Written evidence from Biofuelwatch

The following response is submitted on behalf of Biofuelwatch.

Biofuelwatch has been researching so-called Negative Emissions Technologies (NETs) related to bioenergy (i.e. BECCS and biochar) since 2008. Please see https://www.biofuelwatch.org.uk/geoengineering/ for a list of our relevant reports and articles on this topic. This includes a peer-reviewed article by a Biofuelwatch co-director.

Based on our desktop research and a wide range of peer-reviewed science we have studied, we are deeply concerned that resourcing and potential deployment of NETs could undermine current and near term mitigation efforts, that all of the technologies that are currently proposed are unproven at commercial scale and may never prove scaleable, and that, if commercialised and deployed, they come with a high risk of worsening rather than improving the climate crisis.

We understand that the EAC is specifically considering BECCS and DAC, and will therefore not include any references to biochar, which we have also been researching and consider to be a type of NETs rather than of nature-based solutions.

We hope the committee will recommend that funds which could be used to support NETs instead be invested into energy conservation, efficiency, and genuinely renewable, lower carbon forms of energy production.

This response comes in the form of answers to a selection of the questions posed in the 'terms of reference' listed on the government's website.

We appreciate the opportunity to submit these comments and welcome requests for further information and to give further evidence to the EAC inquiry.

At what technological stage are current NETs, and what is the likely timeframe that will allow NETs to be operational at scale in the UK?

BECCS:

The only scenario involving carbon capture linked to bioenergy production is CO2 capture from ethanol fermentation. CO2 is a byproduct of fermentation which can be captured at relatively low cost from what is a virtually pure CO2-stream. The world's only operational "BECCS" project involves an ethanol refinery in Illinois, US. However, the amount of CO2 emitted from fossil fuel burning to power the refinery exceeds the amount of CO2 captured on an annual basis. Clearly, this process cannot be considered "carbon negative".

One company, Toshiba, announced the commissioning of a biomass demonstration plant with carbon capture in October 2020. Their Mikawa power plant, based in Japan, burns palm kernel residues from Southeast Asia. No further information about the project has been published. We emailed the subsidiary company operating the Mikawa plant on 8th October 2021 asking for information about how much CO2 has been captured, but have received no reply. We would therefore caution the EAC against assuming that this plant is successfully operating with carbon capture.

No other carbon capture project involving biomass combustion has been undertaken so far, with the exception of very small-scale product testing of solvent technologies.

In 2019, Drax commenced such a product-testing trial with the startup company C-Capture. Drax's response to a written question implies that the trial, which involved capturing 1 tonnes of CO2 per day (with Drax

emitting 13m tonnes of CO2 annually from biomass combustion), was not a success. In June 2020, Drax agreed to a similar albeit smaller (300 kg CO2 per day) trial with Mitsubishi Heavy Industries (MHI in June 2020 involving two different amine solvents, one of which had previously been used at the Petra Nova coal CCS project in Texas. That Petra Nova plant was mothballed in 2020, having captured far less CO2 than predicted, and serious questions raised about the cost and success of the carbon capture technology.

The Drax-MHI partnership is now proposing the use of an entirely novel type of amine solvent never demonstrated at scale anywhere. Detailed results of the latest trial have not so far been published. At a consultation in March 2021, Drax admitted in written statements that its BECCS assumptions for energy are not based on trials, or indeed any real-world evidence at all.

It is widely accepted that technology development follows a "technology readiness levels" pathway. On a scale of 1-9, the Drax-MHI partnership has at best reached level 5 (large-scale prototype). The idea that a world-first project such as this could bypass levels 6-8 entirely and succeed at level 9 (full commercial application) right away, as proposed by Drax, seems far-fetched to us.

All of the CO2 captured by Drax so far has been released into the atmosphere.

Please also note that, worldwide, there is only one commercial-scale CCS project involving combustion of a solid fuel (coal): the Boundary Dam Power Station, owned by SaskPower, in Saskatchewan, Canada. That plant has fallen well short of its carbon capture target.

DAC:

As of November 2020 the largest of the handful of facilities implementing direct air capture was only capturing around 4000 tonnes of CO2 per year. A major barrier is the high energy requirement for capturing CO2

from the air. According to a 2020 peer-reviewed study, removing 1 billion tonnes of CO2 would require the equivalent of all total electricity generation in the USA (based on 2017 figures), a figure which excludes downstream life-cycle energy requirements. According to the same study, transporting that amount of CO_2 would require a larger pipeline infrastructure than all global oil handling infrastructure.

What are the trade-offs between availability of land and availability of sustainable biomass to make NETs a viable option in and beyond the UK?

We believe that the main issues here relate to the impacts which potential land-conversions to grow biomass feedstock for future BECCS plants, as well as further logging of forests for such plants would have on the climate, on biodiversity, on food security, on freshwater and soils and - in the case of imported biomass - on land rights and human rights. Those are discussed below in response to the question on economic and social impacts.

Carbon capture and compression requires significant amounts of energy, especially in the case of post-combustion carbon capture and carbon capture with oxyfuel combustion (the latter requiring a lot of energy for purification of oxygen). The only low-energy BECCS pathway that currently exists is CO2 capture from ethanol fermentation which has a very limited potential (see above). This means that large-scale BECCS will inevitably require more biomass to be burned for the same amount of energy output. How large this 'energy penalty' is remains unknown because no real-world data exists.

The authors of a 2013 study calculated that a global BECCS programme aimed at sequestering one billion tonnes of carbon annually would require a minimum of 200 million hectares of land if the feedstock was switchgrass. By comparison, global annual carbon emissions from fossil fuel burning and cement production are 9.9 billion tonnes, hence, land-

conversion on such a large scale would have a very limited impact on reducing annual emissions even assuming zero life-cycle emissions associated with BECCS. Authors of a 2018 peer-reviewed study modelled the land area required for BECCS and found that more than 550m hectares of land would be needed for a 1.5oC pathway modelled by the IPCC that relies heavily on BECCS. By comparison, the entire land area of India is less than 330m hectares. And according to a 2018 report by the Carbon Sequestration Leadership Forum (CSLF) Technical Group, capturing 3.3 billion tonnes of carbon a year with BECCS (still less than many different models foresee) would require between 430 and 580m hectares of land of bioenergy crops.

Clearly, therefore, any meaningful contribution of BECCS to climate policy requires large-scale land use change way beyond anything that has been undertaken for bioenergy production so far.

Looking at Drax, who have put forward the only concrete BECCS proposal in the UK, 97% of their feedstock consists of imported wood pellets, the majority from the Southeastern USA, the Baltic States and British Columbia. Drax power station is not capable of burning large quantities of biomass other than pellets from virgin wood from relatively slow growing trees. Drax currently burns the equivalent of around 138% the UK's annual wood production, so Drax switching to domestic wood sourcing would be neither possible nor desirable in so far as it would result in all other users of wood to shift to importing wood instead.

We see that Net Zero Teesside has mooted the idea of future carbon capture from the MGT Teesside biomass plant. That plant was to supposed to have started operating by March 2018, but is still not generating any electricity. If it was to become operational in future, then it would also burn pellets from North America.

Domestic short-rotation coppicing (SRC) of poplar and willow as well as miscanthus have been proposed as a potential BECCS feedstock source.

Not only would this require significant land use change, but we do not consider it to be a realistic proposition: Despite significant subsidies, no large-scale SRC, miscanthus or switchgrass plantation areas have been successfully established anywhere in Europe or North America. In the UK, the area under SRC willow and poplar has fallen since 2014, while miscanthus is grown on just 8,171 hectares. A 2020 Defra report states that there are no official estimates of achieved yields of miscanthus nor of SRC feedstock in the UK, but that those appear to be highly viable, including according to annual weather as well as site conditions. This makes concrete and realistic land use projects impossible.

Experience from outside the UK also suggests significant obstacles to SRC and miscanthus production. For example, in Ireland, SRC and miscanthus have been heavily promoted, however take up has been negligible. A major obstacle identified there is the fact that, in the absence of subsidies, farmers growing SRC willow will not recover their initial expenses for a period of 10 years. With an initial grant of €1,040/ha, it would still take 7 years for farmers to recoup their outlays.

What are the options for the storage of captured carbon, whether onshore or offshore?

To our knowledge, all potential CO2 storage sites identified in the UK are offshore underneath the North Sea, namely in the Southern North Sea Bunter Sandstone formation . None of the infrastructure for transporting CO2 and injecting it into geological offshore locations has been built so far.

We are concerned about the potential safety risks posed by CO2 pipelines and storage, about which there has been virtually no public information and debate, even though CO2 is transported in supercritical liquid form, i.e. at far higher pressures than oil or gas. A controlled rupture of a buried dense phase CO2 pipeline by the DNV Spadeadam Research and Testing centre illustrated how such a rupture would expose people adjacent to the rupture site to very high concentrations of CO2. At high

concentrations, CO2 harms and even kills people through intoxication and asphyxiation.

In February 2020 a CO2 pipeline ruptured in Satartia, Mississippi. 49 people had to be hospitalised and even months later residents of the town reported experiencing mental fogginess, lung dysfunction, chronic fatigue and stomach disorders. According to the County Emergency Management Agency director, lives were saved by the wind direction blowing the CO2 cloud away from where people were exposed.

Both the proposed "Low Carbon Humber Pipeline" and the "Net Zero Teesside" pipeline would pass underneath populated and in some places densely populated areas, yet to our knowledge health and safety risks associated with potential CO2 inhalation have not been assessed at all.

With regards to the proposal to store CO2 at the Endurance storage site offshore, we note, in 2016, the Strategic UK CO2 Storage Appraisal Project concluded that key information had not been published and that they could therefore not fully assess the suitability of this site. The most recent consultation report on the carbon storage project provides no evidence other than modelling with regards to offshore leakage risks and caprock integrity, and does not cite any actual trials having been conducted. This seems a poor basis for deciding whether to spend what would have to be many billions of pounds in public subsidies on a carbon storage project.

What other drawbacks for the environment and society would need to be overcome to make NETs operational?

DAC:

As stated above, the main concern is the extremely high energy requirement of DAC, regardless of whether it involves sorbents or aqueous solutions containing amines. According to a 2016 peer-reviewed study, capturing 1 billion tonnes of carbon through DAC would require 156 EJ of energy input. By comparison, wind, solar and tidal power

together generate just over 53 EJ of energy per year worldwide. Therefore, using low-carbon renewable energy sources to power DAC, regardless of scale, would make them unavailable for replacing fossil fuels, thus undermining the key priority of reducing greenhouse gas emissions.

BECCS and DAC:

We have commented on the health and safety risks of CO2 transport and storage above. We also note that according to a 2015 report by SEPA (amongst other sources), amines degrade to nitrosamines and nitramines which are potential carcinogens, but that there is insufficient knowledge about the toxicity of different components, that there are no environmental assessment levels or environmental quality standards for such compounds in the UK as yet, and that , essentially too little research has been carried out into the potential public health health impacts of amine emissions to water or air. We are not aware of any UK studies having been commissioned into this since then.

BECCS:

1. As shown above, the only concrete BECCS proposal in the UK involves combustion of imported wood pellets. The impacts of wood pellet sourcing on forests, biodiversity and on the climate are discussed in detail in a joint response with NRDC, Southern Environmental Law Center, Dogwood alliance and Stand.earth.
2. BECCS, if it was to ever become operational at scale, can only be considered 'carbon negative' if the carbon losses which logging causes in forest ecosystems (including loss of soil carbon) and the foregone carbon sequestration due to that logging are ignored. In the USA, where most of Drax's wood pellets come from, logging is responsible for 85.3% of forest carbon loss, and it is diminishing the net forest carbon sink by 35%, not including soil carbon losses. The UK is so heavily dependent on net imports of wood and wood products that increased use of UK forest wood for energy must

indirectly result in greater imports. Climate impacts, too, are discussed in detail in the joint NGO response we support.

3. Wood pellet production is commonly associated with serious local environmental and public health impacts. In February, a Drax-owned wood pellet plant in Mississippi was fined $2.5 million for breaching air pollution rules. This was the largest known penalty awarded to such a facility to date, and related to the plant's emission of excessive volatile organic compounds (VOCs) going back numerous years. In July 2021, CNN reported on the conditions in Northampton County, North Carolina, where the world's largest producer of biomass, Enviva, has had a facility for the past eight years. In 2018, according to the US Centres for Disease Control and Prevention, more than one in ten adults in the area had asthma.
4. If energy crops were used as a feedstock, this would have large impacts on water and fertiliser use. According to a previously cited 2013 study, capturing 1 billion tonnes of carbon through BECCS based on switchgrass would require 20% of global nitrogen fertiliser production and consume 4 trillion m3 of water a year.
5. Energy crops and tree plantations grow much faster in tropical than in temperate regions. If BECCS based on fast-growing feedstocks was ever commercialised, it would therefore likely result in large-scale imports from global South, resulting in land-grabbing and carrying a high risk of leading to further deforestation as has been happening due to European biofuel mandates.

The Government has indicated it will publish a Biomass Strategy in 2022, including the role of BECCS. What should be included in this strategy?

The scale of bioenergy use in the UK is far from sustainable, as shown by the fact that Drax alone burns more wood than the UK produces annually. We believe that energy subsidies must be reserved for those forms of energy that result in the lowest life-cycle emissions and the least environmental impacts, as well as for home insulation and other energy

conservation and efficiency measures. This means sensibly sited wind, solar, wave and tidal power. We would like to see biomass power subsidies in particular redirected to those low-carbon renewable energy sources. Furthermore, we believe that energy crops and bioenergy from energy crops (such as biomethane) should not be subsidised because of the adverse impacts of land use change on the climate, on biodiversity, and on food security. Public funding should not be made available for attempts to develop BECCS.

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