Date of meeting

23rd August

Present:

BEIS	Climate restoration
Dr. Miguel Martinez-Boti (MMB) Dr. Tyrone Dunbar (TD) Dr. Cathy Johnson (CJ)	Kevin Lister (KL) Prof Peter Wadhams (PW) Dr. Alan Gadian (AG)

Notes of meeting

Introduction:

KL thanked the Department for Business, Energy and Industrial Strategy (BEIS) for making the time for the meeting and extending our time allocation from 30 minutes to 45 minutes.

CJ acknowledged that the Lord Bourne letter remained a statement of current departmental policy on climate change. KL suggested that as Lord Bourne had moved to another department and that as his letter was so inconsistent that it would not be productive for BEIS to use the allotted time to defend it.

Overview of BEIS's understanding of the state of climate change

TD presented the BEIS understanding of the status of the melting of the Arctic Ice. He confirmed that BEIS takes this seriously and acknowledged that its rate of melting was far faster than the 2050 date given in the Lord Bourne letter.

TD confirmed that IPCC remains the main source of climate change data that the department sets policy against.

KL noted news reports on the day of the meeting that recent storms had destroyed the last of the multi-year ice, (e.g. http://arctic-news.blogspot.co.uk/2016/08/storms-over-arctic-ocean.html)

AG and PW confirmed that the current rate of the melt is exceeding by far the very worst case projection used by the IPCC.

PW explained that the legacy CO_2 in the atmosphere was already leading to runaway climate change and that methods to sequestrate carbon out the atmosphere had to be urgently developed and without this, it was irrelevant to talk about 1.5^{0}C temperature targets.

TD confirmed the department understood that the current INDCs that form the basis of the COP 21 agreement put the planet on track to a 3.6^{0}C temperature increase.

Post meeting note – It is impossible that civilisation will survive a 3.6^{0}C *temperature increase, and equally unlikely that higher-life forms will survive either.*

Potential Methane releases

TD stated that BEIS's view was that the risk of large and destabilising methane releases was not as great as had been warned by KL's correspondence.

However, PW advised that BEIS's conclusions were based on NERC funded research that was carried out in the deep water of Svalbard which is not representative of the wider problem. At these depths, the methane is absorbed by the water column and does not reach the surface, as such it does not allow assessment of the risks in the shallow continental shelves. PW also advised that the purpose of his visit to Scripps was to identify research work that would quantify the methane that is at risk in the shallow Arctic Seas.

TD stated that they had not been aware of Prof Jim Kennet's work and having read this acknowledged its serious implications; in particular the fractured state of the methane clathrate reservoirs and the level of heat build-up in deep water where methane clathrates exists in fine thermal equilibrium.

KL advised that Prof Jim Kennet (UCL) has already documented new gas releases off the East and West Coast of America (see for example, Evidence for extensive methane venting on the Southeastern U.S. Atlantic margin, L.L Brothers et al and attached).

KL further advised that atmospheric methane was already rising across the Arctic at an unprecedented levels and this can be observed on the greenhouse gas measuring network, (see for example http://www.esrl.noaa.gov/gmd/ccgg/).

TD advised that BEIS believed that the increased methane was coming from Tundra and other sources rather than the ocean.

Post meeting notes: (1) In telecoms with Prof Jim Kennet he has warned that the methane releases off the Washington coast have been triggered by temperature increases of approximately 0.2^{O}C which are far smaller than those already experienced in the Arctic, and even smaller than future projected temperature increases. (2) While is true that some of the atmospheric methane may be coming from the tundra, an immediate risk is that a sharp release will occur from the warming Arctic Ocean which is now in a completely new state. The additional heating this will cause will trigger subsequent far larger releases from the tundra.

PW did not believe that BEIS could stand by their position that methane hydrates would not contribute significantly to methane emissions in the coming century and not pose a serious threat to the environment.

Government position on geo-engineering

CJ outlined the government's position on geo-engineering and in their assessment of the three proposals presented (MCB, buoyant flakes and ice thickening)

CJ claimed from the Latham et al paper (2014), that Marine Cloud Brightening would result in inhomogeneous rainfall patterns. However, AG (who co-authored the paper) clarified that it was absolutely certain that inhomogeneous rainfall patterns will be far more serious without MCB.

KL explained that unless an immediate start is made, that the time scale for development, deployment and effect would mean that it would be too late and runaway climate change would be impossible to reverse.

KL explained that the fluidic oscillator method offered a low energy, highly controllable and highly scalable approach; however much research work was needed to optimise the key control parameters and prove that the droplet size was uniform. KL and AG confirmed that this needed to be done before deployment.

AG explained that it was absolutely essential to start research and further modelling but that it was currently impossible to get funding for work of this nature and requested that political and Whitehall pressure be applied to NERC to secure funding.

AG explained that research had suggested that the MCB could be effective in offsetting the heating from a doubling of atmospheric CO_2. TD suggested that CO_2 levels would never reach this level, but AG and KL countered that we are already well on track towards this and we would soon double pre industrial levels of CO_2.

Post meeting note: estimated preindustrial CO_2 was approximately 250ppm.

KL further explained that the recent increases in CO_2 this year were by far the largest ever experienced and of such a magnitude that they could not be put down to the El Nino, but most likely were indicative of a more a seriously accelerating underlying trend.

CJ claimed that MCB could cause unforeseen precipitation changes which could deprive drought stricken areas of rainfall and this would be politically unacceptable.

Post meeting note: A well designed and controllable MCB could do the opposite and can be used to bring water to drought stricken regions.

AG explained that the risks of a well-managed geo-engineering approach were small compared with the current do nothing approach

On the BEIS assessment of buoyant flakes, CJ cited the "London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter exists to protect the oceans from potential environmental harm" as a reason for doing nothing.

KL explained that the buoyant flakes proposal seeks to restore the chemical balance that existed prior to the industrialisation of the oceans and that this was the quickest way for to sequestrate CO2.

KL explained that initial experiments had shown significant CO_2 sequestration potential from fertilisation, but as the experiments were conducted for short periods and over relatively small areas then the long term sequestration ability could not be documented. KL explained the point of the buoyant flakes was to ensure that the minerals would be held in the surface waters for prolonged periods.

CJ stated that she did not believe there was evidence that the ocean fertilisation would lead to long term sequestration. KL said that this was undeniable as the white cliffs of Dover testify. KL explained that the only stabilisation of the Manu Loa CO_2 trend occurred after the Mount Pinatubo eruption which deposited an estimated 40,000 tonnes of iron rich minerals in the world's oceans and that our proposal would replicate this on a bigger scale, but in a more controllable fashion.

KL further explained that long term sequestration was not necessarily the issue and that the bigger issue was to convert CO_2 into biomass as quickly as possible. KL further explained that this is also necessary to address the acidity of the ocean, which is already a critical issue and that the cooling caused by the MCB could increase it further. KL emphasised that without addressing this, the ocean food chain would collapse.

CJ asked for papers documenting evidence of sequestration of CO2 through ocean fertilisation.

Post meeting note: As requested:

e.g. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.175.8872&rep=rep1&type=pdf

http://www.nature.com/nature/journal/v446/n7139/pdf/nature05700.pdf

etc

On the ice thickening proposals, CJ claimed that they would require too much energy and that wind turbines would be diverted from displacing fossil fuels. KL explained that in general, water would only be pumped though a head a couple of meters and thus the energy consumption for each pump would be minimal, most likely in the order of several kilowatts.

KL further explained that it is not a case of wind turbines being used for the ice thickening or power generation, but a case of being needed for both.

Post meeting note:

The wind turbines that would power the pumping system would not be used during the summer months and can then be used for power generation. Furthermore, once the ice has formed, the wind turbines can be used for energy export if needed.

CJ claimed that the wind turbines would have to be on floating structures and that this would be too complex

Post meeting note: This is now established technology,

e.g. https://en.wikipedia.org/wiki/Floating_wind_turbine

KL explained that the time taken for ice to melt is a lot shorter than the time taken for ice to naturally reform (this is a consequence of the thermodynamics of ice formation and is explained in PW's book – A farewell to ice) and thus even if anthropogenic CO_2 emissions went to zero and the planet was cooled to pre-industrial temperatures then there could be no guarantee that ice would reform in the Arctic; as such, intervention was essential.

KL also explained that a restored ice cap was essential to trap releasing methane.

CJ explained the government's support for BECCS as a CO_2 sequestration solution. KL explained that this would never work as its operation defies the second law of thermodynamics. This is due to two factors. The first is the best thermal efficiency of a power plant is approximately 45%. The second is that about 20% of the available stored energy within a typical fuel is needed to separate the resulting CO_2, transport it and pressurise it for long term storage. The final thermal efficiency is the difference between the two, which is approximately 25%. KL explained that this is only slightly better that the thermal efficiencies of steam engines at the end of the industrial revolution. KL suggested that no energy intensive society could run its critical infrastructure at these levels, especially when faced with a myriad of climate change challenges. MMB said they were unaware of these thermal limitations.

CJ queried if this thermal limitation applied to fossil fuel powered stations.

Post meeting note: This same diminution of thermal efficiency equally applies to fossil fuel powered stations and is the fundamental reason why carbon capture and storage has been so unsuccessful since first being proposed over ten years ago. However, as biofuels burn at lower temperatures than either coal or methane, the thermal efficiency of power plants is always lower than with conventional fuels and as biofuel is more expensive than conventional fossil fuel then CCS will be even less financially viable when using biofuels. Put simply, no investor or government would ever fund a project such as this on the huge scale needed to restore CO2, nor could it ever be done in time.

CJ explained that none of the proposals "tackled the problem at source" by cutting CO_2 emissions. KL, PW and AG explained that legacy CO_2 meant it was impossible to maintain temperature rises below 1.5^0C and failure to intervene would lead to ecological collapse, thus there was a moral obligation to support these proposals and start a climate intervention strategy.

KL explained that desperation would soon force other governments down geo-engineering routes which may involve more risk than the methods he proposed. KL advised that confidential talks are taking place with partners in India on our proposals, but in the US sulphate aerosol injection into the high atmosphere which has a much higher risk than the MCB proposals is being actively considered as the US government does not believe runaway climate change can be avoided.

KL warned of a paradox that as climate change worsened, governments would stick harder to the existing strategy even though it was failing, driven mainly by the need to avoid a free-for-all. The alternative to pursue the climate restoration programme requires acknowledgement that that the current strategy is failing, which is politically difficult.

CJ stated she was not being driven by political expediency and reiterated her view that low carbon was the only solution and apologised to KL for wasting his time.