Submission to Royal Society study on Climate Geo-engineering

Biofuelwatch

Dear Andrew Parker,

In our submission we focus on proposals for terrestrial bio-geoenginering. However, much of our concern relates to the impact which those proposals would have on biodiversity, without which ecosystems would collapse and no longer be able to regulate the climate, nor sustain the lives and livelihoods of people. The same concerns apply to other geo-engineering proposals, all of which have unquantified but potentially very serious impacts on biodiversity (and thus long-term climate stability) and on communities. Ocean-fertilisation or artificial ocean mixing, for example, threatens major negative impacts on marine biodiversity which plays an essential role in the carbon cycle. Any schemes to induce global dimming would impact on photosynthesis and thus also post a new threat to the carbon cycle. We therefore believe that geo-engineering should not be pursued as a policy option.

We focus primarily on proposals to use so-called 'carbon negative' bio-energy as means of reducing atmospheric carbon dioxide, i.e. falling within the first category of Greenhouse Gas Reduction Schemes. Those encompass Bioenergy with Carbon Capture and Storage (BECS) and biochar as a means of drawing down CO2 from the atmosphere.

Summary:

The 'carbon-negative' bioenergy proposals involve manipulating the carbon cycle by greatly increasing the burning of biomass and then attempting to sequester the carbon dioxide. There are serious questions as to whether the proposed sequestration of CO2, particularly in the case of biochar, will be possible.

Supporters of 'carbon-negative' bioenergy have claimed that up to 9.5Gt of carbon per year could be sequestered, specifically through biochar – which is more than the carbon contained in all fossil fuels burnt per year at present. [Biochar sequestration in terrestrial ecosystems", Johannes Lehmann et al, Mitigation and Adaptation Strategies for Global Change (2006) 11: 403–427]. Such a major increase in global biomass burning would require land conversion on a scale which far outstrips all the land-use change that has taken place for current agrofuel use – possibly 20-25 fold, if not more. Peter Read, one of the leading supporters of carbon-negative bioenergy and of biochar in particular, for example, has spoken of a need to convert an area the size of France in the tropics and sub-tropics, plus an area the size of Germany in temperate zones every year (Peter Read, "Biosphere carbon stock management: addressing the threat of abrupt climate change in the next few decades." [Peter Read; An editorial comment", Climatic Change, Volume 87, Numbers 3-4 / April, 2008]. Such large-scale land conversion would put major pressures on global ecosystems and biodiversity and thus on climate stability, on communities and food securities, on freshwater and soils. We believe that this could threaten essential global life-support systems on which we depend for our survival.

1. What do you consider to be the current state of knowledge regarding the feasibility, efficacy and predicted impacts of climate geoengineering schemes?

BECS relies on carbon capture and storage which has not so far been proven to be commercially viable. According to the IPCC, with regards to CCS there are still uncertainties relating to "proving the technologies, anticipating environmental impacts and how governments should incentivise uptake" (Assessment Report 4, Working Group 3 report, Chapter 4). Furthermore, the IPCC has stated that at best, 60% of CO2 emissions from power production and 40% from industry could be captured and sequestered by 2050 (IPCC Special Report, Carbon Dioxide Capture and Storage, 2005). The large-scale commercial deployment of BECS thus does not appear likely in the short term. In the medium and long term, BECS would compete with CCS linked to coal power stations and other fossil fuel burning. If BECS ended up leading to more carbon emissions from fossil fuel burning, that would render any notion of 'carbon negativity' or even 'carbon neutrality' invalid.

Biochar has not so far been proven to result in long-term carbon sequestration in soil. It is true that ancient high-carbon soils have been found, most notably terra preta in Central Amazonia. Pyrogenic carbon from incomplete biomass burning is understood to have played part in such soil formation and the carbon contained in the

ancient charcoal has indeed been highly stable for centuries or millennia. A paper which looks at such soil in North America, Germany and Brazil found that out of six such cases which have been found, three cannot be dated, and three are between 7500 and 2700 years old. ("Potential of pyrolyzed organic matter in soil amelioration", Bruno Glaser et al, International Soil Conservation Conference, Beijing, 26031 May 2002). Whilst that paper refers to the North American soils in question as being of unknown age, another study notes that they have all been under prairie or oak savannah vegetation where fire has been prevalent for 5,000 years. There is as yet no evidence that those ancient charcoal-rich soils can be recreated over a short period, or that they can be recreated at all through reliance on biochar, rather than the adoption of far more complex sustainable farming strategies. Amongst the different charcoal-enriched ancient soils, the Brazilian terra preta has been studied in most detail. The Food and Agriculture Organisation summarises the findings as follows: "Diverse organic nutrient sources were identified such as fish residues, turtle shells, weeds and sediment from the rivers, manures, and kitchen waste other than fish. It appears that the 'Terra Preta management' which produced the Amazonian Dark Earths was a sophisticated combination of organic soil management and burning, using locally available nutrient and carbon sources" (http://www.fao.org/sd/giahs/other_brazil_desc.asp).

There are no studies to prove that use of modern biochar will result in long-term carbon sequestration. We contacted Johannes Lehmann, one of the leading scientists working on biochar, and he advised us: "So far, there are no longer-term studies looking at the retention of carbon and nutrients from biochar in soil. One four year experiment was abandoned and another four-year old study is still ongoing, however neither of those has been published. There appears to be no other study older than about two years" (Email to Biofuelwatch, 27th March 2008). In a peer reviewed paper, Johannes Lehmann concluded that the half-life of biochar was unknown, I
i.e. that we do not know how long the carbon and nutrients will remain in the soil and that nobody knows how to incorporate biochar in soil without aggravating soil erosion and soil depletion (resulting in soil organic carbon loses). (Bioenergy in the black, J. Lehmann, Front Ecol Environ 2007; 5(7): 381–387, www.css.cornell.edu/faculty/lehmann/publ/FrontiersEcolEnv%205,%20381-387,%202007%20Lehmann.pdf). Furthermore, a recent peer-reviewed study by David Wardle et al (Fire-Derived Charcoal Causes Loss of Forest Humus, David A. Wardle et al, Science 2
May 2008: Vol. 320. no. 5876, p. 629) found that when biochar was mixed with boreal forest soil, it substantially increased decomposition of existing soil organic carbon by soil bacteria and fungi, resulting in very substantial soil organic carbon losses through leaching or respiration. Although those findings are specific to soils rich in soil organic carbon, the findings were unexpected and show how premature it would be to rely on biochar to sequester carbon in the absence of long-term field trials.

These represent our concerns about the feasibility of sequestering any carbon through BECS or biochar. Even more serious, however, are the implications of the scale of biomass use required for climate geo-engineering with so-called 'carbon negative' bioenergy.

The German Government's Advisory Council for Sustainable Development, WGBU, has spoken out against biomass with CCS for climate change mitigation because of the large amounts of additional biomass which would be required (www.pik-potsdam.de/members/edenh/publications-1/reccs-short-version-engl). Adopting bioenergy with CCS as a climate mitigation strategy would require the conversion of hundreds of millions of hectares to bioenergy plantations

Scientific understanding of both methodologies, and particularly bioenergy with biochar are in their infancy. As serious concerns about dangerously high GHG levels is prompting exploration of geo-engineering options, we appear not to be taking account of the wider risks of associated collapse of other life-support systems. Both methodologies are currently being promoted by industry at the UNFCCC, and at the US, EU and UK government levels. Yet the scientific basis is questionable and there is no serious critique of the risks and wide- scale impacts.

2. How do you think research into climate geoengineering should be taken forward, and by whom?

The full impacts of any climate geoengineering strategy can only be known if such a scheme was adopted on a large scale. This would mean engaging in a planetary experiment with unknown consequences which, particularly if they were to trigger rapid collapse of ecosystems or biodiversity, could turn out to be irreversible. We believe that the risks are so high, that such research should not be pursued. In the case of biochar, we can see merit in further research into the potential use of charcoal as one amongst many soil conservation methods in sustainable farming, provided that the results of such research were freely and publicly available and not

patented, but this would not be linked to geo-engineering because, as we have discussed above, biochar use on a scale that amounts to geo-engineering would be inherently unsustainable.

3. What factors need to be considered before deploying any climate geoengineering schemes? Who should be responsible for any deployment?

4. What do you consider to be the most important political, social, legal or ethical issues raised by climate geoengineering?

We discuss 3 serious risks associated with BECS and bioenergy with biochar.

A. Ecosystems and Climate

James Hansen and several other proponents advocate large-scale bioenergy production based on low-input, high-biodiversity cultivation methods and on the use of forestry and agricultural 'waste', although Hansen has recently indicated in the media that he may also be looking at tree plantations. There are markedly different estimates of the energy return from biomass. A recent study by Christopher Field et al, estimates one-eighth of the returns compared to the OECD estimate (CB Field et al, Biomass energy: the scale of the potential resource, Trends in Ecology andEvolution Vol.23 No.2, 2008). Field identifies 'abandoned cropland' larger than the sub-continent of India as the source. Abandoned crop land usually means seasonal pasture land, land left fallow for restoration purposes and semi-natural forest, savannah and scrubland used for hunting and gathering. Even without accounting for this dramatic overestimate in yields, Van Zwieten concludes at the IBI Conference presentation (2008) that there is "not enough infrastructure and biomass, so we need to grow energy crops fast to produce enough feedstock" (http://www.biochar-international.org/images/IBI_2008_Conference_Parallel_Discussion_Session_D.pdf).

The scale and speed of bioenergy expansion required for the purpose of trying to reduce atmospheric carbon dioxide levels is fundamentally incompatible with sustainable production. It will inevitably put greater pressure on food production and ecosystems just as agrofuels has done. It will also require policies that favour short-term high yields per hectare, which are ecologically the most damaging. Any policies aimed at the scale of bioenergy use proposed will result in a dramatic expansion of industrial monocultures, even if this is not the intention of those scientists. We note that the key study on which proponents rely for the concept of 'low input, high biodiversity' bioenergy presumes a major intensification of high-input, low-biodiversity industrial agriculture in all other sectors.

Large-scale bioenergy expansion, regardless of the mode of production, will accelerate ecosystem and biodiversity destruction which in turn will accelerate climate change. WGBU (mentioned above) estimate that 428GtC are stored in tropical forests and soils. Losing the Amazon rainforest because a critical tipping point has been crossed, for example, would release 120GtC, nullifying the projected gains from nearly 50 years of bio-geoengineering sequestration. With droughts now an annual occurance in the Amazon, long-term stability is already threatened. Tropical grassland is also a key repository, containing 330GtC, indicative of the large amounts of carbon stored in undisturbed soils.

It will further deplete freshwater and soil and will inevitably compete with food production, threatening the livelihoods of large numbers of people, primarily in the global South. Bioenergy figures used by proponents of these schemes rely on calculations by other scientists which suggest that at least 500 million hectares worldwide would have to be dedicated to bioenergy production. This represents 1.5 times the entire land area of India, and 20 to 25 times the land area currently used for agrofuel production. Conversely studies show that there is no productive land which is not either natural habitat or already under cultivation.

Misleading terms such as 'degraded' and 'marginal' lands are used to describe, for example, semi-arid and community lands slated for conversion to bioenergy. We would also argue that large-scale removal of so-called agricultural and forest 'waste' or residues will deplete soils, greatly speed up soil erosion and soil carbon emissions, as well as trigger chains of biodiversity loss.

The term 'carbon negative' bioenergy is shown (see link to paper below) to be a misleading term. Industrial agriculture and forestry are already one of the leading causes of climate change, as a result of large-scale ecosystem destruction, soil carbon losses, nitrous oxide emissions from fertiliser use, and high energy inputs. Calling them 'carbon negative' or even 'carbon neutral' is misleading and unjustifiable.

B. Communities
Indigenous peoples, small-scale farmers and other communities
in the global South, including many who practice truly low-carbon and sustainable or near-sustainable living, are likely to pay the price for any large-scale bioenergy expansion. The number of people who will be displaced could be of an order of magnitude greater than those currently being displaced by agrofuels, given the scale of land-use change advocated by proponents of such policies.

C. Life Support Systems
We wish to put the question; Is it correct to speak about the 'climate crisis' or should we be even more concerned about the 'convergence of crises', which include not just climate change, but also species extinctions and ecosystem destruction, soil losses and freshwater depletion, as well as myriad forms of pollution. We suggest that it is dangerously reductionist to view those crises in isolation from eachother. Not only does each crisis threaten the very foundations of life on earth, but they interact and compound each other. This is illustrated with the wide-scale collapse and extinction of amphibian populations which is currently occurring. The causes include the converging impacts of agri-chemical pollution, loss of vegetation cover, ozone depletion, the introduction of invasive species as well as climate change. Reptiles and insect pollinator species (essential for crop production) are also collapsing. Such large biodiversity losses can degrade ecosystems to the point of collapse. Throughout the planet's history, ecosystems have both maintained a stable climate and prevented runaway warming. Their role cannot be measured in terms of carbon storage alone. Natural forests, for example, help to regulate the global carbon and nitrogen cycles, the freshwater cycle and cloud formation, thus increasing the planet's reflectivity. Via the production of the chemical, hydroxyl, they also play an important role in breaking down the powerful greenhouse gas methane. Globally, key ecosystems act as a 'heat pumps' regulating rainfall and storm tracks. Without biodiverse ecosystems, the conditions amenable to life could not be sustained and true runaway warming – a 'Planet Venus' scenario - would be the likely outcome.

5. What do you see as the main barriers to, and opportunities offered by, climate geoengineering?

6. Where do you feel that climate geoengineering fits in the greater scheme of climate research and action to mitigate and adapt to climate change?

7. Are there any other issues related to climate geoengineering that you consider to be important? Submissions are welcomed on any of the issues mentioned in the project scope and terms of reference.

Responses which address only one aspect of the crisis – for example fossil fuel burning, whilst ignoring or even aggravating others, offer no realistic hope of avoiding runaway warming and a mass extinction event. The UN Framework Convention on Climate Change makes clear these twin objectives. Both BECS and biochar threaten emissions reduction, ecosystem protection and social justice. Regarding social justice, the burden would predominantly fall on countries in the global South which have contributed the least to global warming but which have the highest photosynthetic rates.

Our hope of survival depends on ending any further destruction and giving the biosphere the best possible chance of maintaining and, if possible, increasing its resilience through ecosystem restoration.

References
For all assertions unsupported by a reference please see the following report: *Climate Geo-engineering with 'Carbon Negative' Bioenergy; Climate Saviour or Climate Endgame?*
http://www.biofuelwatch.org.uk/docs/cnbe/climate_geoengineering_web241108.pdf

Authors:
Almuth Ernsting, almuthbernstinguk@yahoo.co.uk
Deepak Rughani, dee.rughani@btinternet.com