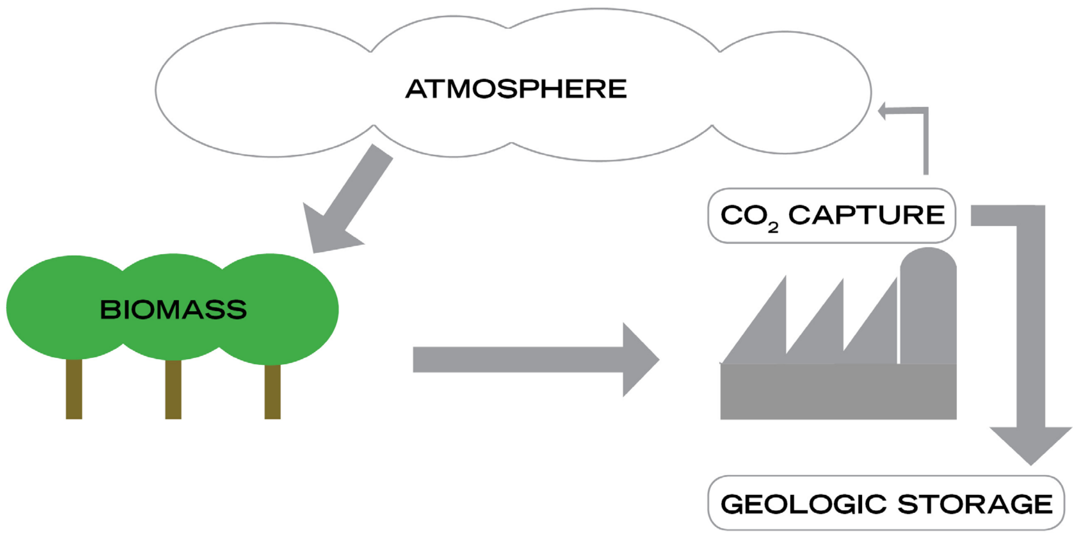
How does BECCS tie into carbon capture and storage?

In most contexts, CCS technology is associated with fossil fuel power plants, but it can also be used to reduce emissions from, for example, steel mills and cement manufacturing plants. CCS applied to fossil fuel combustion sources cannot generate negative emissions, but it reduces the amount of CO_2 emissions. One option available is to co-fire fossil fuels and biomass. Overall, such a combination could either lead to lower, zero or negative emissions, depending on the share of biomass and the efficiency of the CCS system.

Where and at what scale can BECCS be applied?

BECCS could be applied to biomass fuelled industrial plants where CO_2 is prevalent in the flue gas stream, such as pulp and paper plants, ethanol production and biogas upgrading processes, among others.

The scale of CO_2 point sources from biomass varies considerably and there can be multiple point sources on the one plant. The scale can be in the range from a few hundred tonnes of CO_2 per year from a bio-gas upgrading facility to millions of tonnes per year from pulp plants.



In a recent IEAGHG report the potential climate impact of BECCS systems is reported as large, and if deployed could result in negative emissions of up to 10 Gt of CO_2 per year. However, many of the issues associated with CCS are also relevant for BECCS, including reducing capture costs and proving up suitable storage sites for the CO_2.

Is bio-energy with CCS happening today?

More than a dozen projects worldwide have aimed to install a BECCS process so far, with more than half being in advanced stages of development.

As of earlier this year, a large-scale capture and storage facility is under construction at a bio-ethanol plant in Illinois, United States. Approximately one million tonnes per year of CO_2 will be captured once this project is operational in 2013.

The CO_2 will be transported by pipeline for storage in the Mount Simon Sandstone, an onshore deep saline formation at a depth around 2,100 metres. The pilot project associated with this larger project – the Midwest Geological Sequestration Consortium's Illinois Basin-Decatur Test Injection – is expected to commence injection in the second half of 2011.

What challenges does BECCS face?

Biomass needs to be sustainably and reliably sourced: if biomass is sourced unsustainably the negative effects may outweigh the positive. Unsustainably produced biomass can contribute negatively in a number of different ways, including carbon emissions from high CO_2 emitting cultivation methods, water depletion and biodiversity loss. This applies equally to biomass energy without CCS.

For more information on BECCS:

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References

Biorecro, 2010. Global status of BECCS projects 2010, report commissioned by the Global CCS Institute. [online] Available at: www.globalccsinstitute.com/resources/publications/global-status-beccs-projects-2010.

IEAGHG (IEA Greenhouse Gas R&D Programme), 2011. Potential for Biomass and Carbon Dioxide Capture and Storage, 2011/6, July 2011.

Biosequestration

How can the normal rate of biosequestration be increased?

Soil carbon: Processes are developed to increase the amount of carbon that is trapped in the soil (carbon sink), often through agriculture. In some cases this can be enhanced through the addition of biochar – biomass is converted to biochar by combustion under anaerobic conditions to become a charcoal – that is in itself a form of sequestration.

Algal: Can be used to absorb CO_2 from industrial processes, such as power generation.

Issues with soil carbon accounting

The Intergovernmental Panel on Climate Change (IPCC) Special Report on Carbon Dioxide Capture and Storage recognises the benefits of enhancing the storage capacity in natural carbon sinks for CO_2 (including soils) but observes their storage capacity may be limited by land use practice, social and/or environmental factors and time.

References

IPCC, 2005. IPCC special report on carbon dioxide capture and storage, prepared by Working Group III of the Intergovernmental Panel on Climate Change [Metz, B, Davidson, O, de Coninck, H. C, Loos, M, and Meyer, L. A. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, United States.

Garnaut, R. 2008. Garnaut climate change review: Final report. Cambridge University Press, Port Melbourne, Australia. [online] Available at: http://www.garnautreview.org.au