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Re: Call for Evidence - Greenhouse Gas Removals

The undersigned organisations are writing to respond to the Call for Evidence on Greenhouse Gas Removals.[1] We give permission for this response to be shared with third party contractors for purposes of BEIS's analysis. Our organisations' response focuses solely on the use of bioenergy with carbon capture and storage ("BECCS") from forest biomass. We respond specifically to Questions 2, 3, 15, and 25 of the call for evidence.

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Question 2: Do you agree that some greenhouse gas removal methods will be required to achieve the UK's net zero target by 2050? What are your views on the suitability and mix of different technologies in supporting delivery of net zero?

Reliance on large-scale implementation of BECCS from forest biomass will undermine the UK's efforts to reach net-zero emissions by 2050. Today, one of the biggest risks to the UK's ability to achieve its net-zero target is continued public subsidies to biomass electricity—a technology that increases the risk of overshooting Paris Agreement targets and locking in dangerous climate change. As recognized by the Intergovernmental Panel on Climate Change ("IPCC"), the 1.5° target can be reached without any BECCS and with a significantly reduced role of biomass electricity.[2]

Based on the UK's decade-long experiment with large scale biomass-burning in the power sector, we know that:

[1] Greenhouse Gas Removals Call for Evidence, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941191/greenhouse-gas-removals-call-for-evidence.pdf.
[2] IPCC, *Special Report: Global Warming of 1.5°C - Summary for Policymakers* at 14, 17 (2018), https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf ("Significant near-term emissions reductions and measures to lower energy and land demand can limit CDR deployment to a few hundred GtCO2 without reliance on bioenergy with carbon capture and storage (BECCS) (*high confidence*).").

1. A great deal of the biomass that is claimed to be "wastes and residues" is not. For example, most wood pellets imported from forests of the U.S. Southeast (the top pellet supply region for the UK), are made from harvested whole trees. Per Drax's 2019 Annual Report to Investors, 65% of the company's wood pellets were imported from the forests of the U.S. Southeast, and 55% of those imports came from two categories of biomass feedstock: "thinnings" and "low-grade roundwood." Globally, these categories represent 46% of the more than 7 million tonnes of pellets Drax imported in 2019.[3] These terms are industry jargon for whole trees.

2. The research on the net climate impacts of burning trees in power stations is well established.[4] Harvesting and burning these biomass feedstocks in the power sector has a negative impact on the climate, with consequences that can persist for multiple decades or even centuries—far outside Paris Agreement timeframes.[5] This holds true even under the industry's definition of "sustainable" biomass sourcing of thinnings from managed forests.[6]

3. Critically, this also holds true with or without CCS. BECCS relies on the premise that because forests and other plants absorb carbon as they grow, bioenergy is "carbon neutral." Proponents argue that when biomass is burned to fuel a power station, capturing and sequestering the smokestack CO_2 emissions would thus make the process "carbon negative." However, as explained below, the evolving research on carbon accounting suggests that policymakers are overlooking key technical factors in determining the net carbon impacts of biomass harvest for energy production under BECCS.

   In addition to the large supply chain emissions in processing and transporting wood pellets, burning biomass for electricity increases emissions in three key places:

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[3] Drax, *Annual Report and Accounts 2019* at 42, https://www.drax.com/wp-content/uploads/2020/03/Drax_AR2019_Web.pdf [hereinafter "Drax Annual Report"].
[4] *See, e.g.*, Letter from 500+ Scientists re: Use of Forest Bioenergy (Feb. 11, 2021), https://beta.documentcloud.org/documents/20482842-scientist-leter-to-biden-van-der-leyden-michel-suga-moon-february-11-2021; Letter from 800 Scientists to EU Parliament re: Forest Biomass (Jan. 14, 2018), http://www.pfpi.net/wp-content/uploads/2018/04/UPDATE-800-signatures_Scientist-Letter-on-EU-Forest-Biomass.pdf.
[5] Chatham House, *Woody Biomass for Power and Heat* (2018), https://www.chathamhouse.org/2018/06/woody-biomass-power-and-heat/accounting-biomass-carbon-emissions; Timothy D. Searchinger et al., *Fixing a Critical Climate Accounting Error*, 326 Science 527-528 (2009), http://www.sciencemag.org/content/326/5952/527 (also available at: https://www.pfpi.net/wp-content/uploads/2011/03/Searchinger-et-al-2009.pdf).
[6] Spatial Informatics Group, *The Carbon Impacts of UK Electricity Produced by Burning Wood Pellets from Drax's Three U.S. Mills* (2019), https://www.southernenvironment.org/uploads/publications/2019-05-27_Drax_emissions_-_SIG_report_Phase_II.PDF [hereinafter "SIG Carbon Study"].

A. Biomass plants emit CO_2 at the smokestack, effectively transferring the harvested forest carbon into the atmosphere.[7]
B. Biomass harvest in forests releases carbon from the soil.[8]
C. On the landscape, replacing older trees with saplings after harvest reduces the amount of carbon stored in the regrowing forest, even under the best-case scenario in which trees are replanted and regrow immediately. This is a significant source of emissions, known as foregone sequestration.[9]

Even with CCS, biomass will in most cases be a carbon source rather than a carbon sink. **While CCS can in theory capture and store smokestack emissions, it can never mitigate emissions from foregone sequestration or process/transport emissions, which are, in effect, long-term and *'uncapturable'* in a BECCS scenario.** Specifically, even assuming near complete capture of stack emissions onsite at the power plant, carbon capture cannot eliminate the post-harvest degraded sequestration on the landscape or process/transport emission, all of which occur offsite. Thus, adding CCS to these plants does not result in negative emissions.

These principles are discussed in more detail under question #3 below.

4. Emissions from industrial scale biomass burning in the power sector are dramatically undercounted and no mechanism currently—at the national or international level—is accurately picking this up. To date, the third key aspect of carbon accounting, foregone sequestration, has been neglected in the UK and elsewhere.[10]

5. As a result, much of the credit that has been taken for decarbonising the UK power sector is simply not real. This is troubling on its face, but even more so because to the extent

[7] European Academies' Science Advisory Council, *Commentary by the European Academies' Science Advisory Council (EASAC) on Forest Bioenergy and Carbon Neutrality* (2018), https://easac.eu/fileadmin/PDF_s/reports_statements/Carbon_Neutrality/EASAC_commentary_on_Carbon_Neutrality_15_June_2018.pdf ("Carbon emissions per unit of electricity generated from forest biomass are higher than from coal and thus it is inevitable that the initial impact of replacing coal with forest biomass in power stations is to increase atmospheric carbon dioxide levels.").
[8] David L. Achat et al., *Forest Soil Carbon Is Threatened by Intensive Biomass Harvesting*, 5 Scientific Reports art. 15991 (2015), https://www.nature.com/articles/srep15991; Steven P. Hamburg et al., *Losses of Mineral Soil Carbon Largely Offset Biomass Accumulation 15 Years After Whole-Tree Harvest in a Northern Hardwood Forest*, Biogeochemistry 144, no. 1 (2019), https://scholars.unh.edu/ersc/209/; E. D. Vance et al., *Environmental Implications of Harvesting Lower-Value Biomass in Forests*, 407 Forest Ecology and Management 47-56 (2018), https://www.researchgate.net/publication/322176494_Environmental_implications_of_harvesting_lower-value_biomass_in_forests.
[9] N. L. Stephenson et al., *Rate of Tree Carbon Accumulation Increases Continuously With Tree Size*, 507 Nature 90-93 (2014), https://www.nature.com/articles/nature12914.
[10] M. T. Ter-Mikaeilian, S. J. Colombo, and J. Chen, *The Burning Question: Does Forest Bioenergy Reduce Carbon Emissions? A Review of Common Misconceptions About Forest Carbon Accounting*, 11 Journal of Forestry 57-68 (2015), https://www.researchgate.net/publication/271224456_The_Burning_Question_Does_Forest_Bioenergy_Reduce_Carbon_Emissions_A_Review_of_Common_Misconceptions_about_Forest_Carbon_Accounting.

that the UK overshoots its power sector targets (where genuinely non-emitting alternatives are abundantly available at a fraction of the cost of burning wood for electricity), it will mean having to go farther and faster to decarbonise other, harder-to-abate sectors of the economy (e.g. transport, heavy industry), increasing the overall costs of achieving climate targets.

Nevertheless, many forward-looking climate plans appear to be ignoring the lessons above instead of learning from them. Too many scenarios, including from the Committee on Climate Change ("CCC") and National Grid, rely on industrial scale BECCS deployment to achieve net-zero emissions by mid-century. Thus, much of the future abatement from bioenergy that climate plans being developed today rely on will simply not materialise. As the authors of a 2020 Chatham House research paper warned, "The danger at the moment is that policymakers are 'sleepwalking towards BECCS' simply because most models incorporate it."[11] **Rather than prioritising additional subsidies to run BECCS at Drax, a high priority from a climate perspective would be to replace Drax and other industrial scale bioenergy with low-carbon renewables.**

Large scale biomass-burning at Drax and elsewhere also sacrifices genuine opportunities to remove atmospheric CO_2 because it requires harvesting trees, whereas maximal CO_2 removal is achieved by letting forests grow.[12] Protecting and restoring natural carbon sinks, including forests, peatlands, grasslands, and wetlands are the most effective and proven ways of sequestering carbon and are thus critical. In addition to pulling CO_2 out of the air and storing it in organic materials, these approaches can secure food supplies, improve the resilience of ecosystems and communities, and enhance biodiversity.[13]

<u>Question 3:</u> In relation to the GGRs listed in Figure 1 (except afforestation, habitat restoration and wood in construction), is there new evidence that you can submit in relation to any of the following:

(i) technology readiness levels;
(ii) scale-up potential (in the UK and/or globally);
(iii) costs per tonne of CO2 removed;
(iv) constraints to deployment;
(v) ability to verify removals;

[11] Chatham House, *Net Zero and Beyond: What Role for Bioenergy with Carbon Capture and Storage?* (2020), https://www.chathamhouse.org/2020/01/net-zero-and-beyond-what-role-bioenergy-carbon-capture-and-storage.
[12] Bronson W. Griscom et al., *Natural Climate Solutions*, 114 PNAS 11645-11650 (2017), https://www.pnas.org/content/114/44/11645.
[13] Kate Dooley & Doreen Stabinsky, *Missing Pathways to 1.5°C: The Role of the Land Sector in Ambitious Climate Action*, Climate Land Ambition and Rights Alliance (2018), https://static1.squarespace.com/static/5b22a4b170e802e32273e68c/t/5bef947f4fa51adec11bfa69/1542427787745/MissingPathwaysCLARAreport_2018r2.pdf.

(vi) lifecycle emissions for these methods in the UK;
(vii) wider environmental impacts and risks.[14]

As a greenhouse gas removal technology, BECCS, by definition, must be scalable. It is therefore critical to understand what feedstock scenarios, in the context of a BECCS system, can and cannot deliver negative emissions.

UK biomass supply chains, at scale, are dominated by a) woody biomass, which we define as biomass taken directly from forests; and b) imports from overseas forests. A truly de minimus share of biomass burned for industrial scale electricity production in the UK comes from domestic sources.[15] Drax alone burns more imported wood a year than the UK produces for all uses.[16]

There has been much discussion of a transition to domestic biomass production in the UK as a replacement for imports—for example, agricultural residues and energy crops. However, at this time, these domestic supply chains remain only theoretical; indeed, there is little to no evidence that such a transition away from imported biomass is underway.

On the contrary, existing supply chains, dominated by imports, are expanding, locking in biomass imports into the UK energy market. Just this month, Drax announced that it will purchase Pinnacle Renewable Energy, a Canadian wood pellet manufacturer with operations throughout western Canada and the state of Alabama in the United States. Per reporting, the acquisition will more than double Drax's pellet production capacity and make Drax itself the third largest pellet manufacturer in the world. With the addition of Pinnacle's 11 sites, Drax will own 17 pellet plants and development projects. This will give Drax the capacity to produce 4.9 million tonnes of wood pellets annually from 2022, with access to four deep water port facilities and three major wood fibre baskets. Far from investing in domestic biomass supplies, the acquisition accelerates Drax's well-documented and reported-on objective to increase its available self-supply of biomass to 5 million tonnes per year.[17]

At the same time, scalability in terms of domestic biomass production poses an enormous challenge, since supplying many of the feedstocks assumed to be replacement options would come with a host of risks. As described by Ember in its October 2020 report, all net-zero scenarios modeled in the National Grid ESO's *Future Energy Scenarios (FES) 2020* require

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[14] Although not the main focus on this response, the large-scale implementation of BECCS from forest biomass also presents a significant risk of wider environmental impacts, including to biodiversity and land conversion. *See, e.g.*, Felix Creutzig et al., *Considering Sustainability Thresholds for BECCS in IPCC and Biodiversity Assessments*, GCB Bioenergy (2021), https://onlinelibrary.wiley.com/doi/10.1111/gcbb.12798.

[15] According to Drax, domestic sourcing was 0.44% of total wood pellets burned at Drax Power Station in 2019. Drax Annual Report, *supra* note 3.

[16] Forest Research, *Forestry Statistics 2020: Timber*, https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2020/2-timber/.

[17] Erin Voegele, *Drax Signs Agreement to Acquire Pinnacle Renewable Energy*, Biomass Magazine (Feb. 8, 2021), http://biomassmagazine.com/articles/17715/drax-signs-agreement-to-acquire-pinnacle-renewable-energy.

conversion of up to 1Mha of UK land—around 7% of total agricultural land—to energy crop production. The highest-ambition scenario requires an additional global conversion of 200Mha—an area the size of Greenland.[18]

The CCC also states that meeting biomass demand for BECCS with domestic sources would require converting UK cropland to grow energy crops.[19] Reducing the land available for food production risks either greater intensification of agriculture or a reduction in agricultural output. If biomass production has to rely on agricultural intensification in combination with monoculture biomass plantations, it risks damaging biodiversity if forests are converted to plantations heavily reliant on agrochemicals.

Further, producing bioenergy crops at the scale required to meet BECCS demand may not be the best use of land to generate negative emissions. Once the carbon costs of pesticide use, fertiliser use, harvesting and transportation are factored in, any climate mitigation that is realised may be lower than if the same land was used for another carbon-absorbing activity, such as native tree-planting. Per Ember, "although it is technically possible to achieve these various supply scenarios, given the enormous scale of land they require for energy crop production, they are littered with very significant implications around food competition, water consumption, pesticide use, and biodiversity impacts."[20]

Moreover, biomass-burning power stations like Drax are not set up to support these alternative feedstocks. Widespread use of energy crops would require equipment changes, such as new boiler systems at power plants. Most UK biomass power plants were built to process wood pellets—which have broadly standardised specifications—and can only burn small percentages of agricultural residues owing to their often abrasive effect on machinery when combusted.[21]

Finally, across the scenarios modeled by the CCC in its Sixth Carbon Budget, even in the mid-century time frame, imports still comprise a significant share of UK biomass. The Balanced Pathway (the main modeled pathway) has 21% from imports, and at the highest end imports make up 42% of the biomass used for energy in the CCC's modeling.[22]

For these reasons, it is critical for BEIS to improve its understanding of the climate impacts of the UK's existing biomass energy programme, which is dominated by imports of forest biomass, and depends in particular on wood pellets from the southern United States. Specifically, before

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[18] Ember, *Gambling with Biomass: Reliance on BECCS Undermines National Grid's Net-Zero Scenarios* (2020), https://ember-climate.org/commentary/2020/10/28/gambling-with-biomass/ [hereinafter "Ember BECCS Report"].
[19] Committee on Climate Change, *Land Use: Policies for a Net Zero UK* (2020), https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/.
[20] Ember BECCS Report, *supra* note 18.
[21] *UK's CCC Advises BECCS, Domestic Biomass Supply* (2020), https://www.argusmedia.com/es/news/2167380-uks-ccc-advises-beccs-domestic-biomass-supply.
[22] Committee on Climate Change, *The Sixth Carbon Budget: The UK's Path to Net Zero* (2020), https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf.

putting in place expensive additional subsidies for more large-scale biomass-burning in the power sector, BEIS must account for all relevant technical factors in determining the net carbon impacts of biomass harvest for energy under BECCS.

As noted above, even with CCS, forest biomass will likely be a significant carbon source rather than a carbon sink for many decades. Thus, adding CCS to forest biomass power plants in the UK does not result in negative emissions within the timeframe needed to address the impacts of climate change.

There are three primary sources of emissions associated with burning wood pellets for electricity under a scenario without carbon capture (in addition to the emissions from soils after logging operations as noted under Question #2 above):

1. First are the emissions from processing and transport of pellets—which include emissions from trucking, drying, processing, and shipping.

2. The second are stack emissions at the power plant itself, which represent the transfer of carbon from the forest to the atmosphere in the power plant.

3. The third is foregone sequestration: it is the loss of carbon sequestration in the forest after it is logged. Foregone sequestration results from replacing an older tree with a younger tree. It is the carbon storage that would have occurred over time in the uncut forest that never materialises—even accounting for regrowth of the new forest. Specifically, it is the difference between the post-harvest growth of younger understory or planted saplings, compared to the growth of the older forest that would have remained uncut in the absence of bioenergy demand.[23] This too represents an emission since it results in a net increase of carbon in the atmosphere.

In a scenario using BECCS, the stack emissions at the power plant would *in theory* be captured and stored. **<u>But it is critical to note that process/transport emissions and the foregone sequestration are *uncapturable*</u>. These offsite emissions are released to the atmosphere regardless of on-site efforts in the UK to capture stack emissions at the power plant.**

Two studies have analyzed Drax's sourcing of "thinnings" from plantations in the southeastern United States to produce pellets as fuel in the UK.[24] They analyze the thinning of existing plantations[25] to produce pellets for electricity—as opposed to clearcutting natural forests or other

[23] Thinning in a plantation reduces the carbon in the system <u>and</u> reduces the growing stock of trees. After a thin, there is a considerable period of time (on the order of several decades) during which the carbon added by the regrowing forest is far less than the carbon that would be added in an unthinned forest.
[24] Memorandum from Hammerschlag LLC to Natural Resources Defense Council (Feb. 2020) (pre-publication) [hereinafter "Hammerschlag Pre-Publication Memo"]; SIG Carbon Study, *supra* note 6.
[25] These analyses compare two scenarios: how does a forest grow and accumulate carbon without additional bioenergy demand from Drax. This scenario is compared to a scenario depicting how the forest grows and regrows

more intensive management practices—and therefore represent a "best case" scenario from a climate standpoint.[26]

When considering the "uncapturable" emissions, the studies show that when burning pellets for electricity, CCS cannot mitigate emissions from foregone sequestration or process/transport emissions for many decades.

The first study conducted by the Spatial Informatics Group shows that transport/process and foregone sequestration emissions to the atmosphere total approximately 860 kg CO_2/MW-hr on average for the next two and a half decades.[27] The second analysis conducted by Hammerschlag LLC, shows the combined emissions for transport/process and foregone sequestration of 710 kg CO_2/MW-hr on average over the next three decades.[28]

For comparison, the stack emissions from burning pellets for electricity at a power plant in the UK such as Drax's is approximately 900 - 965 kg CO_2/ MW-hr.[29] **These results mean that the *uncapturable* emissions from pellet sourcing and production are comparable to the stack emissions themselves from a power plant for a period of several decades.** Put differently, the uncapturable emissions constitute approximately 43 - 48% of the total lifecycle emissions for sourcing and burning pellets that are sourced from forest thinnings in plantations in the southeastern U.S.

The results illustrate the shortcomings of the misplaced hopes on negative emissions associated with forest bioenergy in conjunction with carbon capture. In sum, offsite emissions are long-term and *'uncapturable'* in a BECCS scenario. BECCS using pellets sourced in the southern U.S. and

after a cut with bioenergy demand. Foregone sequestration is determined by looking at the difference between the two.

[26] The results of these studies are also conservative since much of the biomass imported to the UK from the U.S. Southeast continues to be sourced from clearcuts of mature hardwood forests and includes whole trees and other large-diameter wood known to be high-carbon. This is a routine industry practice in the region, as documented in multiple independent investigations. Emma Gatten, *UK 'Green' Biomass Sourced from Forests with 150 Year Old Trees*, The Telegraph (June 15, 2020), https://www.telegraph.co.uk/news/2020/06/15/emissions-renewable-biomass-should-taxed-report-says/; Dogwood Alliance, Natural Resources Defense Council, Southern Environmental Law Center, *European Imports of Wood Pellets for "Green Energy" Devastating US Forests* (2019), https://www.nrdc.org/sites/default/files/european-imports-wood-pellets-greenenergy-devastating-us-forests.pdf; Channel 4 Dispatches, *The True Cost of Green Energy* (aired Monday Apr. 16th, 2018), http://www.channel4.com/programmes/dispatches.

[27] SIG Carbon Study, Figure 3b, *supra* note 6.

[28] Hammerschlag Pre-Publication Memo, *supra* note 24.

[29] Duncan Brack, Chatham House, *Woody Biomass for Power and Heat: Impacts on the Global Climate* at Table 2 (2017), https://www.chathamhouse.org/sites/default/files/publications/research/2017-02-23-woody-biomass-global-climate-brack-final.pdf; Mary Booth, *New UK Biomass Policy Removes Subsidies for High-Carbon Wood Pellets* at Table 2 (2018), https://www.pfpi.net/new-uk-biomass-policy-removes-subsidies-for-high-carbon-wood-pellets#:~:text=New%20UK%20Biomass%20Policy%20Removes%20Subsidies%20For%20High%2DCarbon%20Wood%20Pellets&text=The%20policy%20sets%20a%20new,for%20wood%20pellets%20to%20meet; Spatial Informatics Group, *Biomass Stack Emission Estimates for Drax Power Plants in the UK 2013-2017* at Table 2 (2017), https://www.southernenvironment.org/uploads/publications/SIG_Drax_stack_emission_calculations_2017-03-01_final.pdf.

burned in a power station in the UK cannot eliminate the post-harvest degraded sequestration on the landscape or the emissions from processing and transport. Thus, adding CCS to these plants does not result in negative emissions in timeframes needed to address climate disaster.

<u>Question 15:</u> Are there any international examples that have proved effective at incentivising GGRs? Why were they effective, and are there any barriers to taking similar action in the UK? Are there examples of international approaches that have not worked well?

There are no examples anywhere in the world of BECCS operating at scale. CCS is difficult and expensive, and BECCS especially so. According to the global CCS institute, as of 2019, five facilities around the world were capturing—not necessarily storing—a combined total of 1.5 million tonnes per year of CO_2. All of these are from ethanol plants—a very different process from biomass combustion—and four are using the captured CO_2 for Enhanced Oil Recovery. The current Drax pilot project is listed as one of just three more in development.[30] This is a far cry from the nearly 13 million tonnes of annual CO_2 emissions from Drax's smokestack.[31] To pin all our hopes of greenhouse gas removal on such a speculative technology is a risk we cannot afford to take.

<u>Question 25:</u> What are your views on the government's intention to coordinate deployment of GGR technologies such as DACCS and BECCS in line with our stated CCUS ambitions, and how could we best do this?

As stated in more detail above, because the underlying bioenergy is not carbon neutral BECCS cannot achieve negative emissions. The government's intentions to deploy BECCS at scale would therefore contravene its goals of achieving net-zero emissions by 2050.

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For the reasons set forth above, the undersigned organisations urge the UK Department of Business, Energy & Industrial Strategies to reject the biomass industry's attempt to further entrench its climate damaging practices by providing support for bioenergy with carbon capture and storage. BECCS cannot deliver negative emissions and will not help the UK reach its climate ambitions.

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[30] Global CCS Institute, *Bioenergy and Carbon Capture and Storage* (2019), https://www.globalccsinstitute.com/wp-content/uploads/2019/03/BECCS-Perspective_FINAL_18-March.pdf.

[31] Drax Annual Report, *supra* note 3.

Respectfully submitted by:

Biofuelwatch
Dogwood Alliance
NRDC (Natural Resources Defense Council)
Southern Environmental Law Center