Consultation: Update on climate geoengineering in relation to the Convention on Biological Diversity potential impacts and regulatory framework – Submission by Rachel Smolker on behalf of Biofuelwatch, August 2015

Comments on the draft documentation for SBSTTA 19 (https://www.cbd.int/sbstta/sbstta-19/19-inf-2-geoeng-en.pdf)

General comments:

These comments refer especially to chapter 3 on carbon dioxide removal and especially to BECCS and biochar. The incorporation of "negative emissions" into IPCC models, and subsequently into CBD text is unfortunate and illustrates the dire consequences of delayed action to reduce emissions. The promotion of BECCS (or biochar) as "essential" to achieving desired stabilization levels is profoundly misguided and will only worsen the overall state of our climate and environment.

Having spent the past 8 years in capacity as co-director of Biofuelwatch following the development of various bioenergy technologies, from corn and cane ethanol to wood pellet cofiring with coal, I can attest that these processes are simply never "carbon neutral" as has been shown to be the case over and over again. As an example, wood bioenergy - burning chipped or pelletized trees for electricity releases more CO_2 per unit of energy generation than coal. That is the case even when ONLY comparing emissions from smokestacks. Emissions from land use change, harvest and transport, soil disturbance and many other sources involved with that process add even further to the emissions. Reabsorption of CO_2 from new tree growth may or may not occur. Harvesting depletes soils and impacts hydrology in ways that may limit future regrowth. Even if regrowth occurs, it may take decades. Claiming that such a process is "carbon neutral" is simply false. Industry refers to use of "waste and residue", and discounts emissions in accordance with that claim, but there are several problems with this. 1) What is waste and residue? Currently it refers to any tree that is not merchantable as timber, hence resulting in more intensive harvesting practices. Wood bioenergy facilities typically have whole trees in their yards, which may then be chipped or pelletized prior to burning. Further, many processes cannot burn twigs, leaves, dirt and other materials because those burn inefficiently and can damage equipment. Rather they require clean, dense, preferably hard wood that burns hotter, more efficiently and with more controllable emissions 2) How is "waste and residue" verified? Independent investigation of pellet manufacturing in the southeastern USA revealed that rare endangered lowland Atlantic forests were being clearcut for pellets to be burned in UK power stations. Most power stations have wood yards that are piled with whole trees and there is no oversight regarding where they are sourced from. 3) What functions do "residues" perform in forest ecosystems and what are the long term prospects for recovery when soils are left exposed and nutrients removed? Burning trees for electricity is far from carbon neutral.

What about other bioenergy processes, for example, ethanol from sugar and corn, biodiesel from soya and palm oil? IAM assessments which are more holistic and thus reflect the real world more accurately indicate that these also result in emissions comparable or even worse than fossil fuels they supposedly replace. Cellulosic fuels from agricultural residues, long touted as a solution to food crop competition and promoted as having better GHG balance have even been shown to be more problematic. First of all their production has proven more difficult that assumed, and second, the removal of residues from fields reduces soil organic carbon and therefore more fertilizer inputs are needed to maintain fertility. Those result in large amounts of GHG emissions (*references provided in following comment). Various gasification processes have been tried and so far failed to prove commercially viable. In sum thorough consideration of carbon balances for bioenergy conclude that in the vast majority of cases, protecting forests, and restoring soils and ecosystems is a far better means to manage atmospheric GHG levels than producing bioenergy, with or without CCS (See: John M. DeCicco. **Biofuel's carbon balance: doubts, certainties and implications**. *Climatic Change*, 2013; DOI: 10.1007/s10584-013-0927-9)

Importantly: if bioenergy processes are not carbon neutral, then capturing and storing the carbon released by those processes cannot render them “carbon negative”. Assuming otherwise, and incorporating that wrongful assumption in models, and then translating the results of those flawed models into policies upon which the future habitability of the planet precariously rests, would be rather ill advised.

To its' credit, CBD outlines many of the concerns and uncertainties. But to then provide lip service to those (as IPCC also did) and then continue to include BECCS in discussion prominently, including referring to it as "essential", as holding "potential" and as "economically attractive" seems odd.

<u>Comments about pages 36-38</u>

It is troubling that CBD excludes consideration of "use", though there are understandably historical reasons for doing so. Yet in the real world the term "sequestration" is a misnomer. Due to the costs of capture (which is energy intensive) and the lack of proven geological storage, the majority of captured carbon to date is used for enhanced oil recovery. Sale of that CO_2 is profitable and offsets some of the costs. And there is an extremely eager market for CO_2 - the oil industry, which uses CO_2 for "enhanced oil recovery". The potential to access vast new supplies of oil exists, and currently is limited by availability and costs of CO_2 for the process. Powerful lobbying efforts are underway and reflected in recent policy decisions in the US - the Clean Power Plan as well as federal tax credits via national budgeting have provided incentives for "use". The National Enhanced Oil Recovery Initiative among other bodies is promoting such use and eying all forms of carbon capture (from bioenergy or fossil fuels). The reality for BECCS is that 1) fermentation provides one of the cheapest processes for capture as it a relatively pure stream of CO_2. Yet corn ethanol is a major cause of biodiversity loss in the USA and is in no way "carbon neutral" (heavy fertilizer use, land use change, displacement of food production, soil depletion and erosion etc.). Sale of CO_2 captured from ethanol production, then used to access oil reserves hardly can be considered a solution to climate change and certainly is not, in the end, "negative emissions". Furthermore, the technologies for both capture and storage (geological) are still embryonic and the time frame for providing real solutions is immediate. This is recognized on page 36 par 95. Yet BECCS continues to prevail in discussions. Both IPCC and CBD should not be providing a platform for serious consideration of BECCS whatsoever given the already identified considerations and uncertainties.

CBD identifies a key problem with all "negative emissions" - BECCS and biochar discussed here on a scale large enough to impact global CO_2 concentrations would require massive quantities of biomass. Even at the current scale of bioenergy production, biofuels and biomass are resulting in expanding frontiers for industrial agriculture (e.g. soya and corn) and deforestation (wood pellet production for electricity and heat) as examples. Cofiring of wood with coal has escalated dramatically, especially in UK. A country that produces about 10 million tonnes of wood (for all purposes) now is importing millions of tonnes from outside its borders and subsidizing that as "renewable energy". Dogwood Alliance and NRDC have investigated pellet manufacture operations in the South-eastern USA and found they were sourcing wood from rare and endangered remaining pockets of lowland Atlantic coast forests. The need for hard, dense wood (rather than pine which burns poorly) appears to be a major factor. In British Columbia, beetle damaged forests have been further damaged by over-eager harvesting to satisfy European market demand. In addition, changes in logging practices resulting from "salvage" logging have resulted in a general relaxation of forest protections in the region.

The term "negative emissions" generally refers to generation of energy - electricity, heat, transportation energy via a process that somehow offsets both the production of that energy (making energy takes energy), and the consequences (i.e. deforestation, food displacement etc.). This is simply not possible based on basic laws of physics. A recent publication in PNAS discusses the thermodynamic balance of earth - solar energy inputs, stored in living plant biomass and fossil reserves in terms of a battery that is being depleted far more rapidly than it is being recharged. This simple model is an urgent wake up to the importance of protecting remaining forests and ecosystems rather than harvesting and burning them for energy. (Shramski et al 2015.

Human domination of the biosphere: rapid discharge of the earth-space battery foretells the future of humankind. PNAS)

The report states: "*such bioenergy provides a direct alternative to fossil fuels and offers a mechanism for net carbon removal when linked to CCS. Bioenergy with capture and storage (BECCS) meets both these needs and is economically an attractive policy option.*" This entirely sidesteps many of the concerns and uncertainties that are elsewhere acknowledged and appears intended to encourage readers to presume BECCS actually "works" in spite of some "trivial" concerns. Also note that bioenergy is rarely an "alternative to fossil fuels" as the scale of fossil fuel use is, and continues to be vast by comparison and overall energy consumption continues to expand. This is well illustrated in graphics depicting global energy consumption such as those produced by the International Energy Agency which provides data and analysis of overall energy use and production. Those clearly indicate that the bioenergy remains a very minute contribution overall, even when traditional uses are included (for cooking). The notion that bioenergy can provide a significant substitute for fossil fuels without very dire impacts on biodiversity etc. is badly misguided.

BECCS as "**economically attractive**"? Carbon capture systems are extremely costly due to the fact that the process of capture adds very significantly (up to 30%) to energy demand for a facility, and the infrastructure for handling CO2 (pipelines, trucking etc.) add further to costs. These costs are considered prohibitive in most cases, though government subsidies have contributed heavily to the few facilities that exist. The Kemper (coal, not biomass) CCS project in Mississippi is one example of the cost overruns associated with carbon capture. That facility, now 2 years behind schedule was initially determined to cost around 2 billion, but has now tripled in cost to over 6 billion. The sale of CO2 for enhanced oil recovery is one means to make up those costs (where infrastructure and proximity to oil wells exists). Even "Climate Engineering" a company working to develop direct air capture recently announced that they would sell their capture CO2 for enhanced oil recovery! (http://www.virginearth.com/2015/03/carbon-engineering-breaks-ground-on-new-pilot-demonstration-plant/) Further note that the geological storage of captured CO2 would require ongoing testing, monitoring etc. of storage sites and pipelines (which do not exist and would need to be constructed) adding yet further to costs over the foreseeable future. Realistically, BECCS, and similarly fossil CCS, are not economically viable, as they are also not environmentally viable. Continued discussion merely diverts attention from other more viable options (see later comment).

In addition to the concerns raised in preceding paragraph re feasibility and estimation of potential, this paragraph should give pause to anyone considering ongoing debates over BECCS. Clearly it is not feasible or desirable especially given the many other glaring facts that all very strongly indicate BECCS cannot and will not in fact provide "negative emissions" in the end even if we were able to achieve these monumental scaling-up requirements. Those are detailed in Table 3.3 and in subsequent sections. The daunting complexity of interacting uncertainties indicated in figure 2.2 should further serve to convince readers that scale up of BECCS would have a multitude of negative consequences, most of which we cannot control or predict, even as we have every reason to assume it cannot in the end deliver "negative emissions" in any case.

Comments about pages 44 and 45:

Here it is acknowledged that "**from a climate perspective, the benefits of reducing deforestation seem much greater and more certain than afforestation/reforestation**." This is certainly the case given that tree plantations are essentially monocultures and do not support species richness as do native forests. Furthermore, this is highly relevant to the issue of BECCS (and biochar). In simplistic terms: We cannot dramatically scale up our use of land and of forests to supply biomass for BECCS or biochar if we are also going to protect forests and other ecosystems. There is an inherent trade-off between protecting and creating more demand that must be clearly identified and policies should work to reduce, not increase demands for biomass.

Raffa et al. ,2015. How does crop residue removal affect soil organic carbon and yield? A hierarchical analysis of management and environmental factors. *Biomass and Bioenergy.*

As with BECCS, biochar remains very embryonic in development. Few field studies under natural circumstances (not sterile soils in laboratories) have been undertaken with full controls. Few studies have continued to monitor soil carbon and yield impacts over more than a year or two. Claiming that biochar is useful as a means to impact global CO2 (climate geoengineering) are thus highly premature. As with BECCS, biochar production requires large amounts of biomass and thus all the same concerns about land use, soil and water resources etc. apply. Similarly, as with BECCS there are many clear indications that it will fail to in fact achieve anything like "negative emissions". Hence it would make far more sense to concentrate attention on techniques and approaches with known and reliable benefits (protecting remaining forests and ecosystems, transitioning away from industrial agriculture and forestry practices to agroecological and locally appropriate practices and reducing overall demands and consumption of resources etc.).

CBD acknowledges that the effectiveness for long term CO2 removal is controversial. This is certainly the case as those claims, that biochar can reliably sequester carbon for "tens or tens of thousands of years" are based on Terra Preta which is very different from modern biochar, not on the results of any reasonably long term studies of biochar. Many of the existing studies span only a single year and growing season.

In 2011, we found and analysed the results of five relevant field studies which, between them, tested biochar on 11 different combinations of soil and vegetation. In 5 out of those 11 samples, adding biochar (except in one case at an extremely high rate of over 100 tonnes per hectare) did not increase the amount of carbon in the soils – i.e. there was zero carbon sequestration. In another case, adding biochar led to a temporary overall loss of soil carbon. The authors did not offer any explanation for the likely reasons of this carbon loss in the article, however other studies have demonstrated that adding biochar to soils can stimulate soil microbes to degrade existing soil carbon, causing it to be emitted as carbon dioxide. In 3 cases, biochar increased soil carbon compared to adding nothing to soils – but not when compared to other common soil amendments, such as saw dust, manure and green manure. In just 3 out of 11 cases did biochar result in additional carbon sequestration, at least short-term but its long-term stability is still in question. Studies of biochar should at the very least include monitoring over several years. Similarly, yield impact studies often are misleading as there is an initial boost in soil fertility associated with nutrients added along with biochar. In subsequent seasons soil fertility may decline, but this will not be captured in studies that do not continue over a longer time frame.

Biochar researchers have been focussed on determining the variables (feedstock, temperature etc.) that produce different char characteristics. Meanwhile, advances in soil science indicate that the determinants of soil carbon recalcitrance are "ecosystem properties" related to soil characteristics and other environmental variables that are not necessarily predictable, consistent or controllable. They find that carbon in organic residues may not last long under laboratory conditions but may remain in living soils for millennia. And black carbon, the form of carbon in biochar, which appears extremely stable under sterile laboratory conditions, may disappear rapidly from soils, depending on highly variable soil and climatic conditions. Relevant references include:

Dungait et al., 2012. Soil organic matter turnover is governed by accessibility not recalcitrance. *Global Change Biology* 18, 1781-1796

Schmidt et al. 2011. Persistence of soil organic matter as an ecosystem property, *Nature* 478. 49-56

Comments about page 47:

The claim that biochar will be useful for climate geoengineering but will only utilize "**crop residues and biowastes**" is highly problematic. To illustrate, in a paper published in Nature (Dominic Woolf, James E. Amonette, F. Alayne Street-Perrott, Johannes Lehmann, Stephen Joseph, “Sustainable biochar to mitigate global climate change," Nature Communications, Aug. 10, 2010) the authors claimed that biochar could potentially offset up to 12% of global emissions without interfering with food production or natural ecosystems. On closer analysis this claim was based on some very risky assumptions: that there are nearly 200 million hectares of "abandoned cropland", that could be converted to crops and trees to produce biochar [2]. That land would be in addition to a further 170 million hectares of tropical grasslands which could be turned into short-rotation tree plantations to produce both biochar and animal fodder.[3] They also assume that globally most forestry residues would be made available. The concept of "abandoned or marginal cropland" has been strongly criticised by social movements and civil society groups around the world because the term is being widely used to describe land on which millions of peasant farmers, indigenous peoples and pastoralists depend. Referring to often biodiverse community lands as "abandoned and marginal" and assuming those lands are "available" for conversion is already resulting in massive land grabs – especially in Africa, Asia and Latin America. Such lands also play an essential role in maintaining biodiversity and regulating the climate. The authors in total assumed an area of about 556 million hectares of land would be utilized for biochar production (an area about 1.7 times the area of India.

Many analyses have pointed to the negative impacts of removing agricultural residues from fields, which reduces soil organic carbon, permits more erosion and reduces water retention, and results in the need to apply more synthetic fertilizers. A few references are provided below. In general nature does not produce "waste". The references refer to agricultural residues. Forests also depend upon recycling of "wastes". Forestry residues left in place allow for the return of nutrients and protect soils from erosion as well as providing habitat for biodiversity and creating pockets of moisture for germination and growth of a future generation of trees. Deforestation should be dramatically reduced as per above, but good practices that protect biodiversity aim to minimize removal of materials. Providing incentive to remove more material (and even expanding the definition of "waste" to include any tree that is not merchantable as timber, hence encouraging clearcutting) has serious negative consequences. Collecting, pyrolizing and tilling residues into soil elsewhere is not likely to protect forests or contribute to resolve climate change.

Liska et al 2014. Biofuels from crop residue can reduce soil carbon and increase CO2 emissions. Nature Climate Change 4, 398-401

http://www.sciencedirect.com/science/article/pii/S0961953415300611

Raffa et al. 2015. How does crop residue removal affect soil organic carbon and yield? A hierarchical analysis of management and environmental factors; *Biomass and Bioenergy.*

Drewniak, B. A., Mishra, U., Song, J., Prell, J., and Kotamarthi, V. R.: Modeling the impact of agricultural land use and management on US carbon budgets, Biogeosciences, 12, 2119-2129, doi:10.5194/bg-12-2119-2015, 2015.

Albedo effects of biochar are mentioned but these should be further emphasized. Biochar is black carbon, and easily breaks down to very small particles that can become airborne. Additionally, amended soils are darkened and thus also heat up more readily with impacts on plant growth. For example, in a non-peer-reviewed field trial study in Quebec "*an estimated 30% of the material was wind-blown and lost during handling, transport to the field, soil application and incorporation . The particle size of the biochar produced by the company which supplied that trial was analysed by the Flax Farm Foundation, who found that it "approaches a low of 5 µm in size*" . This is smaller than the size of many (airborne) soot particles. Furthermore, according to a report published by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), "*the size of biochar particles is relatively rapidly decreased, concentrating in size fractions <5µm diameter*" . In other words, over time, larger biochar particles are likely to also break down to the size of black soot particles. Given that wind erosion of black carbon is well documented, it seems surprising that no scientific literature has been published about the potential warming effects of airborne small biochar particles.

Also missing from the discussion of biochar is the potential for toxins to be concentrated and then released into soils and crops grown with added biochar. Some references:

Buss et al. 2015. Inherent organic compounds in biochar - their composition and potential toxic effects. Journal of Environmental management, col 156. pg 150-157

Jones et al. 2014. Metal contaminated biochar and wood ash negatively affect plant growth and soil quality after land application. Journal of Hazardous Materials

Maud Viger, Robert D. Hancock, Franco Miglietta, Gail Taylor. **More plant growth but less plant defence? First global gene expression data for plants grown in soil amended with biochar**. *GCB Bioenergy*, 2014; DOI: