Will be CCS/BECCS lost in energy transition?

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Abstract

In the energy transition, carbon capture and storage (CCS) techniques have an ambiguous status: they are seen as an instrument for minimizing the overall cost of the energy transition by decarbonizing sectors that cannot do without fossil fuels in the short/medium term. As a result, they enjoy the support of producers in these sectors, and are seen by their detractors as techniques that contribute to the "carbon lock-in" of our economies. We might add that their large-scale deployment would generate additional demand for energy, and hence greater reliance on fossil fuels. On the other hand, CCS associated with the energetic use of biomass, BECCS, has the ability to achieve negative emissions, enabling it to be considered a Carbon Dioxid Removal (CDR) technique. This means that these technologies should continue to be used *after* the energy transition. BECCS, which initially appeared as a *complement* to CCS, should eventually become its *substitute*, as the decarbonization of fossil fuel-using industries progresses.
To be more precise, the development of BECCS as a source of negative emissions is increasingly being promoted both in academic work and by international institutions (IPCC, IEA) as an indispensable means of achieving the objective of limiting global warming to 1.5$\circ$. This situation is all the more paradoxical given that the deployment of both CCS and BECCS remains very slow, despite the fact that this recourse seems increasingly necessary in view of the difficulty our economies have in decarbonizing. In other words, the more difficult it becomes to reach our decarbonization targets, the more legitimate the call for these technologies becomes... on a horizon harder and harder to reach.

In other words, using BECCS as a CDR means recognizing the difficulty we have in reducing our CO2 emissions *today*, and promoting a technology that will enable us to extract it from the atmosphere *tomorrow*. In this way, the development of BECCS could help to legitimize the development of CCS, which initially originated in the oil and gas industries.

The first objective of this article is to examine this paradoxical configuration, which sees CCS both as an instrument for perpetuating the "carbon lock in", and as an integral part of a new carbon-neutral energy mix. It will then provide an initial assessment of the state of progress of all CCS/BECCS techniques.

As far as BECCS is concerned, the figures provided by both the IEA through the Global CCS Institute (GCCSI 2022) and the IPCC (IPCC, 2005) point to negative emissions volumes (or CDR) of the order of 333 to over 1,200 Gt of CO2 in 2100, of which 226 to 900 Gt for BECCS, the remainder being provided by direct air capture technologies (DACS) whose status is still uncertain and whose costs are high. Modeling carried out by Imperial College

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using the MONET (Modelling and Optimization of Negative Emissions Technologies) model produces the same orders of magnitude (Chiquier et al, 2023), without taking into account DACS techniques, but with that of Afforestation/reforestation. Finally, the work of Rickels et al (2022), provides an assessment of the various available sources of negative emissions, including sources of still very uncertain status (Direct Air Capture, DACS). They show that BECCS has a potential close to that of reforestation or land management change, with a much stronger permanence of storage.

In the second part of the paper, we'll look at the chances of success of this paradoxical configuration, and in particular at the limits that could be imposed on a large-scale deployment of BECCS.

First of all, while BECCS uses techniques close to those of CCS, and will therefore benefit from advances in these techniques, its energy production units are much smaller, and the sources of CO2 from biomass are much more diffuse than those used by fossil fuel CCS. So adapting CCS infrastructures to BECCS will be costly, and will undoubtedly require large-scale developments.

Another limitation relates to the financing of negative emissions: even if a legal framework already exists, the question of how to price these emissions remains open, especially if BECCS deployment becomes widespread - which we hope it will.

A final limitation to the large-scale deployment of BECCS is the land-use change it could lead to. BECCS will not be able to use agricultural waste alone. As a result, deployment could increase pressure to produce biomass for energy purposes, to the detriment of food production. This problem of land-use change is not specific to BCCS, and immediately concerns the use of biomass for energy purposes, particularly agrofuels, but it should not be overlooked. Modeling carried out at global level does take these various constraints into account and leads to the definition of optimal solutions, enabling us to limit these changes in land use, but it is to be feared that the operation of real economies will lead to results that are far removed from them.

Finally, the question raised by the BECCS, and all the work on negative emissions, raises the question of the viability of a strategy that consists in pinning our hopes of limiting climate change on the future deployment of a technology that is struggling to establish itself today.

Keywords: Carbon Dioxid Removal, Carbon Capture storage on Bioenergy, Climate Change Mitigation