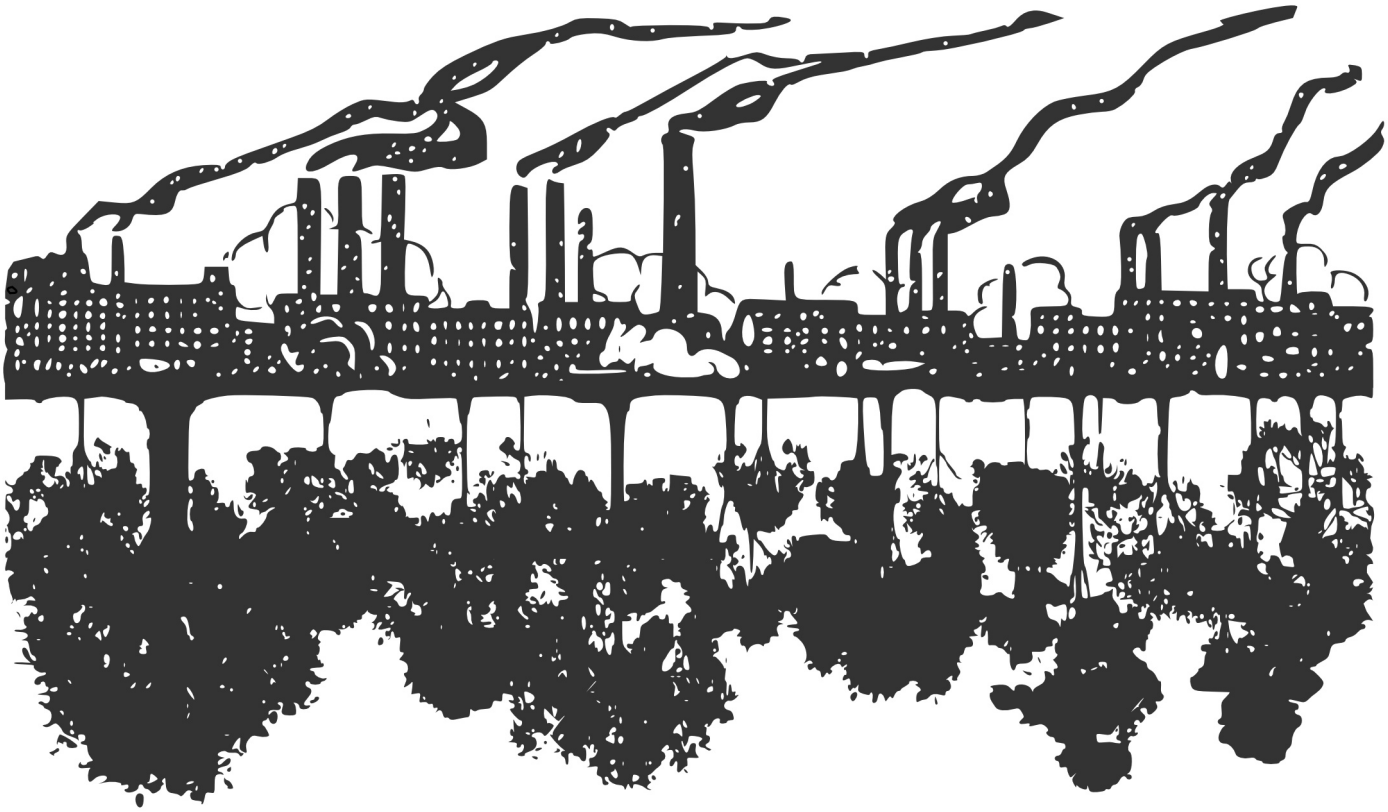
Last-ditch climate option, or wishful thinking?

Bioenergy with Carbon Capture and Storage

A report by Biofuelwatch

Executive Summary



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BECCS is the combination of bioenergy with Carbon Capture and Storage. It would involve capturing CO_2 from biofuel refineries or biomass-burning power stations and pumping it into geological formations. The concept is based on the assumption that large-scale bioenergy can be carbon neutral, or at least low carbon, and that sequestering some or all of the CO2 emitted from burning or refining it will render it carbon-negative. The International Energy Agency defines BECCS as "a carbon reduction technology offering permanent net removal of CO_2 from the atmosphere.

Various studies suggest that BECCS could in future remove as much as 10 billion tonnes of CO_2 every year. This idea has risen to prominence since the International Panel on Climate Change (IPCC), published their most recent Assessment Report in 2014. Most of the models considered by the IPCC suggest that keeping global temperature rises within 2°C, will require BECCS, as well as rapid reductions in greenhouse gas emissions.

The urgency of the climate crisis does indeed require societies to drastically curb greenhouse gas emissions, as well as exploring credible means of removing some of the CO_2 already in the atmosphere. The question is, whether BECCS could ever be a credible means of drawing CO_2 from the air? For this to be possible, three conditions would need to be met: Firstly, one would need to show that the total greenhouse gas emissions associated with growing, removing, transporting and processing biomass for energy could be kept to an absolute minimum and that low carbon bioenergy can be massively scaled up. Secondly, BECCS technologies would need to be technically and economically viable, not just as small pilot projects, but on a very large commercial scale. And finally, long-term safe storage of CO_2 would need to be proven.

Biofuelwatch's report analyses the scientific literature and other evidence relating to relevant investments and policies in relation to each of these aspects.

Does the concept of large-scale carbon-negative bioenergy make sense?

Virtually all peer-reviewed studies about BECCS rely on the assumption that, subject to sustainability standards being in place, large-scale bioenergy will be at least close to carbon neutral. None of them discuss the large and growing volume of studies about the direct and indirect greenhouse gas emissions associated with bioenergy.

Evidence shows that existing policies which promote increased use of biofuels and wood-based bioenergy have had serious negative impacts, including on the climate. This is true

for EU biofuels, too, despite the fact that sustainability and greenhouse gas standards are written into legislation: Direct and indirect emissions from land use change for biofuels are so high, that biofuels are commonly worse for the climate than the oil they replace. Wood-based bioenergy has led to increased forest degradation and destruction, and higher carbon emissions from land-use change associated with the expansion of industrial tree plantations. Large-scale removal of 'residues' from forests and agriculture depletes soil carbon and nutrients and harms future plant growth.

For carbon negative bioenergy to be possible, it would not be enough to keep bioenergy-related emissions down: Land-based ecosystems remove 23% of all the CO_2 emitted through fossil fuel burning and cement production. Damaging natural carbon sinks for the sake of trying to create a new, unproven artificial one through BECCS would be highly dangerous. Experience with bioenergy so far clearly demonstrates that the basic concept of carbon negative BECCS is a myth.

Are BECCS technologies viable and scalable?

Biofuelwatch's report looks at each of the proposed BECCS technologies in detail. Only one of them has ever been demonstrated: This involves capturing the highly pure stream of CO_2 from ethanol fermentation. It is highly unlikely to become commercially viable unless the CO_2 is sold for Enhanced Oil Recovery (EOR), i.e. to exploit otherwise unrecoverable oil reserves. One highly subsidised project involves pumping CO_2 from an ethanol plant into a sandstone formation, rather than using it for EOR. However, the CO_2 emissions from the fossil fuels which power the refinery, are higher than the amount of CO_2 captured and not even the owners of the ethanol plant call it 'carbon negative'.

"Advanced biofuel" production presents a significant opportunity for BECCS, according to the IEA, because it yields pure CO_2, which is much cheaper and easier to capture than the diluted CO_2 in power station flue gases. Yet the "advanced biofuels" technologies considered by the IEA are not, and might never become viable: nobody has found any way of producing net energy with them.

Capturing CO_2 from power stations that burn biomass has never been attempted. This report therefore examines the experience with capturing carbon from coal power plants. Only one commercial scale power plant project exists and it uses post-combustion capture.

An economic analysis shows that if the scheme was operating as intended, with CO_2 being sold to an oil company for EOR, it could still not break even financially over its lifetime. A Freedom of Information request revealed that the plant has been beset with serious problems: so little CO_2 has been captured that the operators have had to pay fines to the oil company for breach of their CO_2 supply contract. Two other

technologies exist: oxyfuel-combustion and Integrated Gas Combined Cycle (IGCC) plants with carbon capture.

Oxyfuel combustion with carbon capture has been tested in pilot scheme and found to be highly costly and inefficient with current technical knowledge. IGCC plants are extremely expensive, complex, and failure prone. One IGCC plant with carbon capture is under construction but costs have spiralled from $1.8 billion to $6.4 billion, amidst long delays.

Studies about Carbon Capture and Storage (CCS) tend to assume that prices will come down over time. This is based on the belief in a natural 'learning curve' for all new technologies which inevitably reduces prices, provided enough initial funding is allowed. In reality, such 'learning curves' exist for some technologies but not for others and there is no evidence to suggest that CCS will ever become commercially viable.

The report concludes with an examination of the reliability of carbon storage. All existing commercial CCS projects, (apart from the one malfunctioning power station project), involve capturing pure CO_2 streams from industrial processes and using them for EOR. During EOR, around 30% of the CO_2 is directly emitted again. Once carbon emissions from the additional oil that is exploited are counted, EOR projects generally result in net carbon emissions – even if 70% of the captured CO_2 was to remain securely locked up.

There is a strong industry bias in many studies looking at how securely CO_2 can be stored underground, with much of the monitoring being conducted or financed by oil companies. There is now an increasing body of evidence that underground storage is far less reliable than CCS proponents hope.

The argument that we need BECCS seems no more convincing than an argument that we need carbon-sucking extra-terrestrials. The availability of large-scale carbon-negative BECCS appears no more credible than the existence of such extra-terrestrials. The only proven ways of removing carbon from the atmosphere involve working with nature, i.e. agro-ecology and the regeneration of natural ecosystems.