1a. Technical Experience in TCP area - Understanding of the sector in the UK and internationally

The UKs history with bioenergy is one that has been turbulent and often resulted in bad PR. For example, the Energy Crops Scheme offered subsidies for farmers to plant bioenergy crops, and whilst the uptake was reasonable and expanded UK energy crop production, there were significant fallouts. There was no end-market made for these crops and as a result a lot of farmers were left disenchanted and subsequently removed crops. Generation subsides, such as those which have supported the successful operations of Drax Power Company, are now under serious public scrutiny for funding 'unsustainable' imported biomass. Other such schemes have been open to abuse, such as the RHI scandal in Northern Ireland which saw biomass boilers running for no reason to afford financial gain to users.

The position the UK currently finds itself in is one where BECCS is an essential technology required to meet our climate targets –100 out of the 116 scenarios in which we limit global warming to less than 2°C, BECC technology is essential (IPCC, 2018). The UK is in a strong position when it comes to the CCS component, both being an island but also having much heavy industry conveniently located, with locations such as the Humber Cluster showing promise for applications of this technology (Donnison *et al.*, 2020). However, when it comes to the bioenergy component there are still several issues.

The UK has a clear commitment to advancing the biomass and bioenergy industry in the UK, this in part can be evidenced by the long awaited biomass strategy which promises to provide a road map for the UK bioenergy industry in the near term. As well as the investments currently being made in programmes like the Biomass Feedstock Innovation Programme (BFIP) and other such funding calls as part of the Net Zero funding portfolio. However, the overcoming some of the barriers discussed below will be essential to ensuring such investments provide ROI.

The science

In terms of understanding the carbon dynamics of bioenergy, in a UK context, I would say we are there. We have a good understanding of potential yields for different crops in different regions of the UK. We have a good understanding of the impacts of land use change (LUC) on water and carbon dynamics, and have such tools to support such decision making – [REDACTED] A key knowledge gap for UK bioenergy cultivation are the impacts on other ecosystem services such as biodiversity. Few studies have investigated this area, and [REDACTED].

It is not possible for the UK to rely solely on domestic biomass to meet the aims of the Paris Agreement (Donnison *et al.*, 2020), therefore a robust understanding of how imported feedstocks are cultivated is essential. LUC is well known to be where the carbon accounting or potential benefits can be undone, however for UK energy crops we largely understand this. Internationally, this poses more of an issue as there are more vulnerable landscapes (both carbon and biodiversity) as well as poorer policy

and legal infrastructure to protect such landscapes. However, strong legislation from the UK can help mitigate some such risks. Some work we recently completed on compliance and verification as part of [REDACTED] showed that C+V is an effective means of ensuring sustainable sourcing (Majer *et al.*, N.D).

Policy

To date, the UK has never offered a comprehensive set of policies which support the full bioenergy supply chain. This is one of the fundamental flaws with the Energy Crops Scheme as mentioned above, and a key risk to schemes such as the BIFP. The BIFP is a multi-million-pound investment in supporting the development of new technologies which will support the UK biomass industry. As a lead on one of these projects, and a key message from all the other projects, is that this scheme risks providing little ROI if there is no stimulation of the UK bioenergy industry. At present bioenergy crops do not offer sufficient financial returns for farmers to invest, there is a barrier for farmers in terms of a change in management (less management in most cases but different machinery may be needed, a learning curve etc.) as well as changes in the timing of financial paybacks. For example, SRC willow is harvested every three years where as *Miscanthus* is an annual. Arguably the recent increases in cultivation of *Miscanthus* can in part be due to an annual return, as well as companies such as Terravesta offering security to farmers but offering a minimum purchase price, harvesting and purchase of the feedstock.

Beyond bioenergy is also the lobbying power for things like a carbon price which would be transformative for an industry like bioenergy. Lack of a universal carbon price keeps bioenergy feedstock costs low, making it unattractive to farmers and a low priority investment for industry. With the biomass strategy due to be released imminently, the UK is at a turning point for setting a bioenergy agenda and landscape for future decarbonisation.

An image problem

Given we largely understand the science in terms of bioenergy cultivation, a major barrier for the UK is public understanding of bioenergy and surrounding perceptions. Most of this attention is often aimed at Drax, including weekly media attacks about the import of forest biomass, accusations whole trees are being used (BBC Panorama documentary) and general claims that biomass is dirtier than coal.

There is a strong anti-bioenergy lobby, which includes a number of academics, which continues to tarnish the public understanding of carbon dynamics, forest management and bioenergy. A notable example is a paper by Norton *et al.* (2019) which had a number of non-truths but that gained significant media attention. [REDACTED] a reply, aiming to dispel such myths (Cowie *et al.*, 2021). The public does not understand that active management enhances forest sinks, that the bioenergy portion is taken from waste wood from the timber industry, or that the scale and point at which emissions are counted can completely change the perceived sustainability of the feedstock. Even British MPs seem to fundamentally misunderstand imported biomass (Horton & Harvey, 2023). An education campaign for the general public on the benefits of bioenergy and the potential for BECCS is necessary to ensure successful and rapid deployment in the UK.

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