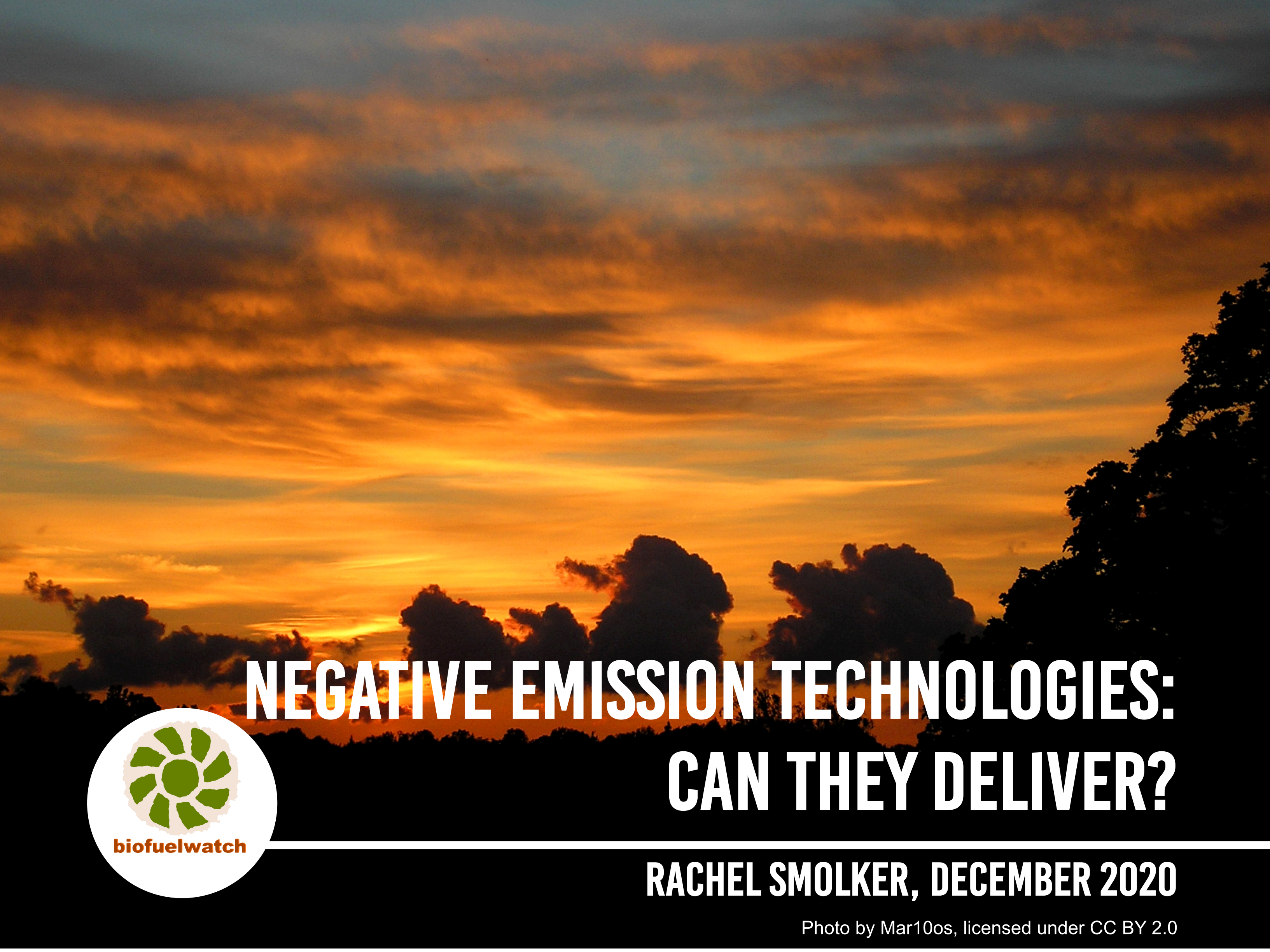

NEGATIVE EMISSION TECHNOLOGIES: CAN THEY DELIVER?

biofuelwatch

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WHAT IS A "NEGATIVE EMISSION TECHNOLOGY"?

A negative emission technology (NET) is a technological approach to removing greenhouse gases that have already been emitted into the atmosphere. That differs from "mitigation" which focuses on preventing emissions in the first place. Aside from concerns about how future availability of NET might undermine current and near term mitigation efforts, there are further serious concerns: the technologies that are currently proposed are unproven at commercial scale and may never prove scaleable. They are extremely expensive and could worsen rather than improve our climate woes.

NETs are, by definition "technologies". The most prominent technologies that have been proposed include bioenergy with carbon capture and sequestration (BECCS) and direct air capture (DAC). Less prominent are enhanced mineral weathering, and ocean iron fertilization, both of which have received less enthusiastic embrace. These technological approaches to carbon removal are positioned alongside land-based approaches such as tree planting, forest restoration, carbon sequestration in agriculture and soils (including biochar) and the various approaches recently referred to as "nature based solutions". Land based approaches, while they would be an important contribution if done correctly, face natural limitations.

A technological approach to carbon removal appeals because it could, in theory, be unlimited, enabling continued consumption of carbon intensive fuels and "overshoot" of targets, assuming that they can later be "cleaned up".

WHAT IS BECCS?

BECCS would entail massively upscaling the use of bioenergy, capturing the carbon emitted and burying it below ground (CCS). A fundamental concern lies with the scale of land use change that would be required. A key early impetus for BECCS was a proposal to focus not on reducing emissions from the energy sector, but on "countering" those emissions through the massive implementation of BECCS, which would require the conversion of around 500 million hectares of land, primarily in the global south, for dedicated biomass crop production. Since then, BECCS has gained traction, featuring in the EU Flagship Programme for Carbon Capture and Storage, and even within many of the models used for the analyses presented in the IPCC's 2014 Fifth Assessment report (though de-emphasized in following reports). Over time the real impacts of large scale bioenergy on land use, and on climate, food prices, human rights and biodiversity, have become evident, however that learning has been sidestepped in the new dialogues on BECCS.

The amount of land conversion that would be required to implement BECCS on a scale sufficient to address global atmospheric CO_2 concentrations would be *unimaginably vast.*

In part due to the requirement for land, large scale implementation of BECCS would not be a solution, but rather would worsen climate change. The underlying logic of BECCS is flawed and erroneous, resting foremost on a blanket assumption that bioenergy is carbon "neutral". That claim has been applied to wood bioenergy, where it has been soundly refuted. But other bioenergy processes (for example corn ethanol or soya or palm oil biodiesel) have never been considered "neutral". While it is widely acknowledged that forest restoration and tree planting can contribute to carbon sequestration and other benefits, large scale bioenergy demand works counter to that goal given the prominent role of wood bioenergy (and deforestation from expanding agricultural frontiers).

Once it is recognised that converting land to grow crops or trees for energy, logging forests, or removing large quantities of agricultural and logging residues from soils are far from benign for the climate, it becomes clear that BECCS cannot be "carbon negative". In this context, it is important to remember that in order for BECCS to play a role in climate policies, it needs to be applied on a large scale, which means it needs to have substantial impacts on forests, land use and/or residues removal.

UNPROVEN

The technology for BECCS is virtually unproven.[1]

A project in Japan has been established at the Mikawa power plant which converted from burning coal to palm oil kernel shells. Claiming to be the "world's first", the project was recently commissioned to capture about 500 tons of CO_2 per day, half of the overall facility's CO_2 emissions. Captured CO_2 is to be injected in offshore storage sites. Developers enthusiastically refer to it as carbon negative, in spite of the fact that it relies on the steady supply of palm oil kernels, with palm oil being a major driver of forest degradation and human rights violations. Creating demand for palm oil kernels will likely contribute to the overall profitability of palm oil, further driving expansion of the industry with all the attendant harms.

A second "world's first" BECCS pilot project, announced with great fanfare in 2018 is a small project attached to the Drax Power Station in the UK. Drax burns coal as well as biomass. In fact more wood is burned every year at Drax than the UK produces, much of it imported from

1. In some cases (such as Shell's "sky scenario"), capture of fermentation CO_2 from corn ethanol refineries, a relatively straightforward process, has been referred to as "BECCS", though few would claim that ethanol refineries are "carbon neutral". Most are powered by coal or gas, and emissions from growing corn, including use of nitrogen fertilizers, are recognized to be substantial.

the Southeastern USA, resulting in forest degradation and destruction of ecosystems. Drax is also linked to forest destruction in Estonia and Latvia.

The Drax project, funded by the UK government, is a very small test of a solvent for carbon capture, by a startup company, C-Capture. It was initially to capture 1 tonne of CO_2 daily - a minute portion of Drax overall emissions, ultimately to be buried below ground. The very small amount of CO_2 so far captured has been sold to local breweries to fizz beer - a far cry from addressing the climate crisis. DRAX nonetheless boldly claims they will become the first “carbon negative power station” and that “*power generation would no longer contribute to climate change, but would start to reduce the carbon accumulating in the atmosphere.*”

MAGICAL THINKING

The above quote from Drax goes to the heart of reasons that BECCS in particular has won such attention among negative emission technologies. It is the only approach that claims to both produce “renewable” energy and simultaneously remove CO_2 from the atmosphere. A “win-win” that unfortunately amounts to dangerous wishful thinking, enthusiastically embraced by, for example, Shell Oil.

CCS AND EOR

CCS, whether applied to bioenergy or any other industrial process, is itself problematic. Any large scale CCS project would require massive

Drax power station, photo by nican45 licensed under CC BY-NC-SA 2.0

infrastructure for compressing and transporting of CO_2 (via pipelines) to geological formations deemed suitable for long term below-ground storage. The reliability of long term storage is itself questionable. To date, almost all CO_2 captured from such facilities (most from natural gas processing, fertilizer production or ethanol fermentation) is sold for use in “enhanced oil recovery”. Pumped into depleted wells, compressed CO_2 can push remaining inaccessible oil to the surface for recovery. But accessing more oil is hardly a climate “solution”.

ENERGY PENALTY

Because emissions from burning biomass are heterogeneous, separation of CO_2 is relatively complicated and energy intensive. Based on experience with coal CCS, it is estimated that capturing CO_2 would use 20-30% of the facility’s generating capacity. Burning wood for power is inefficient in the first place, and this “energy penalty” means that even far more fuel would be required to produce the same amount of energy. Far more trees would be cut, far more damage to forests would occur, and far more carbon and other pollutants would be produced.

DIRECT AIR CAPTURE

DAC is the most prominent negative emission technology along with BECCS. The concept is for ambient air to pass across a medium that will bind with CO_2 such as a hydroxide (basic) solution or a solid amine adsorbent.[1] The CO_2 can then be separated, compressed and stored below ground while the binding medium is regenerated for repeated use.

INFRASTRUCTURE DEMAND

Like BECCS, scaling up DAC to a level that would remove billions of tonnes of CO_2 - enough to impact global atmospheric CO_2 levels would require rapid construction of massive infrastructure and the materials and land area for that infrastructure.

1. Use of amines raises concern that their release from DAC facilities could result in formation of highly carcinogenic compounds.

ENERGY DEMAND

CO_2 comprises only a small component of ambient air (unlike more concentrated streams of CO_2 from power stations, refineries etc). Because it is relatively dilute, a very large amount of air must pass through equipment for capture of any significant quantity of CO_2. Separation of the CO_2 from the sorbent and processing for injection into storage sites is energy/heat intensive. Some estimates, based on modelling studies anticipate up to 300Exajoules per year of energy input would be required for DACS by 2100 if it were to be scaled up. That is about half of current overall global energy demand. Developing such an energy intensive technology - to remove CO_2 from energy production (and other sources), makes little sense. Even if renewable energy is used to power DAC, the demand for such vast amounts of energy would require construction and materials for an unimaginably vast energy and capture infrastructure, and all at an extraordinarily rapid pace if it is to address climate on a meaningful timeframe and scale.

COST

In part due to the very high energy and infrastructure demands, DAC is costly with estimates ranging wildly from $100-1000 per ton of CO_2 captured. Currently there are no policy supports or subsidies that contribute to these costs (hence sale of captured CO_2 for use in EOR is attractive to offset expenses).

RELIABILITY OF C STORAGE

If the CO_2 that is captured is to be stored below ground, the same concerns about access and transportation to sufficient suitable and reliable locations for underground storage would apply. Oil industry estimates that about 30% of CO_2 used for EOR is re-emitted into the air, with further emissions from combustion of the retrieved oil.

UNPROVEN

DAC still remains largely unproven. Major players in the field include Carbon Engineering, Climeworks and Global Thermostat. Carbon Engineering has a pilot plant in Canada, and plans for a first commercial scale project to be constructed in the Permian Basin. Climeworks has piloted its technology, commissioned a commercial scale facility, and raised significant finance, including for a facility in Iceland to capture and store 4000 tonnes of CO_2 annually. Global Thermostat meanwhile has two pilot plants, and recently won significant support from ExxonMobil to scale up a larger facility.

DO WE REALLY "NEED" NETS?

Removing carbon already in the atmosphere would be necessary if emissions "overshoot" the targeted levels considered essential to limiting global warming. Whether that is the case or not depends on steps taken now. The IPCC special report on achieving 1.5 includes scenarios that do not overshoot targets, and thus do not rely on future CO_2 removal. But proponents of NETs argue they are necessary to allow for slower emission reductions, therefore less costly policies - especially for sectors such as transportation and industry. But gambling our future on hopes for an effective implementation of unproven technology is flagrantly irresponsible.

DELAYING ACTION

Negative emission technologies such as DAC and BECCS are unproven and unlikely to be effective solutions. They have won favour among those who benefit from delay (Shell, BP). NETs offer the false promise of a technofix that will allow ongoing carbon intensive fuel use; "overshoot" of emission reduction targets undermine the urgent necessity of immediate and effective policies for addressing climate change.

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