

BECCS DONE WELL

Conditions for Success for Bioenergy with Carbon Capture and Storage

**Prepared by
The High Level Panel on BECCS Done Well**

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Disclaimer: The views and recommendations expressed in this Report reflect those of the High Level Panel Members, not necessarily those of the organisations the Members or Expert Witnesses are associated with.

The High Level Panel has had full editorial control over the contents of this Report, whilst acknowledging the support of *Drax Group plc* in commissioning *Forum for the Future* to design and facilitate the process. The Report has been written for Drax, but is in no way endorsed by Drax.

The following Supplementary Material can be downloaded at this [link](#):

- Drax Submission and Social Supplement
- Expert Witness Session Summaries and Written Evidence Submissions

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EXECUTIVE SUMMARY

In an ideal world, political leaders would have acted on the 1992 Framework Convention on Climate Change systematically to reduce emissions of greenhouse gases over the last 30 years. They didn't. They did the opposite: 50% of current greenhouse gas concentrations in the atmosphere have been emitted since 1992¹.

As a result, humankind now finds itself in the midst of a full-on Climate Emergency. As of the end of 2022, UN experts tell us we are on track to an average temperature increase of 2.5°C by the end of the century, with a vanishingly small prospect, at this very late stage, of restricting that temperature increase to no more than 1.5°C – still seen by climate scientists as the best chance we have of ensuring a reasonably stable climate for ourselves and for all future generations.

That cumulative, collective political failure all but guarantees what is called 'overshoot': with such high concentrations of greenhouse gases already in the atmosphere, the only sustainable way of avoiding a cataclysmic outcome for humankind will be to draw down billions of tonnes of CO₂ back out of the atmosphere. Dealing with overshoot means Carbon Dioxide Removals – with billions of tonnes of removals and storage needed every year by 2050. A number of Negative Emissions Technologies – both nature-based and technology-based – will be required to make that possible. And BECCS (Bioenergy with Carbon Capture and Storage) is very much in that mix.

Indeed, BECCS is on the cutting edge of today's emerging Negative Emissions Technologies. It refers to the combustion of woody biomass to generate both electricity and heat, with the CO₂ emissions from that process removed from the flue gases (sometimes through the use of specialist solvents) then compressed and transported via a purpose-built pipeline to be injected into depleted oil and gas reservoirs or saline aquifers, effectively locking that CO₂ away on a very long-term basis.

The contribution from BECCS is projected to expand significantly over the course of the next 30 years. Throughout this Report we have flagged the importance of taking a precautionary approach to this projected expansion, regarding complex issues like Indirect Land Use Change^r (see page 53) carbon payback periods, supply chain emissions, and community engagement.

In and of itself, there is now only a tenuous justification for using public money to subsidise the burning of biomass to produce electricity alone. There are many better ways of producing low carbon electricity, particularly solar and both onshore and offshore wind, although balancing large amounts of renewables on the grid can be challenging. The UK's current subsidy regime supporting renewables by burning biomass will end in 2027².

Government support for BECCS to remove and store CO₂ (rather than for bioenergy without CCS) is a different matter, and we believe this is justified given the 'overshoot' challenge referred to above. This Report is not about policy design, but from an affordability point of view, 'value for taxpayers' money' is just as important as regards BECCS as it is in terms of allocating subsidy to different sources of renewable electricity. The critical consideration here is that Drax's proposed BECCS plant at its power station

near Selby in North Yorkshire gives the UK the best possible chance of testing those economic criteria at scale in the near term.

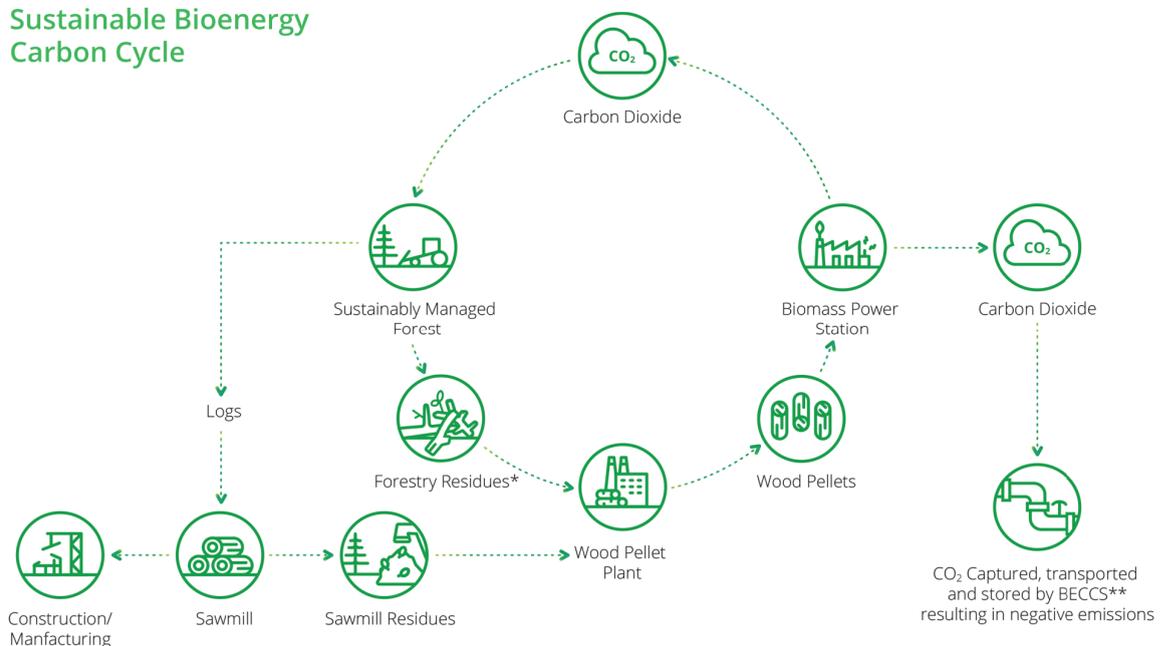
The scale of the proposed BECCS plant at Selby is enormous, raising significant ‘first of a kind’ engineering issues both from the capture and the storage perspectives. By any standards, this is a high-risk venture, but we believe such an ambition level is indeed appropriate given the scale of the challenge the UK faces in delivering on its Net Zero by 2050 target.

The capture and storage element of this complex supply chain comes right at the end. We’ve also looked all the way upstream, to the sourcing of the millions of tonnes of biomass that underpin the entire process, investigating many of the controversies that surround this industry: forest management, feedstock classification, certification, biodiversity protection, community engagement, monitoring and transparency. But we make no claim to provide a comprehensive treatment of any of these areas: our task has been to propose a set of conditions that Drax must meet if it is going to be able to demonstrate that BECCS can indeed be ‘Done Well’.

In conclusion, coming at it from four very different perspectives as members of the High Level Panel collectively responsible for this Report (see page 14), we believe BECCS can be done well – subject to the Conditions we have developed.

And that is globally significant. Without BECCS in the emerging portfolio of Negative Emissions Technologies, dealing with the overshoot challenge would become all the more problematic.

Sustainable Bioenergy Carbon Cycle



*Forestry residues includes branch tops and bark, thinnings and low-grade roundwood. **BECCS is a bioenergy carbon capture and storage system where CO₂ from renewable power generation is captured and stored underground.

Figure 1 - The BECCS Carbon Cycle. Source: The Glasgow Declaration on Sustainable Bioenergy, 2021.

KEY FINDINGS

1. Even if sustainably sourced, burning woody biomass is neither the cheapest nor the most efficient way of generating renewable electricity. By capturing and permanently storing the resulting CO₂ emissions, however, companies like Drax can make a significant and relatively rapid contribution to Net Zero targets through delivering these 'negative emissions'. There are currently no BECCS plants using woody biomass other than Drax's own pilot plant.
2. Woody biomass from well-managed forests (including thinnings and low-grade roundwood) and from waste matter from sawmills (sawdust, bark etc) can make a sustainable and economically significant contribution to existing forestry operations and local economies.
3. Independent third party monitoring, verification and certification is a critical part of this process, especially in terms of protecting biodiversity, water resources, soil carbon, Old Growth forest, and so on. Proactive engagement with local communities is equally fundamental.
4. Importing millions of tonnes of biomass pellets from the USA and Canada is self-evidently a carbon-intensive business. Every effort must be made to reduce greenhouse gas emissions all the way along that supply chain, from forest to final disposal of the captured CO₂ in saline aquifers and depleted oil and gas reservoirs beneath the North Sea.
5. As regards Carbon Capture and Storage (CCS), this Report relates specifically to the use of CCS with bioenergy plants. BECCS will remove some CO₂ from the atmosphere (through sustainable forest biomass to permanent storage), achieving Net Negative emissions. Our Report comments on the overall state of the wider CCS industry, but is not advocating for CCS more broadly. In that regard, members of the Panel have different views about the potential role of CCS, but all agree that CCS on fossil carbon (rather than biogenic carbon) can never be Net Negative.
6. The implications of any significant expansion of BECCS plants globally are significant, necessitating both a highly precautionary approach from governments and private sector operators, and the strictest independent monitoring and governance arrangements to ensure positive outcomes for people, the environment and the climate.

INQUIRY QUESTIONS: SUMMARY OF CONDITIONS

INQUIRY QUESTION ONE: What conditions would need to be complied with to ensure that the sourcing and processing of woody biomass delivers positive outcomes for nature, climate and people?

To deliver BECCS Done Well, it is necessary to:

1. Certification Schemes

Ensure 100% of feedstocks are certified under internationally-recognised sustainable certification schemes that deliver positive social and environmental outcomes to the highest possible standard.

2. Responsible Sourcing Policy

Exercise a policy of 'zero tolerance' with suppliers revealed to be in breach of these certification requirements, over and above compliance with all relevant national and local legislation.

3. Catchment Area Analyses

Ensure 100% of the supply chain is assessed under Drax's Catchment Area Analyses (CAAs), to ensure that Drax is sourcing only from areas with stable or growing carbon stocks, and subject these CAAs to independent peer review. The company must apply this high standard to all forest types in the USA, British Columbia and other sourcing countries.

4. Old Growth/High Conservation Value (HCV) Forests

Strengthen the company's current position on Old Growth / High Conservation Value forests, including an unequivocal commitment not to be involved in forestry operations (or purchase of products from operations) that damage or destroy Old Growth / HCV forests (as defined in each of its principal sourcing areas).

5. Biodiversity/Nature Positive

Commit to substantive forest restoration and biodiversity enhancements, together with local operators, with a view to turning the idea of being 'Nature Positive' into measurable, durable on-the-ground benefits for nature and local communities.

6. Feedstock Assurance

Refine the existing Responsible Sourcing Policy for Biomass to tighten feedstock classification, ensuring complete alignment with classification under the Sustainable Biomass Program. Provide monthly reports on the composition of different feedstocks for each individual pellet mill, for example: sawmill residues (sawdust, bark etc); tree branches and tops; low-grade, diseased roundwood; thinnings; agricultural residues; pulpwood.

7. Best Available Technology

Install Best Available Technology for pollution prevention (covering air, water and soil) on all pellet plants, going beyond local regulatory requirements where necessary.

8. Community Engagement

Set up equitable and inclusive Community Engagement Programmes that reflect the regional context and specific areas of concern to stakeholders. Formalise the importance

of these Programmes through the operation of Regional Advisory Councils (see Condition 28).

9. Smaller Forest Owners

Investigate the possibility of working with smaller forest owners in south east USA to help cover the costs of multiple certifications.

10. Ombudsman

Together with Drax's Independent Advisory Board, investigate the feasibility of establishing an independent Ombudsman covering all Drax's operations globally, reassuring stakeholders that Drax is prepared to be held to account in an appropriately transparent and rigorous way.

11. A 'New Narrative'

Develop a 'new narrative' regarding the company's positioning in the wider forestry industry, ensuring the kind of consistent and totally transparent communications on which trust in its business model depends.

INQUIRY QUESTION TWO: What conditions would need to be complied with to demonstrate that energy from woody biomass makes a positive contribution to decarbonisation, energy security, affordability and a just transition?

To deliver BECCS Done Well, it is necessary to:

12. Third Party Life Cycle Assessment Auditors

Work with NGOs and with independent third party Life Cycle Assessment auditors to agree and validate input assumptions and data along each step of the BECCS value chain. Regularly update the resulting information at least annually for public consumption.

13. Value Chain Decarbonisation

Aggressively reduce emissions both from direct operations and the wider value chain, prioritising investment in renewable power for all pellet-making plants, while scoping out the feasibility of further decarbonisation measures on any new BECCS plants.

14. Working with Suppliers

Investigate options for working with suppliers to invest in low-carbon logging equipment, machinery and transportation.

15. Heat Recovery

Revisit and solve the challenge of maximising heat recovery to be able to produce both low carbon power and heat at the Selby plant, and work with regulators to ensure that all new BECCS plants will be designed to produce both power and heat.

16. Land Availability Constraints

Review the existing analyses of potential availability of land for bioenergy production, at a global, national and regional level, and publish Drax's own assessment of potential constraints.

17. Pellet End-use

In terms of further expansion of pellet sales to global customers, restrict the sale of pellets to end-users that meet the Conditions outlined in this Report, including the potential incorporation of CCS technology into all bioenergy schemes at the design stage.

18. Forest Carbon Stock / Carbon Debt

Restrict the sourcing of biomass feedstocks to extended forest landscapes, within well-regulated jurisdictions, that can demonstrate clear evidence of a constant or (preferably) an increasing carbon stock, through remote sensing and satellite technology, and seek to help grow carbon stocks in all principal sourcing areas.

19. Domestic Feedstocks

Optimise the use of domestic biomass feedstocks here in the UK, subject to detailed consideration of land use constraints and sustainable sourcing conditions. Prioritise local sourcing for all new BECCS plants in other countries to minimise transport-related emissions.

20. Carbon Accounting and Reporting

Engage proactively with key NGOs and academics to explore complexities and controversies in current carbon accounting and reporting methodologies, reaching out to Government departments to help facilitate the dialogue.

INQUIRY QUESTION THREE: What conditions would need to be complied with to ensure that BECCS from woody biomass makes a material, ongoing contribution towards Net Zero targets?

To deliver BECCS Done Well, it is necessary to:

21. Knowledge Transfer Centres

Establish open knowledge-sharing platforms with all existing and prospective BECCS operators globally.

22. Carbon Capture Rates

Given this is a huge 'first of a kind' engineering challenge, Drax and its capture technology partner, Mitsubishi Heavy Industries, may reasonably anticipate relatively low average capture rates in the first year of operation (to make on-site engineering adjustments and adaptations), but must then operate at a 95% capture rate from the start of Year Two.

23. Transparent Reporting

Agree, as a condition of future Government support for Drax's carbon removals, to publicly disclose stack emissions (including SO_x, NO_x, uncaptured CO₂ and capture-solvent derivatives), as well as captured tonnages of CO₂ on a weekly basis. Agree that all such support from taxpayers should be paid retrospectively on the basis of tonnes of CO₂ successfully captured and stored.

24. Negative Emissions Credits

If the company moves to commercialise the negative emissions credits from its Carbon Dioxide Removals, it must be prepared to surrender enough removal credits to ensure its own value chain is strictly Net Zero, and must avoid any double counting once the new standards for negative emissions credits have been agreed.

25. Enhanced Oil Recovery

Continue to prohibit the use of any captured CO₂ for Enhanced Oil Recovery here in the UK, and commit to the same constraint for all future BECCS plants, operated or supplied by Drax, in the USA, Canada and globally.

INQUIRY QUESTION FOUR: What are the implications for Drax of these conditions, and for the wider biomass industry, in terms of policy and governance? How will verification work, in an authoritative and transparent way, demonstrating compliance with these conditions?

To deliver BECCS Done Well, it is necessary to:

26. Precautionary Principle

Consistently apply the Precautionary Principle[†] (see page 53) when making decisions regarding sourcing biomass feedstock and siting new BECCS facilities, particularly as regards the risk of deforestation through Indirect Land Use Change and the need for totally robust certification and governance standards which may exceed local standards.

27. Transparency and Disclosure

For purposes of full transparency across the entire value chain, the company should publish:

- its biomass supply chain GHG emissions, externally assured (as in Condition 12), as it already does today;
- the current emissions from the burning of the biomass in its plant at Selby, prior to the reabsorption of those emissions in new forest growth (as in Condition 22), as it is already required to do;
- and, when the two CCS units are fully operational at the Selby plant, emissions associated with the capture, compression, transport and injection of the CO₂ for storage in saline aquifers or depleted oil and gas reservoirs.

28. Transparency Dashboard

Consult with policymakers and NGOs on setting up a comprehensive Transparency Dashboard, establishing a set of indicators with ambitious targets to generate positive nature, climate and people outcomes, as laid out in earlier Conditions. Put the resulting Dashboard into operation as soon as possible.

29. Regional Advisory Councils

Establish multi-stakeholder Regional Advisory Councils in all principal sourcing regions to reflect a diversity of views and interests, coordinated in conjunction with Drax's existing Independent Advisory Board. Ensure all Community Engagement Programmes are properly represented on these Councils.

30. The Glasgow Declaration

Work with all signatories to the Glasgow Declaration on Sustainable Bioenergy to minimise risks associated with a possible 'boom in new BECCS', particularly in those parts of the world where regulation and enforcement are weak. BECCS Done Well must become the watchword for any emerging global industry, and Drax must take the lead here.

PROJECT SCOPE

The debate about the potential role of BECCS as a Negative Emissions Technology has been a major item in discussions amongst policymakers for many years. It is only in the last two or three years that it has started to command wider attention in the media and with the general public. That has been caused in part by the emphasis on the concept of 'Net Zero': reducing gross emissions of greenhouse gases as rapidly and as comprehensively as possible, and compensating for all residual emissions through drawing down an equivalent amount of CO₂ from the atmosphere (from offsetting, insetting, and so on). There is now growing attention to the scale and complexity of that drawdown challenge.

Governments have calibrated their own pathways for getting to a 'Net Zero' position partly on the basis of those drawdown assumptions – particularly in the USA, the EU and here in the UK. Back in 2012, one of the most significant decisions taken by any western government was to support Drax Power Ltd in the conversion of its huge coal-fired power station, near Selby in North Yorkshire, from burning coal to burning biomass. By 2018, four of its six units had already been converted, making Drax the largest generator of renewable energy in the UK, providing around 12% of that total.

Initially, most NGOs and academics were cautiously supportive of this ambitious transition process. Over the last ten years, however, new data and research has become available, and the majority of NGOs are now either somewhat sceptical or downright hostile about the use of biomass to generate electricity at an industrial scale.

Some of the reasons for this include:

- the unanticipated consequences of the EU's Renewable Energy Directive (RED) remain hugely controversial in that it has accelerated deforestation in some south east Asian countries (through direct and Indirect Land Use Change) to produce palm oil for biodiesel;
- NGOs argue that emissions from the burning of biomass have never been properly accounted for, with the prevailing assumption that biomass should automatically be considered as 'carbon neutral' coming in for more and more criticism;
- NGOs believe that this has led to inappropriate or ill-judged uses of subsidy to support the burning of biomass, when more could have been achieved by supporting alternative (and cheaper) options, including solar and wind power, as well as a host of energy efficiency measures;
- NGOs have argued convincingly that governments are not keeping up with the latest evidence about accelerating climate change (and about critical tipping points in particular), and that these new scientific insights should be urgently taken into account when assessing future policy on bioenergy;
- the projected expansion of uses of different bioresources is seen to be more and more of a problem, in terms of its potential impact on land use (direct and indirect), biodiversity and water consumption in many different countries;
- in that regard, the projected expansion in bioenergy (especially from woody biomass, but also from designated energy crops) is seen as raising many different challenges, but most of all in terms of implications for land use globally;

- the speculative hype on the part of the IPCC and others about possible expansion in the use of Bioenergy with Carbon Capture and Storage (BECCS), a largely untested new technology, is causing additional concern.

Drax has found itself caught up in this swirl of controversy and increased polarisation, including starkly diverging views between many of the scientists involved in this area. Some NGOs now believe that there is no role for unabated bioenergy (i.e. burning biomass without CCS, as currently happens at Drax), and only a very limited role for BECCS at scale. Others acknowledge that there may indeed be a role, but only if certain conditions as to 'BECCS Done Well' are strictly complied with.

Hence this particular initiative, with Drax commissioning Forum for the Future to carry out an independent Inquiry into what those conditions for BECCS Done Well might look like, primarily with a focus on Drax here in the UK, but with an eye to the wider BECCS scene (the Terms of Reference for the project appear as Appendix 1).

To carry out this commission, Forum for the Future convened a High Level Panel made up of a small number of individuals with significant experience and expertise in different aspects of the BECCS value chain (see Appendix 2). Their personal statements appear below. The Panel has operated on the basis of complete editorial independence.

The Panel agreed on a number of Expert Witnesses (reflecting views across the spectrum of opinions regarding BECCS) with whom we were keen to engage, inviting each to contribute a written statement and/or to join us for an hour online to discuss their views. Expert Witnesses (see Appendix 3) were invited to respond to a Preliminary Submission prepared by Drax (Supplementary Material), and a summary of those contributions from Expert Witnesses can be found in the published Supplementary Materials which can be downloaded at the following [link](#).

Our Expert Witnesses included academics and representatives of key stakeholder organisations. The Panel invited an additional 25 experts to contribute, predominantly from the academic and NGO communities, of whom 22 declined for a variety of different reasons, and 3 did not respond. Ideally, we would have liked to include more NGO voices, but that proved difficult. In addition to our Expert Witnesses, we have therefore drawn on a very wide range of published materials (see Appendix 4).

We hope we have done justice to those contributions, even if the conclusions that we have come to as a Panel may diverge from some of the views expressed.

The opening premise here, as is widely acknowledged, is that BECCS will need to play a significant role in the world of Negative Emissions Technologies if we are to remain under or close to that 1.5°C temperature increase threshold. If that's the case, how can scientists, policy makers, the private sector and representatives of civil society ensure that BECCS is developed in the right way, ensuring positive outcomes for society, forest ecosystems, the climate and the economy?

It was therefore agreed to frame this Inquiry in terms of four critical questions:

- 1. What conditions would need to be complied with to ensure that the sourcing and processing of woody biomass delivers positive outcomes for nature, climate and people?***
- 2. What conditions would need to be complied with to demonstrate that energy from woody biomass makes a positive contribution to decarbonisation, energy security, affordability and a just transition?***
- 3. What conditions would need to be complied with to ensure that BECCS from woody biomass makes a material, ongoing contribution towards Net Zero targets?***
- 4. What are the implications for Drax of these conditions, and for the wider biomass industry, in terms of policy and governance? How will verification work, in an authoritative and transparent way, demonstrating compliance with these conditions?***

The project was designed as a fast-moving, six-month process. We had no illusions about what we could and couldn't do in that timeframe. There is a voluminous literature covering every aspect of the complex issues around sustainable biomass and BECCS, and it was not part of our brief to seek to summarise that material. Nor have we been able to do any detailed financial analysis. Our focus has been on thinking through the conditions for BECCS to be done well - and on what it will take for it to be done as well as possible.

We are aware that our Report comes at an important time. There are critical policy decisions pending here in the UK (not least with publication of the Government's new Biomass Strategy now imminent), in the EU (with significant changes pending in the Renewable Energy Directive), and in the USA, where the Inflation Reduction Act is just starting to play out in many areas of energy policy. Many companies are contemplating the implications of these policy developments, with tens of billions of dollars of new investment potentially in play depending how policy develops.

There is an inevitable question about 'boundary conditions' here: what must be addressed and resolved by governments, either acting alone or through international agreements; what must be addressed by the relevant business sectors (forestry, pellet-making, CCS); and what must be addressed and resolved by individual companies acting both in the interests of their shareholders and wider society?

Drax is the second largest pellet producer in the world; it has a significant role to play in the forest industries of those areas from which it sources its raw materials; and it's about to become a very big player in the world of Carbon Capture and Storage. Even so, its boundary conditions are still determined by governments – by their interpretation of the science of climate change (mediated through the IPCC and, here in the UK, by the Climate Change Committee), by their policy-making, target-setting and regulation and enforcement.

It's right that people should expect a lot of Drax, including a legitimate expectation that it should always be prepared to go over and above government policy and regulation when it knows that this is the right thing to do. There are a number of critical areas we will address in this Report (carbon accounting, historical and future bioenergy policy in the EU, use of public money, and so on) where Drax remains entirely dependent on UK and international policy settings, with limited opportunities to step outside those regulated parameters.

We do not believe that this gives Drax a 'free pass' to go on benefiting from transparently inadequate – and still dangerously complacent – government policies around the world. Nor can it rely on the 'counterfactual' that is referred to most often: how much worse would it be if Drax were still burning unabated coal in its boilers at Selby? The situation regarding the relative position of different renewables (including biomass) has changed constantly over the last ten years, and the debate about the most cost-effective use of public subsidy has shifted dramatically. Burning unabated biomass should not be assumed to be acceptable just because it's not coal or gas.

Drax has undertaken to respond formally to the conditions we have proposed, positively or negatively, and to provide a rationale as to how they will now seek to move things forward. It will no doubt do this in conjunction with its Independent Advisory Board, which plays a critical role in Drax's overall sustainability governance arrangements.

HIGH LEVEL PANEL: PERSONAL STATEMENTS



Bradford S Gentry

I am trained as a biologist and a lawyer. My work is focused on bringing more investment into improved environmental performance, particularly in natural systems. I am the Frederick K. Weyerhaeuser Professor in the Practice of Forest Resources Management and Policy at the Yale Schools of Environment and Management. I also co-direct the Yale Center for Business and the Environment. Given the amounts of investment in and controversy around BECCS, this Inquiry into how it should be done well seemed like a good fit for me. It is also consistent with the work other colleagues and I are doing here on the biophysical and social aspects of managing forests and trees well for the huge variety of benefits they provide when they are healthy.



Stuart Haszeldine

I have investigated energy all through my geological career, at the overlap between academic research and commercial application. This is where ethics and nature sometimes collide with money and profit. To restore a habitable planet, it's clear that humans need to recapture some of the fossil-carbon and bio-carbon they have released, to replace that carbon back beneath the ground. And that activity is already 50 years too late. With this Inquiry, I wanted to see if BECCS can be one part of that restoration. Is woody biomass BECCS genuinely sustainable? Can harvesting additional wood and wastes avoid damaging old ecosystems? Can inefficient combustion of pellets enable enough carbon to be captured and stored, which is greater than the carbon emitted during harvesting, processing, transport and stockpiling? And will a multinational corporation create, enforce and communicate its own standards to set an impeccable benchmark for future BECCS activities in forests globally?



Claire O'Neill

As the former UK Energy and Climate Minister, I was involved in and supportive of the conversion of coal to biomass in the UK and the early pilot CCS plant installed by Drax. I remain focused on the global decarbonisation challenge in my post-political life, most recently at the World Business Council for Sustainable Development where I oversaw the global climate and energy program, and for whom I now co-chair the Global Imperatives Advisory Board -along with other advisory and NED roles. According to the IPCC, carbon removal through capture and long-term sequestration is a critical part of solving the net zero equation, and the global level of interest in both carbon removal and negative carbon emissions is growing dramatically. I joined this Inquiry to understand better the specific circumstances of the Drax proposal, the criteria for high quality BECCS, and to help set guidelines that would ensure other operators know what good looks like.



Jonathon Porritt

The complexities of sustainable development have filled my life for the last 50 years, most challengingly since the establishment of Forum for the Future back in 1996. Sustainable development has always been hotly contested territory, with a lot of ‘grey areas’ between the often facile definitions of ‘sustainable’ and ‘unsustainable’. This project fascinated me right from the start: however much I may regret the need for BECCS and other Negative Emissions Technologies (now inevitable as a direct consequence of 30 years of political failure), it serves little purpose averting one’s eyes from that realpolitik. And if it’s going to happen (which it assuredly will), we all have a responsibility to ensure that it’s done as well as possible. I hope this Report makes a significant contribution to that process.

INQUIRY QUESTION ONE

What conditions would need to be complied with to ensure that the sourcing and processing of woody biomass delivers positive outcomes for nature, climate and people?

1.1 SOURCING

1.1.1 Current situation

Drax publishes details about its biomass feedstock sources every year³. In 2021, out of a total of 8,470,690 tonnes of biomass (used for pellet-making), roughly 3.6 million tonnes was made up of sawmill waste and roughly 4.1 million tonnes from thinnings and low grade roundwood. Our focus in this Report is primarily on operations in the USA and Canada, which make up nearly 7 million of the 8.5 million tonnes.

Drax Group biomass feedstock sources in 2021

In 2021 our biomass was sourced from established, responsibly managed working forests in the US south, Canada, Europe, Brazil, and Russia.

Drax Group sources of fibre

	Sawmill and other wood industry residues (t)	Branches and tops (t)	Thinnings (t)	Low grade roundwood (t)	Arboricultural residues (t)	Agricultural residues (t)	Country total (t)
USA	1,795,400	358,018	1,171,304	1,738,747	–	73,602	5,137,071
Canada	1,459,514	153,986	18,131	181,579	–	–	1,813,209
Latvia	121,618	–	108	597,391	–	–	719,117
Estonia	86,594	–	26,615	96,273	–	–	209,482
Brazil	–	–	–	170,562	–	22,368	192,930
Portugal	19,144	61,045	40,045	66,685	290	–	187,209
Belarus	107,828	–	–	2,401	–	–	110,229
UK	–	–	–	–	–	57,023	57,023
Russia	508	–	–	–	–	33,321	33,829
Other European	5,090	–	–	181	–	5,320	10,591
Total	3,595,695	573,048	1,256,204	2,853,819	290	191,634	8,470,690

Figure 2 - Source: Drax Group plc. 2021.

As soon as it was decided to convert from burning coal to burning biomass, Drax voluntarily adopted high biomass sourcing standards, and imposed on itself an important condition regarding the forests from which it would be sourcing its raw materials: "that overall stocks of carbon should be stable or rising."

It has carried out detailed Catchment Area Analyses⁴ to demonstrate that this is indeed the case, and has now completed those Analyses on two thirds of its supply chain. It accepts that its broader principles for optimising the sustainability of feedstocks must always reflect local conditions – and be "situationally specific". We believe it will be necessary for Drax to achieve 100% coverage of all its Catchment Areas, with regular updates given how fast conditions can change on the ground. This is now completely feasible given all the improvements in remote sensing technologies.

It would be good for Drax to commission an independent peer review process to ensure that these Catchment Area Analyses are giving it the information it needs, as well as helping to meet stakeholder expectations.

In 2019, Drax adopted a 'Responsible Sourcing Policy for Biomass', which has underpinned everything it has done since then. It uses a range of third-party sustainable certification systems, all of which rely on independent annual audits. These include the Sustainable Forestry Initiative (SFI), the Forestry Stewardship Council schemes (FSC), endorsed under

No company these days can operate without that kind of assurance process, and without a rock-solid commitment to regular third party verification of key data sets.

the Programme for the Endorsement of Forest Certification (PEFC), and the Sustainable Biomass Program (SBP).

Almost 100% of Drax's pellet plants are certified under the SBP, together with underlying SFI, FSC or PEFC Chain of Custody certification. All that is important. But no company these days can operate without that kind of assurance process, and without a rock-solid commitment to regular third party verification of key data sets.

1.1.2 Thinnings

It's important to distinguish between different kinds of forests (hardwoods/softwoods; plantations/natural forests; Old Growth/new afforestation etc), with different management regimes in place depending on different forest types. But in all well-managed forests with timber grown primarily for sawlogs (for use in construction, industry and other high-value sectors), thinning the forest is an essential management practice. In south east USA, those thinnings, together with a lot of unthinned, short-rotation timber, historically went to pulp and paper mills. But many of these have now closed down, leaving many private forest owners with no market for their thinnings. This has deprived them of an important source of additional income.

Right from the start, there was an understandable desire within Drax to distance itself from a forestry industry that is often seen as controversial – both in the USA and in Canada. Positioning pellet-making primarily as a user of residual wastes from sawmills (sawdust, bark), and only secondarily making use of diseased and poorly-formed whole trees that could not be processed as sawlogs, made sense in that regard.

As part of its case for sustainable biomass, Drax based much of its communications on the idea that it did not 'use whole trees'. But that is demonstrably not the case, as is immediately evident when inspecting log piles at its pellet mills. A thinned tree is still a whole tree – even when its stump and roots are left behind to protect soil carbon. A diseased tree is still a whole tree. A misshapen tree is still a whole tree. But none of these trees are of any value as sawlogs.

A thinned tree is still a whole tree. A diseased tree is still a whole tree. A misshapen tree is still a whole tree. But none of these trees are of any value as sawlogs.

So Drax does indeed use whole trees from thinnings and other smallwood unsuitable for sawlogs – and should be comfortable making public statements to that effect. Drax cannot have a 'close relationship' with the industry when it suits it, and an 'arms-length' relationship when things go awry.

Indeed, we believe Drax needs to position itself very differently – not so much as a hungry user of very low-value residual wastes, but as an INTRINSIC PART of the forest industry, working closely with forest managers (in both the public and private sector) to optimise best management practices and financial returns. In many instances, this is what Drax’s relationships ‘on the ground’ already look like, but it could go further than that. For instance, it has significant opportunities to deepen its working relationship with First Nations people in British Columbia. And in south east states in the USA, it would be possible to explore collaboration with smaller forest owners to help cover the costs of multiple certifications.

All this is completely consistent with certification under the Sustainable Biomass Program.

Drax’s Responsible Sourcing Policy commits it to avoiding ‘damage or disturbance to high carbon forests and soil’, and ‘damage or negative impact to known sensitive sites or high biodiversity areas’. However, as BBC’s Panorama programme on Drax’s operations in British Columbia demonstrated back in October, there are clear risks for Drax being seen as ‘another big forestry company’, with its own felling licences over and above its sourcing of biomass for its pellet-making plants. Even though this is all strictly regulated by the British Columbia Government, it inevitably ‘muddies the water’ when it comes to Drax having a ‘clean’ narrative to help build trust.

Drax currently holds two such Licences in British Columbia. The rights to the timber in these areas are granted by Drax to some of the sawmills from which Drax sources its residuals – sawdust, chips and bark. It’s all perfectly legal (no Old Growth areas are involved), but it’s complicated, and we suggest that Drax would be well-advised to get rid of these Licences – and certainly not to bid for any more, as the company has already undertaken.

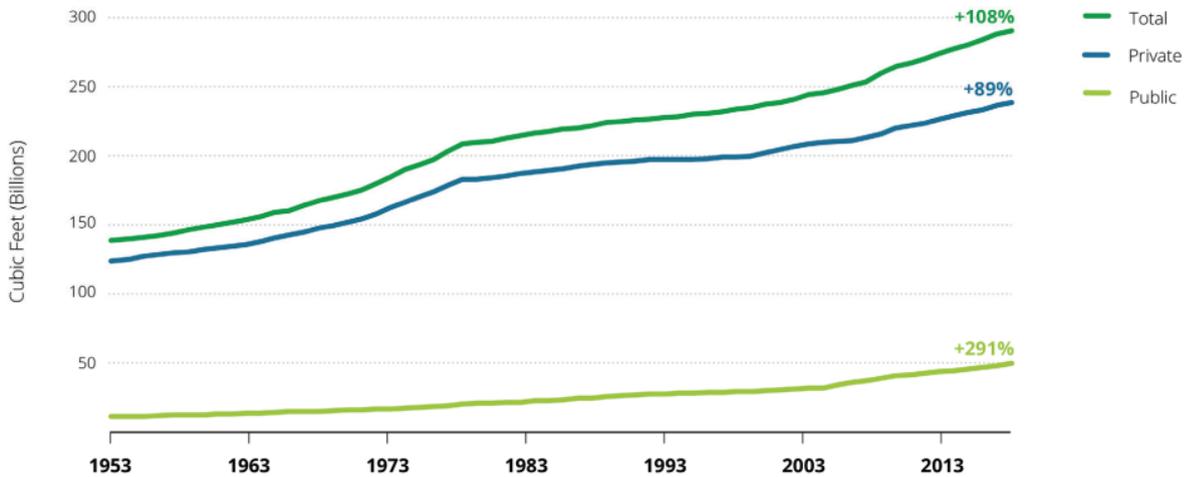
1.1.3 Biodiversity

A strong case has been made by the forestry industry that biomass harvesting does not create additional negative impacts on biodiversity (over and above the impacts on biodiversity, water, soils and so on that are inevitably associated with standard forestry operations, including clear-felling), or lead to additional forest loss. This has been confirmed by many academic papers. Thinning can actually improve habitat conditions for a variety of different species, ensuring greater light penetration on the forest floor. All forestry certification schemes include biodiversity protection measures.

There is no evidence of net conversion of hardwood forests to pine forests in south east USA⁵. Current harvest rates are roughly half of those levels achieved before the 2008 Recession, and total forest cover has more than doubled since the 1950s⁶.

US Forests are storing more carbon year-on-year

Source: Forest2Market, "Historical Perspective on the Relationship Between Demand and Forest Productivity in the US South," July 2017.



The US Southern region is the world's largest single supplier of modern wood-based biomass for bioenergy, but it has been supplying other industries for many decades. This has led to investment and revenues for sustainable forest management, and more than doubled the volume of wood growing in the working forests since the 1950s.

Figure 3 - Source: Sustainable Biomass Program, 2021.⁷

A critical question relates to the proportion of slash (or 'woody debris') that should remain on the forest floor after forestry operations. Some believe that managing forests for biomass productivity runs counter to managing forests for biodiversity, but the evidence we have heard does not indicate this is a significant risk in well-managed forests.

NGOs are understandably focussed on Old Growth / High Conservation Value forests. This matters enormously both from a biodiversity and from a cultural perspective. This is also a critical part of the SBP certification process, as all certified companies have to undertake to avoid any activities in Old Growth or High Conservation Value forests – unless exemptions need to be secured in areas which have been ravaged by disease. This is particularly important in British Columbia, where the protection of Old Growth forest remains a critical area of concern for NGOs and for First Nations people. It's less of an issue in the south east of the USA, where there is very little Old Growth forest left.

We suggest it would be sensible for Drax to issue a new statement on its approach to Old Growth / High Conservation Value forests, including an unequivocal commitment not to be involved in any operations that could cause damage to Old Growth forests, as defined in each of its principal sourcing areas.

As regards Forest Restoration, the SBP is now considering whether its new Standard (to be published in 2023) should mandate restoration of special ecosystems, through Conservation Easement schemes and set asides. All managed forests should have set asides and a reservation system, within a matrix of managed stands across the whole landscape. Specific arrangements will be dependent upon the uniqueness of the ecology,

sensitive aspects of the hydrology and soils, and accessibility (steep slopes, ravines etc). Without that, many critics believe that individual transgressions will slowly degrade forest ecosystems over time – even as the industry in British Columbia reminds people that the average age of its forests is still getting older.

This is one of the ways in which we believe Drax could make a more positive impact on the ground, by seeing itself as a critical player in the forestry sector. It would be able to collaborate with other players (in both the private and public sectors) to prioritise more ‘nature recovery’ projects in the areas where it is operating, through funding, education projects, conservation schemes, and so on.

All in all, there are many detailed issues here that we have not been able to take evidence on. But we feel Drax may still be approaching this whole area in a rather piecemeal, issue-by-issue way, rather than thinking about its role more holistically. There would be merit in Drax embracing a ‘nature positive’ position, and, through that, exploring specific, proactive interventions it would be in a position to take forward in partnership with other key players on the ground.

1.1.4 Proforestation

There is an extremely lively debate in the USA regarding the legitimacy of the entire forestry industry. Given the urgency of addressing the Climate Emergency today, there are some NGOs which argue that most forests should not be used for commercial exploitation at all – and that “the primary goal of forest management should be to increase stocks of forest carbon”. This would mean lengthening the time of harvesting rotations, or avoiding harvesting altogether.

Other NGOs argue that such an approach doesn’t make much sense in itself, as all the products that are currently made using commercially-available timber would then need to be made from other products. And what would be the carbon footprint of those substitute products – from steel or concrete, for instance? They also point to the growing risks of forests being affected by disease, wildfires, storms, drought and insect infestations, all of which could worsen if forests are no longer being managed for commercial operations, with the unfortunate consequence of less carbon remaining sequestered in those forests than is often claimed.

That doesn’t justify really poor forestry management practices anywhere in the world. It is primarily up to governments to impose higher standards on intensive monocultural forestry operations to protect soils, water, biodiversity and wider ecosystem services, but as part of their ‘social licence to operate’, companies like Drax must be able to demonstrate best practice regardless of the standards wherever they are operating.

It has to be said that the Panel was largely unconvinced by this ‘proforestation’ argument. Indeed, it seems reasonable to assume that there will be more demand for forest-based products in the future, not less, particularly in terms of construction and housebuilding. If that’s the case, then responsibly managed forests all around the world will remain a critical underpinning element in any Net Zero trajectory. This view is endorsed by some of the academics with whom we engaged (see evidence from Darren Miller and Angie

Larsen), who believe that managing forests for commercially valuable timber (including biomass for bioenergy as a by-product) provides greater carbon mitigation potential than managing those forests for conservation and carbon stocks alone.

1.2 PROCESSING

Importing millions of tonnes of pellets, from a number of different exporting countries, entails complex supply chains, which need to be managed very carefully to enable Drax to meet its overall climate targets (see page 26). Here in the UK, Drax is statutorily obliged to measure all supply chain emissions, reporting to Ofgem under the Renewables Obligation and as part of its Contract for Difference with the Government. This is a rigorous and carefully managed process.

Potential supply chain 'leakage' has to be counted at every point, from the transport of raw materials to the pellet-making plant (either as residuals and waste materials from sawmills, or small roundwood from the forest), through to the drying of these materials at the plant, the manufacture of the pellets themselves, and then transport to the nearest dock for onward shipment to the Drax power station in Selby (see Figure 4 on page 30).

Drax produces around five million tonnes of pellets in its own plants in south east USA and British Columbia, most of which is exported to Drax. It sources the remaining volume from other pellet producers, imposing the same specifications and standards on them as it applies to its own pellet-making plants. It is currently engaged in a five-year programme to bring all production in the plants that it purchased from Pinnacle in 2021 up to the highest standards.

This is what one would expect of a company seeking to achieve best practice in supply chain management. However, there is inevitably a question mark about the challenge associated with imposing such high standards on less committed suppliers, just as there is about selling pellets (which Drax now does) to customers who often specify to lower sustainability standards. These are all significant risk factors for Drax as it seeks to expand its international pellet sales.

Drax must expect to be held to the highest standards here.

1.2.1 Pellet-making

Pellet-making is itself an energy-intensive business. The heat for drying the woodchips it uses is self-generated, but the power used is all standard carbon-intensive electricity from the grid. There is currently no use of renewable electricity at the plants, which sits oddly with the image of the company that is itself the largest producer of renewable electricity in the UK. This is now a priority target for Drax to accelerate its decarbonisation process.

At the same time, the cost pressures on Drax's pellet-making process are intense. In 2021, the cost per tonne of its pellets (including from those plants it took over through its acquisition of Pinnacle⁸) was \$143⁹. The company has set itself a target of reducing that to \$100. Whilst this makes good sense commercially (one of the most commonly heard criticisms of the use of biomass in generating electricity is that it cannot compete with either solar or wind, which continue to get cheaper year after year), it is crucial that there

should be no diminution in its sustainability performance and in the investments needed to reduce the carbon intensity of its plants.

1.2.2 Environmental compliance / air quality

It is something of a no-brainer to say that Drax must be 100% compliant with all local and federal laws and standards if it wants to persuade stakeholders that it is serious about securing positive outcomes for the environment and society, as well as for shareholders.

However, as of now, this has been an elusive ambition. There have been significant regulatory non-compliances in its pellet-making plants both in Mississippi (with its Amite plant near Gloster having been found to have exceeded emission limits for VOCs since 2016, and consequently fined \$2.5 million by the Mississippi Department of Environmental Quality), and in Louisiana, where Drax recently made two payments of \$1.6 million (without accepting liability) to the Louisiana Department of Environmental Quality. This was to settle claims against two of its pellet plants situated close to black and low-income communities. These settlements led to the charge from the NAACP that “the UK Government is subsidising environmental racism” in its financial support for Drax.

There is much for Drax to learn from these failures. Pellet-making is still a relatively new industry, and it is clear that the original designs (and regulatory standards) for pellet-making plants significantly underestimated the risk of VOC emissions. Drax now claims that these failings have been rectified, but the reputational damage has been done. A ‘zero tolerance’ policy must now apply, with Best Available Technology rolled out at all its plants.

1.2.3 Community engagement

There are continuing concerns that the pollution from the Amite plant caused some significant health issues in the nearby town of Gloster, a community in which the concept of ‘environmental racism’ may resonate strongly (70.6% of its citizens are Black, according to the US Census), and in which any new environmental pollution may be compounded by decades of historical racism of one kind or another.

It must now be a priority for Drax to establish formal Community Engagement Programmes for each of its plants in both south east USA and in British Columbia, going a lot further than the usual tokenistic ‘consultation’

Equally, there is no doubt that many members of the communities of both Gloster and Liberty (the next nearest town) are supportive of Drax’s presence, citing both the direct jobs created and the indirect economic uplift in an area which was profoundly affected by the closure of Georgia Pacific’s huge pulp and paper mill a few years ago.

Though the Panel has not had the opportunity to hear evidence on this, it appears to us that Drax’s community engagement strategy is still somewhat under-developed. It must now be a priority for Drax to establish formal Community Engagement Programmes for each of its plants in both south east USA

and in British Columbia, going a lot further than the usual tokenistic ‘consultation’, as well as to investigate, together with its Independent Advisory Board, the idea of establishing some kind of independent ombudsman role for local citizens who feel they have a grievance that Drax is not responding to. Drax has been keen to demonstrate that it has already made significant progress in this area in British Columbia, as recounted in its Preliminary Submission to the Panel¹⁰:

“We already work with those First Nations who are partners in our business, such as the Witsset Nation in Houston, British Columbia, and we are building capacity in the business to ensure that we can work with more First Nations as they become involved in the planning and decision-making in their region. It is worth noting that the First Nation communities we already work with welcome our contribution, partly because we provide an economic route for material that they would otherwise have piled or burned, and that the material we remove is increasingly being removed out of necessity to reduce the risk of forest fire.”

1.2.4 Healthy Forest Landscapes

Together with the Earthworm Foundation, Drax is pioneering what it calls its ‘Healthy Forest Landscapes’ (HFL) approach¹¹. This will provide an evidence-based approach to measure and evaluate the ecological, social and economic impacts in Drax’s supply areas. This includes input from remote sensing and satellite technologies, which have seen remarkable improvements over the last few years. Earthworm is also developing a socio-economic evaluation methodology to assess community wellbeing.

In all, HFL looks at four different metrics: forest cover, carbon stock, biodiversity and community wellbeing. Drax’s aim, over the next four years, is to roll out the HFL approach across all its principal catchment areas. This will allow the company to track and report its specific and aggregate impacts on the four key metrics of forest landscape health.

It’s important to recognise that these are areas where Drax itself has limited expertise, imposing on them an expectation that all such initiatives should command significant support from expert stakeholders, not least because of the significant costs entailed in all such initiatives. The same is true with its commitment to detailed Catchment Area Analyses, and the cost of multiple (sometimes overlapping) certification commitments. These represent the basic costs of doing business for Drax, ensuring it retains its social licence to operate.

INQUIRY QUESTION ONE: CONDITIONS

What conditions would need to be complied with to ensure that the sourcing and processing of woody biomass delivers positive outcomes for nature, climate and people?

To deliver BECCS Done Well, it is necessary to:

1. Certification Schemes

Ensure 100% of feedstocks are certified under internationally-recognised sustainable certification schemes that deliver positive social and environmental outcomes to the highest possible standard.

2. Responsible Sourcing Policy

Exercise a policy of 'zero tolerance' with suppliers revealed to be in breach of these certification requirements, over and above compliance with all relevant national and local legislation.

3. Catchment Area Analyses

Ensure 100% of the supply chain is assessed under Drax's Catchment Area Analyses (CAAs), to ensure that Drax is sourcing only from areas with stable or growing carbon stocks, and subject these CAAs to independent peer review. The company must apply this high standard to all forest types in the USA, British Columbia and other sourcing countries.

4. Old Growth/High Conservation Value (HCV) Forests

Strengthen the company's current position on Old Growth / High Conservation Value forests, including an unequivocal commitment not to be involved in forestry operations (or purchase of products from operations) that damage or destroy Old Growth / HCV forests (as defined in each of its principal sourcing areas).

5. Biodiversity/ Nature Positive

Commit to substantive forest restoration and biodiversity enhancements, together with local operators, with a view to turning the idea of being 'Nature Positive' into measurable, durable on-the-ground benefits for nature and local communities.

6. Feedstock Assurance

Refine the existing Responsible Sourcing Policy for Biomass to tighten feedstock classification, ensuring complete alignment with classification under the Sustainable Biomass Program. Provide monthly reports on the composition of different feedstocks for each individual pellet mill, for example: sawmill residues

(sawdust, bark etc); tree branches and tops; low-grade, diseased roundwood; thinnings; agricultural residues; pulpwood.

7. Best Available Technology

Install Best Available Technology for pollution prevention (covering air, water and soil) on all pellet plants, going beyond local regulatory requirements where necessary.

8. Community Engagement

Set up equitable and inclusive Community Engagement Programmes that reflect the regional context and specific areas of concern to stakeholders. Formalise the importance of these Programmes through the operation of Regional Advisory Councils (see Condition 28).

9. Smaller Forest Owners

Investigate the possibility of working with smaller forest owners in south east USA to help cover the costs of multiple certifications.

10. Ombudsman

Together with Drax's Independent Advisory Board, investigate the feasibility of establishing an independent Ombudsman covering all Drax's operations globally, reassuring stakeholders that Drax is prepared to be held to account in an appropriately transparent and rigorous way.

11. A 'New Narrative'

Develop a 'new narrative' regarding the company's positioning in the wider forestry industry, ensuring the kind of consistent and totally transparent communications on which trust in its business model depends.

INQUIRY QUESTION TWO

What conditions would need to be complied with to demonstrate that energy from woody biomass makes a positive contribution to decarbonisation, energy security, affordability and a just transition?

2.1 Carbon neutrality

All of those conditions (regarding the sourcing and processing of woody biomass) would apply at any time. But this is not just any time. This is a time of massive jeopardy for the whole of humankind as the threats associated with accelerating climate change become clearer and clearer.

The Paris Agreement commits all countries to cut emissions in line with “holding the increase in global average temperature to well below 2°C above pre-industrial levels, and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”. In November 2021, the Glasgow Climate Pact explicitly noted that “the impacts of climate change will be much lower at the temperature increase of 1.5°C compared with 2°C”, and resolves “to pursue efforts to limit the temperature increase to 1.5°C”, recognising that this requires rapid, deep and sustained reductions in global greenhouse gas emissions.

As Professor Kevin Anderson pointed out to us in his contribution as an Expert Witness:

“Updating the IPCC’s headline 1.5°C budget to the start of 2022 means that we have around 400 billion tonnes of carbon dioxide to emit, with a 50% chance of not exceeding 1.5°C. To put this into context, current global emissions are approximately 42 billion tonnes each year. So, at the present rate of emissions, the total global carbon budget for 1.5°C will be consumed in under a decade. Put another way, each month we consume almost 1% of the remaining budget – in other words, since the start of this year (2022), we have emitted over 7% of the total carbon dioxide that, for all practical purposes, we can ever emit.”

In reality, governments prefer to avert their eyes from such deeply uncomfortable carbon budgeting. The language of “Net Zero by 2050” remains far less challenging, and almost inevitably reinforces a sense of wholly unwarranted complacency across much of society. That is very much the case here in the UK. However, all companies seeking to do the right thing here must be mindful of what the science is really telling us.

Drax has set ambitious targets to become “carbon negative by 2030”¹². That means achieving Net Zero across Scopes 1, 2 and 3 by 2030. It is committed to the Science-Based Targets initiative (SBTi), and submitted targets to SBTi for validation in 2021. This includes a 75% reduction in Scopes 1 and 2 from electricity generation by 2030, against the 2020 baseline. It has yet to hear if that target has been validated.

The emphasis on “carbon negative” is obviously critical. Drax seeks to be a global leader in negative emissions, and, as we will see under Question Three, is developing options for BECCS and targeting eight million tonnes per annum of negative emissions of CO₂ here in the UK by 2030 – which would make its Selby plant the world’s first carbon negative plant at scale, as well as the world’s largest BECCS plant. It has also indicated that it will be

looking for a further four million tonnes of CO₂ per annum to be captured and stored from BECCS plants in the USA.

2.2 Carbon accounting and reporting

Bioenergy should not be assumed to be carbon neutral by default. Impacts differ depending on the origin of the biomass and the time lag involved in sequestering the resulting emissions through new afforestation. Recent reviews by the EU's Joint Research Centre (JRC) showed a wide range of so-called 'payback times' for different types of biomass – with a marked contrast between very short payback times associated with residues and other wastes from sawmills, and forestry operations where the biomass comes from thinning and other low grade roundwood, where payback times of up to fifty years or more were likely, depending on forest rotation cycles. The JRC summarised the issue of time lags as “decades to centuries to never”.

Bioenergy should not be assumed to be carbon neutral by default.

Unfortunately, a lot of the problems associated with this debate about what carbon neutral means in this context go back to GHG accounting principles established at the time of the Kyoto Protocol. The Intergovernmental Panel on Climate Change (IPCC) allows stack emissions to be “zero rated”, on the assumption that the carbon in the biomass that is being burned has already been reported in countries' forestry inventories - confirmed as recently as 2019 in the IPCC's Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories¹³.

What this means is that emissions from burning biomass (from any bioenergy plant anywhere in the world) are being treated in a way that many people feel obscures the reality of what is actually happening. Many NGOs, research organisations and academics argue that all calculations should be based on real emissions ending up in the atmosphere, and should not depend on what they see as artificial accounting rules.

This poses a direct challenge for Drax. In following widely-accepted reporting methodologies (recently confirmed by the EU's MEPs, Commission and Council in the latest reform of the ETS Directive), Drax is correct in saying that burning millions of tonnes of imported biomass at its Selby plant is not in itself causing the build-up of greenhouse gases in the atmosphere.

But in so doing, it opens itself up to the charge that it is not being as transparent as it needs to be about those emissions. Critics of Drax have consistently accused the company of a calculated sleight of hand here, even as Drax argues that it is simply following those IPCC rules.

These rules are also accepted by the UK Government. In its Guidance for Monitoring and Reporting Biomass Installations¹⁵, it states that operators using biomass can indeed apply an emission factor of zero. However, in the interests of allowing regulators to gain a more accurate picture of actual greenhouse gas emissions, “all operators . . . must report a preliminary emission factor for biomass used, irrespective of whether it is solid, gaseous

or liquid, or meets sustainability criteria.” The preliminary emission factor accounts for total CO₂ released by combustion of the biomass, “regardless of whether the CO₂ is stemming from fossil or biomass carbon.”

Any move away from those accounting rules would have significant implications for Drax, and indeed for the emerging BECCS industry, the rationale for which largely depends on those accounting rules.

However, this remains an area of considerable controversy, with influential organisations like Chatham House and European Academies’ Science Advisory Council (EASAC) arguing strongly that the current status quo is untenable, and that the liability for the embedded carbon in the imported biomass pellets should remain with the user of that biomass and not with the country of origin. This would entail a complete rethink of the current IPCC rules, involving all Parties responsible for those rules.

This is clearly not in Drax’s gift. But it seems sensible to us for Drax to engage proactively with those who take a very different position to theirs. Such discussions could usefully be hosted by UK Government Departments (BEIS and DEFRA) responsible for implementing current carbon rules.

Which takes us back to the thorny issue of carbon debt.

2.3 Carbon debt

The principal justification for bioenergy being a very low carbon source of power (even if not completely carbon neutral) is that most of the emissions released through combustion of the biomass are reabsorbed by new forest growth in a closed-loop cycle. However, this common sense rationale is now under ever greater scrutiny as a consequence of the latest scientific evidence regarding the timeframe within which governments need to act if we are to ensure that the average global temperature increases by no more than 1.5°C by 2100.

This turned out to be one of the more controversial areas of investigation in our Inquiry. Mike Norton of the European Academies’ Science Advisory Council (EASAC) argued that:

“There is clearly a time lag between harvesting and the regrowth. In the case of local leftovers from harvesting for forestry products, this may be less than a decade, but in the case of additional harvesting to provide biomass for pellet production, it is likely to be in the order of decades to centuries. The use of forest biomass in facilities such as Drax thus inevitably increases atmospheric CO₂ levels for periods which are well beyond the short term needed to help reduce levels in the atmosphere.”¹⁵

By contrast, Annette Cowie pointed out that “The IPCC did not determine that individual mitigation measures must meet specific payback times”, and went on to argue that:

“Applying a ten-year payback time as a criterion for identifying suitable mitigation options is inconsistent with the long-term temperature goal of the Paris

Agreement, which requires that a balance between emissions and removals is reached in the second half of this century.”¹⁶

There is merit in both cases. However, whatever view one takes about the appropriate timescale for assessing carbon debt, the balance of evidence points to the fact that it’s highly unlikely that 100% of the emissions from burning biomass will ever be reabsorbed by new forest growth given inevitable ‘leakage’ at different points in the value chain. It is precisely this kind of issue which would benefit from closer engagement with key NGOs and academics.

As we’ve discovered, much of this debate revolves around the complicated issue of carbon stocks (the net amount of carbon in a given forest area) and carbon flows (the amount of carbon lost through commercial forestry operations balanced against new growth in the same area). A lot depends on the scale of the forested area under consideration:

“Where management activities are coordinated across the whole landscape to obtain a continuous flow of wood for the forest industry, calculating carbon balance at the landscape scale can be more appropriate (Eliasson et al, 2013; Cintas et al, 2016). The large shifts observed at the stand level, from net carbon sequestration to net carbon emissions at harvest, are not observed at the landscape level. Carbon losses in some stands are balanced by carbon gains in other stands, so that across the whole forest landscape the carbon stock follows a trend line that can be increasing or decreasing, or roughly stable over time.”¹⁷

This debate will clearly run and run, but a clear priority for Drax is that it should only be sourcing from extended forest landscapes where it is possible to use remote sensing to demonstrate a constant carbon stock – or even, preferably, an increasing carbon stock.

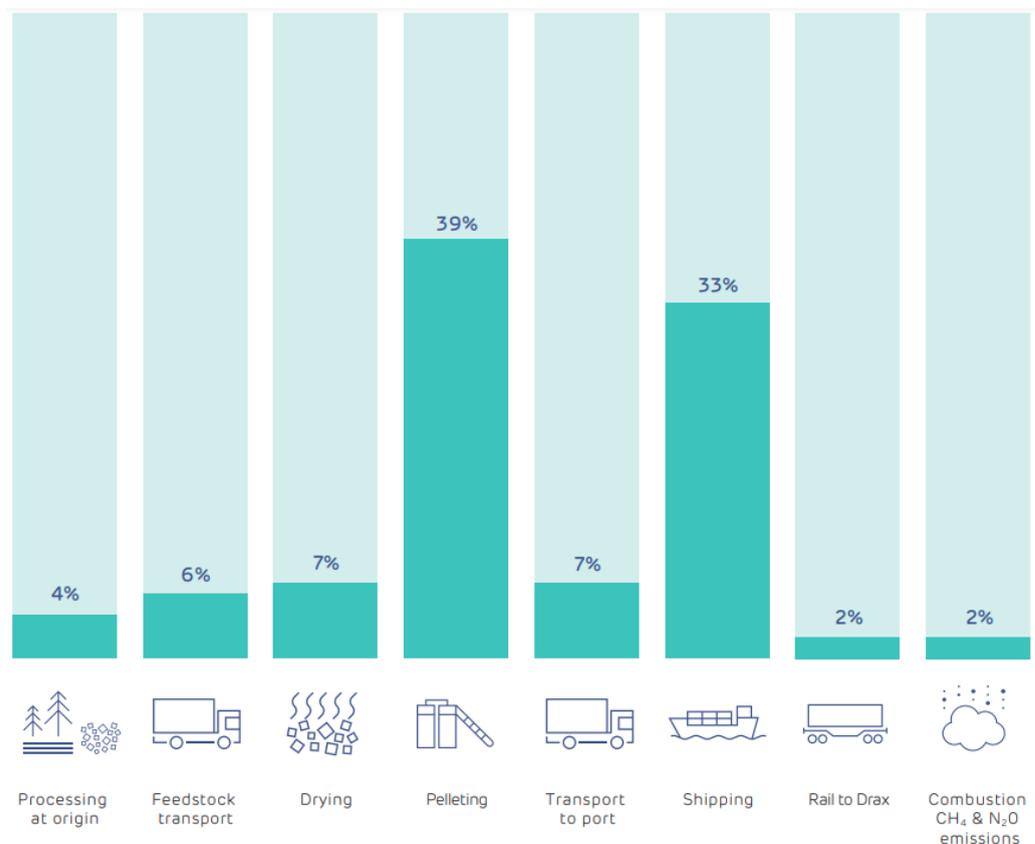
That said, Drax (and the whole bioenergy sector) should be mindful of the direction of travel here in terms of our understanding of the carbon debt issue. It now seems inevitable that we will see:

- a ratcheting up of decarbonisation policies over the next few years to take better account of those timescales - this is already apparent in new policy developments, as with the EU’s RED II, and the end to the current subsidy regime here in the UK in 2027;
- a growing awareness amongst concerned citizens that more needs to be done in the short term, with less of the decarbonisation burden being left to still speculative Carbon Dioxide Removal technologies in the future.

2.4 Life Cycle Assessments (LCAs)

There is, inevitably, significant controversy associated with assessing bioenergy supply chain emissions. As already indicated, the UK Government has set a limit on bioenergy emissions under the Renewables Obligation and Contract for Difference schemes. That limit is 200 kgCO₂e/MWh¹⁸. In 2021, Drax’s emissions amounted to 100 kgCO₂e/MWh of electricity¹⁹ – following the IPCC’s guidance that the embodied carbon biomass should be accounted for in the country of origin.

One of the most influential papers in this area is the Natural Resource Defence Council's (NRDC) report, 'A Bad Biomass Bet', published in October 2021²⁰. Unfortunately, the NRDC declined to engage with the Panel, so we were unable to get clarity on a number of issues that remain contested, including the question of sequestration forgone: "Because old trees store more carbon than young growth, harvesting trees leads to 'sequestration forgone', the carbon storage that would have occurred over time in the uncut forest, but never materialises." Again, this is complex territory, with the forest industry arguing that more carbon is sequestered by the mature sawlogs still growing once a forest area has been thinned than would otherwise be the case.



Note: includes the biomass supply chain emissions associated with both Drax's direct operations (Pellet Production business) and third parties. This is an estimate based on the average carbon footprint of pellets received at Drax Power Station for each stage in the biomass supply chain.

Figure 4 - Source: Drax Group plc. 2021

LCA has always been a source of controversy in many different areas. But it is particularly problematic here. It seems to us that key protagonists involved in these disputes have a responsibility to agree to establish as much common ground between them as possible, coming together (under the facilitation of neutral LCA experts) to share assumptions, data points, latest research and so on. The likelihood is that there would still be disagreement on matters like sequestration forgone and impacts on soil carbon, but it should still be

possible to communicate to policymakers, regulators and all interested stakeholders where there is agreement and where there is not.

One of the reasons why Drax's carbon footprint will always be worse than it should be is because the Selby plant makes no use of the heat which arises as a waste product from the generation of electricity. Numerous attempts have been made to address this challenge over the years (including various greenhouse schemes), but there are currently no plans under consideration.

It seems inconceivable to us that any government today would look favourably on a new bioenergy facility that wasn't producing both 'heat and power' and, indeed, able to capture its CO₂ emissions, as we'll address in the next section. The UK Government cannot retrospectively mandate Drax to resolve the wasted heat dilemma, but it remains incumbent on Drax to work with others to create new technology and business opportunities in this regard.

In other regards, it is much more likely there will be agreement on emissions from transport at various stages in the value chain: proxy values exist for logging trucks, HGVs carrying the pellets to ports, rail transport and shipping – depending on distances, fuel types etc. Nearly half of Drax's supply chain emissions in 2021 came from transport, including a third from shipping (as shown in Figure 4).

The whole question of international shipping remains controversial. Drax is investigating ways of decarbonising its shipping footprint (including alternative fuels, wind-assisted power, and so on), but it's still a slow process. Two of our expert witnesses argued strongly that a condition of 'BECCS Done Well' should be that all biomass feedstocks are sourced from as close to a bioenergy plant as possible, and that internationally-traded feedstocks (such as pellets from the USA or Canada) would therefore be ruled out.

We are not convinced by that argument with specific regard to Drax as a repurposed coal-fired power plant. By inference, it would need to apply to all energy feedstocks imported into the UK, and indeed to all imported timber products. The UK is already dependent on imports for 80% of its timber requirements²¹, given that forestry is such a weak industry here in the UK. One consequence of that is that there are very low volumes of residuals (sawdust, woodchips, etc) available from UK sawmills.

In future, however, as argued by Kevin Anderson, there may be far harder questions to answer regarding energy security (see Section 4.3), as well as meeting the challenge of how best to determine 'a fair share' of limited sustainable bioenergy resources.

We believe there is a strong case for Drax to initiate trials of home-grown sources of biomass, particularly miscanthus (elephant grass) or short rotation coppice, where Drax is already in consultation with the NFU. Given the scale of the Drax plant, however, it would be unwise to assume that these feedstock sources would ever contribute more than a low percentage of the tonnages required. Here again, the sheer scale of Drax's plant at Selby is in itself problematic.

One consideration in assessing the availability of home-grown feedstocks will be the implications such developments would have on land use here in the UK. Competition for land is already a big issue, with different protagonists favouring the use of land for food, for forestry, for other sources of fibre, for biodiversity, for Nature-Based Solutions and so on.

2.5 Land availability

This situation in the UK is just a microcosm of the much bigger debate about the availability of land globally to provide the volumes of biomass required (for bioenergy of one kind or another), especially when new demand is factored in for BECCS plants in other countries.

As mentioned in our Executive Summary, one of the reasons so many NGOs remain either sceptical or hostile to the very notion of BECCS are the different projections out there for the amount of land that will be required to produce the biomass. Some estimates put the land take associated with high levels of BECCS at between 380 and 700 million hectares – the latter figure being equivalent to one and half times the combined area of the EU’s 27 countries, or up to twice the area of India. This kind of hype (including various scenarios promulgated through the IPCC itself) rightly causes concern.

We feel strongly that any future strategy for BECCS globally should be supply based rather than demand driven. Detailed assessments will need to be done on a country by country basis, to ensure robust, scientifically-valid analysis of competing demands for increasingly scarce land. This needs to be much more clearly reflected in the Glasgow Declaration on Sustainable Bioenergy which currently states that: “sustainable wood-based bioenergy” will deliver 50 million tonnes of captured emissions by 2030, and 260 million tonnes by 2050. Interestingly, that’s the equivalent of six Selby-sized BECCS plants (at 8 million tonnes a year) by 2030, and 33 such plants by 2050.

In this regard, we were persuaded that the analysis of the Energy Transitions Commission currently provides the most realistic assessment of future availability of land once one factors in certain critical conditions: that no standing forest should be converted for energy crops, avoiding all direct and indirect conversion pressures; that food production should remain the key priority for land use, ensuring that increased demand for biomass does not trigger damaging land use change; that protection of biodiversity and the growing need for ‘nature recovery strategies’ of one kind or another should not be set aside in a rush for what would be ‘BECCS done very badly indeed’²².

How much biomass can we use?

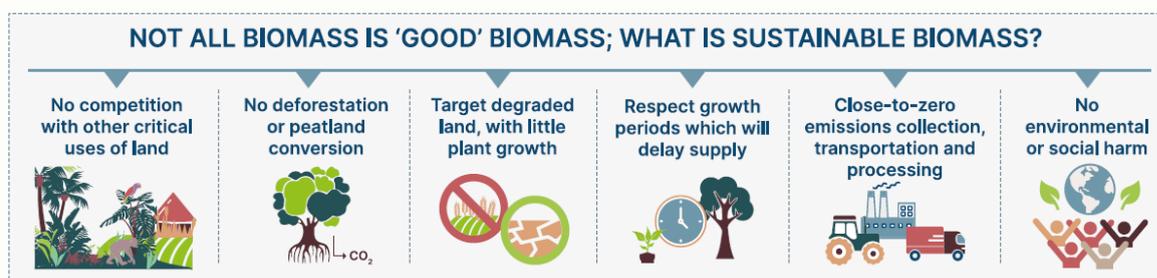


Figure 5 - Source: The Energy Transitions Commission. 2021

The complexity regarding Indirect Land Use Change was recognised by the IPCC in its August 2019 Special Report on Climate Change and Land²³:

“The production and use of biomass for bioenergy can have co-benefits, adverse side-effects, and risks for land degradation, food insecurity, GHG emissions and other environmental and sustainable development goals. These impacts are context specific and depend on the scale of deployment, initial land use, land type, bioenergy feedstock, initial carbon stocks, climatic region and management regime, and other land-demanding response options can have a similar range of consequences.”

As demand grows for negative emissions through BECCS, there is a continuing risk of land being converted from natural forest to intensively managed forest plantations, causing significant impacts on biodiversity, water, soil carbon and so on. Drax (and all pellet producers, as well as operators of BECCS plants) must do everything they can to avoid sourcing from areas affected by land conversion of this kind.

The ETC report cited above acknowledges that some of these variables may change. More land might become available (providing “a maximum potential scenario”) if significant changes in food and farming – primarily, a massive reduction in meat consumption – free up large amounts of land. At the moment, this seems improbable, however great the global sustainability benefits would be of such a profound transformation in diets today. But the fact that we won’t be able to achieve Net Zero targets by 2050 without such a reduction in meat consumption, as now acknowledged by multiple studies, is clearly something that needs to be borne in mind.

There are significant implications here. If a genuinely precautionary approach is adopted, avoiding any further Indirect Land Use Change, mandating rigorous standards in sourcing and supply chain management, prioritising food production, then the land mass available for BECCS may be much, much less than even the more modest of today’s projections would indicate. In which case, the idea of large numbers of BECCS plants all around the world enabling the withdrawal of billions of tonnes of CO₂ from the atmosphere by 2050 becomes somewhat fantastical.

Underpinning all of these discussions lies the ineluctable reality that photosynthesis is not in itself a very efficient process, converting just 1% of solar radiation in comparison, for

instance, to solar power's 15%. With that in mind, the ETC argues strongly that all these supply and efficiency constraints mean that biomass use must be restricted to a small number of priority sectors – including new biomaterials, alternative fuels for aviation, and carbon removals. But not for bioenergy without CCS.

INQUIRY QUESTION TWO: CONDITIONS

What conditions would need to be complied with to demonstrate that energy from woody biomass makes a positive contribution to decarbonisation, energy security, affordability and a just transition?

To deliver BECCS Done Well, it is necessary to:

12. Third Party Life Cycle Assessment Auditors

Work with NGOs and with independent third party Life Cycle Assessment auditors to agree and validate input assumptions and data along each step of the BECCS value chain. Regularly update the resulting information at least annually for public consumption.

13. Value Chain Decarbonisation

Aggressively reduce emissions both from direct operations and the wider value chain, prioritising investment in renewable power for all pellet-making plants, while scoping out the feasibility of further decarbonisation measures on any new BECCS plants.

14. Working with Suppliers

Investigate options for working with suppliers to invest in low-carbon logging equipment, machinery and transportation.

15. Heat Recovery

Revisit and solve the challenge of maximising heat recovery to be able to produce both low carbon power and heat at the Selby plant, and work with regulators to ensure that all new BECCS plants will be designed to use both power and heat.

16. Land Availability Constraints

Review the existing analyses of potential availability of land for bioenergy production, at a global, national and regional level, and publish Drax's own assessment of potential constraints.

17. Pellet End-use

In terms of further expansion of pellet sales to global customers, restrict the sale of pellets to end-users that meet the Conditions outlined in this Report, including the potential incorporation of CCS technology into all bioenergy schemes at the design stage.

18. Forest Carbon Stock / Carbon Debt

Restrict the sourcing of biomass feedstocks to extended forest landscapes, within well-regulated jurisdictions, that can demonstrate clear evidence of a constant or

(preferably) an increasing carbon stock, through remote sensing and satellite technology, and seek to help grow carbon stocks in all principal sourcing areas.

19. Domestic Feedstocks

Optimise the use of domestic biomass feedstocks here in the UK, subject to detailed consideration of land use constraints and sustainable sourcing conditions. Prioritise local sourcing for all new BECCS plants in other countries to minimise transport-related emissions.

20. Carbon Accounting and Reporting

Engage proactively with key NGOs and academics to explore complexities and controversies in current carbon accounting and reporting methodologies, reaching out to Government departments to help facilitate the dialogue.

INQUIRY QUESTION THREE

What conditions would need to be complied with to ensure that BECCS from woody biomass makes a material, ongoing contribution towards Net Zero targets?

3.1 Scenarios

It's been recognised for a long time that governments will need both to accelerate policies to reduce emissions of greenhouse gases, and to prepare for removing significant volumes of CO₂ from the atmosphere in the future if we are to stay within that temperature threshold of 1.5°C/2°C. That is what Net Zero entails. As we pointed out in our Executive Summary, it would of course have been better if governments had set and met national targets to achieve critical climate goals without incurring that kind of overshoot (in terms of CO₂ needing to be brought back down out of the atmosphere), but that opportunity is long gone. It's now inevitable that we will overshoot the thresholds compatible with ensuring a stable climate for all future generations, which will necessitate the withdrawal of billions of tonnes of CO₂ from the atmosphere.

Here in the UK, the Government's official target is currently set at 10 million tonnes for all carbon capture and use by 2030, including 5 million tonnes of Carbon Dioxide Removals, including BECCS²⁴. The Climate Change Committee (CCC) has set a more ambitious target for capturing 22 million tonnes of CO₂ from all sources by 2030²⁵; the BECCS plant at Selby will play a very big part in that. The CCC currently has no scenarios for the UK being able to get to Net Zero without BECCS²⁶.

There is an important difference here between 'avoided emissions' through different kinds of CO₂ capture from energy generation and other industrial processes, and 'carbon dioxide removals', when CO₂ is drawn back down out of the atmosphere through Nature Based Solutions or technologies like Direct Air Carbon Capture and Storage. (The storage element is the same for both.) It has not been part of our brief to make comparisons between these different Negative Emissions Technologies.

Drax has set a course to have two BECCS units up and running at its Selby plant by 2027, capturing and storing 8 million tonnes of CO₂ per annum. This will be the largest 'negative emissions' facility in the world.

3.2 Credibility gaps

When it comes to both CCS and bioenergy with CCS (BECCS), many people are increasingly concerned about the weight of expectations regarding the contribution it is hoped that these technologies will make to delivering on global and national Net Zero targets. There is a lot of 'gapology' at work here: 'we have no choice but to secure withdrawals at this scale – so that's what we're going to do!'

There is a lot of 'gapology' at work here: 'we have no choice but to secure withdrawals at this scale – so that's what we're going to do!'

These credibility gaps are not of Drax's making. They go back a long way – to the origins of the IPCC's climate modelling on CCS and BECCS, and its dependence on what are called Integrated Assessment Models (IAMs).

IAMs are compiled from detailed sectoral models, and are widely used by the IPCC and others to explore differences in the effects of certain policies. They provide broad insights about future pathways rather than specific and absolute answers.

Many scientists have been critical of the IPCC's over-dependence on projecting huge levels of Carbon Dioxide Removals to correct what is now recognised as the all but inevitable failure of governments to cut greenhouse gas emissions fast enough to stay below 2°C (let alone 1.5°C) without those Removals. They believe that this over-dependence on the projected role for BECCS can be explained by a number of significant biases, including: unrealistic estimates of the availability of land to grow the necessary volumes of biomass (see page 32); a poor understanding of carbon payback periods (see page 28); the use of a high discount rate; a continuing failure to take account of dramatic reductions in the cost of solar and wind ; and the usual optimism bias.

Kevin Anderson was rather more brutal in his critique of IAMs: “climate modellers are almost exclusively western, older, white, male academics who have an inherent bias towards scenarios which don't challenge their lifestyle and consumption patterns”²⁷.

Steve Smith pushed back against this characterisation, arguing that he had never “witnessed any evidence of nefarious watering down or hiding anything to try and make the scenarios more palatable to policy makers”²⁸.

3.3 Current state of play with CCS

This debate about IAMs is important. The same biases can be seen to affect every one of the major forecasting organisations regarding CCS, including the International Energy Agency, the Climate Change Committee, and even the Energy Transitions Commission.

Interestingly, and commendably, the one organisation that might be most interested in amplifying this hype (the Global CCS Institute) has steadfastly resisted that temptation, providing a more realistic annual snapshot of the industry for which it is the principal representative.

Its 2022 Global Status Report shows that 30 commercial CCS facilities are in operation at the moment, with 11 under construction and more than 150 in various stages of development²⁹. The current total of CO₂ captured and stored is just over 42 million tonnes per annum; if all those new plants were to be built, this would rise to around 244 million tonnes. It's worth pointing out that this amounts to just 0.6% of current annual greenhouse gases emissions from burning fossil fuels. The Institute itself points to the huge gap between today's 42 million tonnes per annum and the 5,600 million tonnes captured and stored per annum that it has been argued would be necessary by 2050 to achieve Net Zero targets.

The latest report (September 2022) from the Institute for Energy Economics and Financial Analysis (IEEFA)³⁰ is equally sobering, confirming the figures quoted by the Global CCS

Institute in 2021, and then focussing in on performance by looking at 13 ‘flagship projects’ which account for more than half of today’s total capacity of 42 million tonnes. Few of these projects have got close to meeting the targeted capture rates (usually of more than 80%, and sometimes up to 95%), with most failing even to reach 50%.

Most of the successful CCS operations are located in well-regulated countries (such as Norway), and all are serving the direct interests of fossil fuel companies, mostly through the use of the captured CO₂ for Enhanced Oil Recovery. The IEEFA Report tells us that up to 75% of the 42 million tonnes captured in the year was reinjected through Enhanced Oil Recovery projects.

However, such an unpromising background does not lead automatically to the rather simplified conclusion that the technology has failed: in fact, the use of CO₂ for Enhanced Oil Recovery has been very successful. It can be argued that it is essentially the operation of markets (with oil and gas companies reprehensibly reluctant to invest a material percentage of historical profits in CCS R&D) and inadequate regulation that have failed, not the technology as such. And as has been pointed out, “it is better to bail fast with a rusty bucket than to sit in the sinking boat arguing about perfect solutions”³¹.

That said, there is still a serious question mark regarding the costs associated with CCS in the future. There are those who still talk of cost and risk profiles for future CCS similar to those experienced by the offshore wind industry. Given that CCS already has a 50-year record of chronic underperformance, and that costs have remained stubbornly resistant to any such reduction curves, this seems like wishful thinking.

3.4 BECCS

There are very few operating BECCS plants. The most successful are those operating on large corn ethanol plants in the mid-west of the USA. There are also some interesting plants using waste biomass as a partial feedstock, with a successful operation in Oslo, and a major new Energy from Waste plant now planned for Stockholm.

There are currently no BECCS plants using woody biomass other than Drax’s own pilot capture plant at Selby. This is a joint project between Drax and Mitsubishi Heavy Industries (MHI), using sophisticated amine solvents (KS21) to strip out the CO₂. It is projected that this technology will be able to achieve a 90 to 95% capture rate. The ‘scaling challenge’ involved here is enormous, going from just a few tonnes a year to 8 million tonnes after 2027.

This is very much a ‘first of a kind’ challenge, and as such it is legitimate for the UK Government to provide support. It provides a unique opportunity to assess the feasibility of BECCS at scale, with a view to being able to drive down costs in the future.

3.5 Parasitic energy

One of the most controversial aspects of all CCS plants relates to the amount of energy that is required by the capture process itself. The more energy that is consumed in operating capture and compression for the CCS plant, the less is available for the grid. In the case of the BECCS units at Drax, this means that more biomass will have to be burned to produce

the same amount of electricity. Drax will need to maximise the efficiency of its CCS units by minimising the amounts of both electricity and heat that will be needed. With new BECCS plants, a new supply of electricity and heat will be created, making those plants self-sufficient in their ability to capture and store CO₂.

3.6 Baseload vs. Dispatchable

We are not in a position to comment on the way in which the Selby power station will be operated once the BECCS units are up and running. A number of our Expert Witnesses commented on the desirability of electricity from Drax being used for grid balancing, on a dispatchable basis. Given the availability of cheap wind and solar in the future (including the possibility of ‘excess’ wind power regularly becoming available at zero marginal cost), it will be hard for Drax to compete on electricity prices. This will have clear implications for broader affordability issues in terms of impacts on prices paid both by consumers and businesses. On price alone, Drax would be lower in the merit order, and would expect to be ‘turned off’ at times of low demand or high output from wind power.

However, it’s possible that there will be multiple engineering issues associated with managing the first-of-a-kind MHI capture technology, and it seems unlikely that it will be possible to achieve a 90 to 95% capture rate without the plant being run on a continuous baseload basis. Moreover, Drax may be favoured not so much for its electricity as for its Carbon Dioxide Removals as part of the UK’s overall Net Zero strategy.

This will clearly affect the financing mechanism necessary after 2027. Discussions are continuing between Drax and the UK government as to the nature of that funding mechanism. Drax would appear to have a clear choice here regarding the capture and storage elements of its Selby plant: to rely on further financial support from Government, for an agreed period of time, for the Carbon Dioxide Removals on a per tonne basis; or to sell the credits associated with those removals through the voluntary carbon markets, possibly to be used by buyers in other countries. It clearly cannot expect to be paid twice over.

This will be critical for the future of the Selby plant. As was pointed out to us in his written evidence by Josh Burke from the Grantham Research Institute at the LSE:

“Public support for BECCS and DACCS is currently low, whilst afforestation and other land-based greenhouse gas removal processes are *a priori* popular. BECCS could therefore be susceptible to further public opposition if the policy for funding and deployment fails to account for undesirable distributional consequences. Choosing an equitable funding model from the outset can help to ensure public legitimacy of greenhouse gas removal technologies, including BECCS, and in turn enhance the immediate political feasibility as well as the durability of policy over time.”³²

Cost effectiveness will obviously be a critical criterion for any post-2027 agreement with the Government. Financial support for the electricity generated will need to be weighed against support for other technologies. Wind and solar will always be cheaper, and will always be able to demonstrate shorter carbon payback periods. Public investment in

demand management and energy efficiency (particularly when it comes to retrofitting the UK's wretchedly leaky and inefficient housing stock) will always provide better value for money over any generating technology, simultaneously delivering massive social and economic benefits. So the rationale for the continuing use of subsidised bioenergy will be heavily dependent on the contribution it makes to removing greenhouse gases from the atmosphere.

Whatever happens here, this points to the need for different outputs from Drax to be reported on and verified on a different basis. Campaigners have long argued that accounting for emissions reductions (via bioenergy) should be kept entirely separate from accounting for Carbon Dioxide Removals. As Duncan McLaren points out³³:

“There are multiple mechanisms through which promises of future carbon removal can undermine near-term mitigation. Like any potential carbon removal technique, BECCS requires a governance framework which ensures no erosion of mitigation. The key policy tool to achieve this is clear separate targets and accounting.”

We believe it's important that Drax should be paid for Carbon Dioxide Removals on a retrospective basis

There's one further consideration³⁴. One of the concerns surfaced regarding large amounts of taxpayers' money being used to support CCS in other countries is that much of the funding up until now has been made unconditionally, in different countries, regardless of the amount of CO₂ actually captured. This is highly unlikely to command

public support here in the UK. We believe it's important that Drax should be paid for Carbon Dioxide Removals on a retrospective basis – in terms of real tonnes of CO₂ captured and then permanently stored – once new financial arrangements are in place with the UK Government.

3.7 Transport and storage

The UK Government is now committed to two new CCS clusters: the East Coast Cluster (involving Zero Carbon Humber and Net Zero Teesside, with Drax as the 'anchor project'), and HyNet North West, focussing on CCUS and hydrogen.

There are many partners involved in the East Coast Cluster, including BP and National Grid Ventures, which will be responsible for building the pipeline taking the CO₂ from Drax to a facility on the coast, and then for sequestering it in offshore oil and gas reservoirs. It's too early to comment on the complex governance conditions that will need to apply here.

However, all parties in this process are confident that it will be possible to achieve permanency in storage of this kind, and the evidence to date demonstrates that no engineered storage facility has as yet experienced any leakage.

Beyond that, Drax has already undertaken that none of the CO₂ that it is responsible for capturing will be used for Enhanced Oil Recovery, a process seen by many as nothing more

than ‘an emissions multiplier’ in that it permits more marginal oil and gas assets to be kept in production at a time when we should be accelerating the closure of all such assets.

It is important that the commitment that Drax has made here in the UK should also apply in the USA, with any new BECCS investments that it is planning over there and elsewhere.

3.8 Future BECCS

We should point out that our Panel was asked to look at conditions for BECCS Done Well in Drax’s plant at Selby, with no remit to explore issues regarding proposals for new BECCS plants in the USA or elsewhere. However, we are aware of a surge in very bullish projections about the future of BECCS, particularly in the USA. The US Government’s new Inflation Reduction Act has heightened those expectations. A sum of \$85 in tax credits will be available for every tonne of CO₂ sequestered, which has clearly influenced Drax’s desire to have its first plant in the US operational by 2030. On top of that, Drax has already done a deal with a company called Respira to sell two million tonnes of carbon credits a year.

There’s certainly a role for new BECCS plants in the USA, and the general idea of ‘taking the plant to the forest rather than the forest to the plant’ – constructing new BECCS plants in or very close to heavily forested areas rather than processing and transporting pellets from the forests to new BECCS plants elsewhere – makes good sense. Proximity to appropriate storage facilities (in saline aquifers or depleted oil and gas reservoirs, for instance) will also be critical.

One particular factor in the USA is the opportunity to use BECCS to address two increasingly severe problems faced by the forestry sector: huge acreages of forest already severely affected by disease, and the ever greater threat of wildfires.

These are strong foundations for the development of BECCS in the USA. But it is still our opinion that Drax should take a precautionary approach to some of the over-hyped projections that are now being discussed by others in the USA and globally. The reason for this is simple: every condition that we believe Drax will need to comply with in terms of BECCS Done Well here in the UK (to put that precautionary approach into practice) will need to be applied with no less rigour to EVERY new plant anywhere in the world.

What’s more, feedstock-limiting constraints may become apparent faster than is currently envisaged. Analysing the potential impact of the recent Inflation Reduction Act in the USA (providing substantially enhanced tax credits for CCS projects), the thinktank FutureMetrics has suggested that 27 coal-fired power stations could qualify for that enhanced subsidy by converting from coal to biomass³⁵. Just as Drax’s plant at Selby has done.

However, from a global perspective, it should be pointed out that there is no silver BECCS bullet. There are hundreds of coal-fired plants around the world, with more than a thousand in China alone, 280 in India and so on. BECCS conversions (bound by all the same Conditions raised in this Report) will only be viable for a small fraction of this total: the rest will still need to be phased out just as rapidly as possible as all nations get serious about ‘powering past coal’.

INQUIRY QUESTION THREE: CONDITIONS

What conditions would need to be complied with to ensure that BECCS from woody biomass makes a material, on-going contribution towards net zero targets?

To deliver BECCS Done Well, it is necessary to:

21. Knowledge Transfer Centre

Establish open knowledge-sharing platforms with all existing and prospective BECCS operators globally.

22. Carbon Capture Rates

Given this is a huge 'first of a kind' engineering challenge, Drax and its capture technology partner, Mitsubishi Heavy Industries, may reasonably anticipate relatively low average capture rates in the first year of operation (to make on-site engineering adjustments and adaptations), but must then operate at a 95% capture rate from the start of Year Two.

23. Transparent Reporting

Agree, as a condition of future Government support for Drax's carbon removals, to publicly disclose stack emissions (including SO_x, NO_x, uncaptured CO₂ and capture-solvent derivatives), as well as captured tonnages of CO₂ on a weekly basis. Agree that all such support from taxpayers should be paid retrospectively on the basis of tonnes of CO₂ successfully captured and stored.

24. Negative Emissions Credits

If the company moves to commercialise the negative emissions credits from its Carbon Dioxide Removals, it must be prepared to surrender enough removal credits to ensure its own value chain is strictly Net Zero, and must avoid any double counting once the new standards for negative emissions credits have been agreed.

25. Enhanced Oil Recovery

Continue to prohibit the use of any captured CO₂ for Enhanced Oil Recovery here in the UK, and commit to the same constraint for all future BECCS plants, operated or supplied by Drax, in the USA and Canada and globally.

INQUIRY QUESTION FOUR

What are the implications for Drax of these Conditions, and for the wider biomass industry, in terms of policy and governance? How will verification work, in an authoritative and transparent way, demonstrating compliance with these Conditions?

4.1 Leadership

In our opinion, there's no doubting Drax's sincerity of intent in seeking to be a leader in its respective sectors: pellet-making, bioenergy and CCS. The targets it has set and the commitments it has made are indeed sector-leading. However, as critics point out, to be sector-leading in a sector which relies on flawed sustainability assumptions and criteria, represents a somewhat compromised notion of leadership..

The answer to that, we believe, is for Drax to be less defensive

Historically, Drax has certainly got some things wrong, as highlighted in our Report, but no more so than every other company operating in these sectors. The answer to that, we believe, is for Drax to be less defensive, to stop trying to 'massage' the complexities and controversies of operating in these

sectors, to adopt more of a 'warts and all' approach, and to engage much more directly with local communities and – wherever possible – with critical stakeholders and NGOs. We know this is not easy.

4.2 Raising the bar

Over and above what Drax needs to do to meet the high standards it has set for itself, its suppliers and its customers, it also needs to engage proactively with the pellet-making and bioenergy sectors to help lift everybody's game. All such controversial sectors are only as good as their poorest performers; leaders get damned as eloquently as laggards.

4.2.1 The Glasgow Declaration on Sustainable Bioenergy

One notable output from the Conference of the Parties in Glasgow in 2021 was a new Declaration on Sustainable Bioenergy³⁶, supported by many of the major players in the sector, including both Drax and Enviva, the two largest pellet-making companies in the world.

The Declaration is predictably prone to overstatement ("BECCS is a proven technology, already operating at multiple sites around the world" – an assertion that is just plain wrong when it comes to woody biomass), vacuous generalisations and a lot of wishful thinking. But its 16 Principles provide a useful foundation.

Drax could build on the Glasgow Declaration to help lead the sector (and its customers) to enhance stakeholder confidence. That kind of confidence will only be delivered when the whole sector delivers to the highest standards, and this will be particularly important as the bioenergy economy grows in developing and emerging economies.

4.2.2 The Sustainable Biomass Program (SBP)

After what most acknowledge was a difficult start, the SBP has established itself as a credible standard-setting and certifying body for the whole bioenergy sector (almost 100% of Drax's woody biomass is certified under the SBP). But both the SBP itself, and the biggest companies in the sector (Enviva and Drax) must recognise that no certification body, operating in any land use sector, has yet found an acceptable way of eliminating the risk of Indirect Land Use Change.

There are lessons to be learned here from other sectors. Eighteen years after its establishment, the multi-stakeholder Round Table on Sustainable Palm Oil has failed to 'become the norm' for all producers of palm oil around the world. RSPO-certified growers account for no more than 19% of total palm oil production today, and although the industry hates the inference that 81% of palm oil production must therefore be 'unsustainable' (not least as both Malaysia and Indonesia have their own sustainability certification schemes), that's the inference that many NGOs choose to make. It would be a serious situation if the global biomass industry ended up in the same position.

As we heard from Francis Sullivan³⁷, SBP's Executive Chair, the SBP has a revised standard coming out in 2023, which will take much greater account of different regulatory and legislative standards in different parts of the world – in effect, creating a new 'hybrid standard', incorporating both legally binding minima and higher voluntary requirements. It will also strengthen a number of social protections around workers' rights, traditional landowners and First Nations, community engagement, health and safety, and so on.

Drax needs to work more closely with the SBP to ensure that certification under SBP becomes the norm so that all those involved in the bioenergy / BECCS world understand what is now required by stakeholders. In short: no SBP certification, no purchase order.

Promoting the new standard will be particularly important as the markets for biomass / bioenergy open up outside of the EU and the US, with a lot more South to South trades across different regions.

4.3 Access to woody biomass

A number of NGOs and academics are focussed on what they call 'a fair share' of prospective volumes of sustainable biomass being available for developing and emerging countries. "Drax must use only a fair share of sustainable levels of biomass" was a statement we heard on more than one occasion.

Intuitively, that has to be right. But that implies some kind of international override on the way in which governments regulate producers of biomass in their own jurisdictions, and on the way in which global markets operate in this space. Who would actually define what is meant by a 'fair share' for any country, and would there ever be a scientific consensus to underpin such judgements?

Frankly, we believe a far bigger driver as far as Drax is concerned is going to be competition for access to supplies of woody biomass. The geopolitical implications of increased competition for woody biomass are enormous. For instance, as the aviation

industry flexes its muscles for access to different feedstocks to meet its targets for Sustainable Aviation Fuels, and as the global chemicals sector keeps widening its innovation funnel to develop new ‘value adding’ biomaterials, straightforward biomass for electricity could rapidly be priced out of this new marketplace. What if the USA or Canada decided, at some point over the next ten to fifteen years, that its bioresources (including its forests) were as crucial to its national security as its hydrocarbon resources are today? Who is to say, in such circumstances, that a large number of proposed pellet-making or bioenergy plants, dependent on imports from other countries, may not have already become stranded assets in ten years’ time?

Which is why bioenergy without CCS (and the Carbon Dioxide Removals that can be secured through those CCS plants) is likely to be seen as a problematic technology choice. By contrast, BECCS Done Well, subject to all the caveats and conditions raised in this Report, may well have a role to play in other countries seeking to transition out of their dependence on coal and other fossil fuels. If China, Vietnam or Indonesia, for instance, wanted to accelerate their exit from coal, what is happening at Selby could well be seen as a role model, even allowing for all the policy recalibration needed today to reflect greater understanding of issues like carbon debt, Indirect Land Use Change and so on. However, as we’ve argued above (see page 42) this would mean that any such investments (supported by the Asian Development Bank, for instance) would need to insist on the same conditions as mapped out in this Report.

4.4 Radical transparency

Drax already puts a huge amount of data into the public domain. And, as described earlier, it remains resolutely committed to independent certification for all its suppliers and to third party verification in terms of its supply chain emissions.

But there’s still considerable controversy regarding the composition of the raw materials that it’s using in its pellet plants. As already explained, we do not believe that Drax should be apologetic about the use of biomass derived from thinnings, branches and tops of trees, diseased trees and other low grade roundwood that has no other market (other than for pulp and paper) in well-managed sustainable forestry operations. But the volumes it uses differ considerably in different catchment areas, with its operations in British Columbia predominantly dependent on sawmill wastes and other residues, whereas its plants in south east USA have a broader mix of sawmill wastes and small diameter roundwood (see page 16). Language is so important. As we’ve said before, the phrase “we don’t use whole trees” should be banished from the Drax lexicon.

Beyond that, NGOs will still expect to see more granular data about exactly what is going into Drax’s pellet-making plants on a daily basis. In this regard, it’s interesting that the Sustainable Biomass Program has recently established a new Data Transfer System, based on the same logic as Blockchain, which allows full traceability back to each pellet-making plant and through to each bioenergy plant.

When the new BECCS plant at Selby is commissioned, this will raise a whole new dimension in terms of monitoring and verification – with a completely new configuration of technologies and partners. Drax must be thinking right now of the kind of monitoring

and verification regime that will be most appropriate for its BECCS plant, not just to provide assurance to all stakeholders (particularly regarding capture rates and CDR tonnages), but to set the benchmark for all future BECCS investments that will follow.

We believe it's imperative that Drax should start work on some kind of integrated Transparency Dashboard, learning from examples of best practice already in operation with other companies. This would be one very practical area where engagement with sceptical NGOs would make a lot of sense. In the long run, this kind of transparency is the best way of building trust, and therefore the best way of protecting shareholder interests.

4.5 Biting the bullets

As we have set out to demonstrate, there are a number of difficult issues that already loom large for Drax as it positions itself for a new BECCS era with regulators, shareholders and wider stakeholders.

It is, for instance, understandable that Drax relies on IPCC and UK government guidance as to the 'inherently carbon neutral' basis of the bioenergy business (see page 27). Indeed, it has no choice. But the resulting exclusion of emissions from burning biomass from national greenhouse gas inventories will remain problematic for a lot of ordinary citizens, let alone campaigning NGOs. As we said in our Executive Summary, this is more a challenge for government than it is for individual companies, but Drax needs to get its ducks in a row on its own position here. Hence our recommended Condition 20 (see page 36).

And that leads inevitably to the whole question of carbon payback periods – the carbon debt conundrum (see page 28). The reality here is clear: governments have wasted so much time in failing to get to grips properly with the Climate Emergency that much, much more will need to be done, in much, much shorter periods of time. The scientific consensus on this gets stronger all the time.

That doesn't mean that every single government policy or intervention must be capable of ensuring verifiable reductions in greenhouse gas emissions within the next ten years. But it does mean that short-term, cost-effective policies will need to be given preference over longer-term policies that won't impact on concentrations of greenhouse gases in the atmosphere until after 2050.

These policy challenges have clear implications for Drax's future procurement strategy. It may be too simplistic to argue that it should only make use of thinnings and low grade roundwood (and, possibly, pulpwood) from forests with very short rotations (25 to 30 years), as is the situation in south east USA and on the west coast, whilst relying exclusively on sawmill waste and residuals in British Columbia where rotations are much longer (70 to 80 years). But the carbon debt conundrum cannot be wished away – and it will only get more pressing as proposals for new BECCS plants are developed. Governments may well bring forward new policies to favour short-rotation biomaterials (including energy crops), essentially applying a discount value on forestry sequestration in the distant future.

4.6 BECCS Advocacy

We have already expressed some concerns about the ever-rising interest in BECCS using woody biomass – before even the first plant is up and running! Over-selling BECCS is a problem in itself: the number of new plants, bound by the same Conditions that we have raised in this Report, subjected to the same supply constraints that we believe will be crucial, is likely to be significantly lower than some of the more inflated estimates that have been published.

Beyond that, there is also the issue that a lot of today's pro-CCS advocacy is coming from a different place, clearly intent on slowing or diluting the deep and urgent mitigation measures that are now more necessary than ever. By consistently 'hyping' the putative benefits of CCS in general, the fossil fuel sector has successfully slowed down exit strategies from fossil fuels, and provided big banks with a rationale for continuing to invest in new hydrocarbon assets on the vague assumption that CCS will miraculously make them compatible with Net Zero targets in the future. Kevin Anderson made the point for us very compellingly:

“The allure of BECCS and other Negative Emission Technologies is that they substitute immense political, economic and social challenges of mitigation today for highly speculative removal of CO₂ from the atmosphere tomorrow. This proposed transfer of responsibility between generations has been one factor in weakening the pressure on policy makers to face mitigation challenges head on.”³⁸

Of one thing we are clear at the end of this Inquiry: there's no doubt that BECCS has an important role to play in the world of Negative Emissions Technologies and Carbon Dioxide Removals. But this has to be kept in proportion. Drax is now in a position where it can demonstrate real leadership in advocating for BECCS in a measured, thoughtful way, mindful of its intergenerational responsibilities.

INQUIRY QUESTION FOUR: CONDITIONS

What are the implications for Drax of these conditions, and for the wider biomass industry, in terms of policy and governance? How will verification work, in an authoritative and transparent way, demonstrating compliance with these conditions?

To deliver BECCS Done Well, it is necessary to:

26. Precautionary Principle

Consistently apply the Precautionary Principle[†] (see page 53) when making decisions regarding sourcing biomass feedstock and siting new BECCS facilities, particularly as regards the risk of deforestation through Indirect Land Use Change and the need for totally robust certification and governance standards which may exceed local standards.

27. Transparency and Disclosure

For purposes of full transparency across the entire value chain, the company should publish:

- its biomass supply chain GHG emissions, externally assured (as in Condition 12), as it already does today;
- the current emissions from the burning of the biomass in its plant at Selby, prior to the reabsorption of those emissions in new forest growth (as In Condition 22), as it is already required to do;
- and, when the two CCS units are fully operational at the Selby plant, emissions associated with the capture, compression, transport and injection of the CO₂ for storage in saline aquifers or depleted oil and gas reservoirs.

28. Transparency Dashboard

Consult with policymakers and NGOs on setting up a comprehensive Transparency Dashboard, establishing a set of indicators with ambitious targets to generate positive nature, climate and people outcomes, as laid out in earlier Conditions. Put the resulting Dashboard into operation as soon as possible.

29. Regional Advisory Councils

Establish multi-stakeholder Regional Advisory Councils in all principal sourcing regions to reflect a diversity of views and interests, coordinated in conjunction with Drax's existing Independent Advisory Board. Ensure all Community Engagement Programmes are properly represented on these Councils.

30. The Glasgow Declaration

Work with all signatories to the Glasgow Declaration on Sustainable Bioenergy to minimise risks associated with a possible 'boom in new BECCS', particularly in those parts of the world where regulation and enforcement are weak. BECCS Done Well must become the watchword for any emerging global industry, and Drax must take the lead here.

CONCLUSION

As the IPCC has argued:

“The deployment of carbon dioxide removal (CDR) to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO₂ or GHG emissions are to be achieved.”³⁹

BECCS is a technology it would be infinitely preferable not to have to rely on to help protect that ‘safe operating space’ for humankind – however, this is where we are.

Given the potential scale of this new industry, operating in the future in jurisdictions that may well have inadequate regulation and governance standards, it’s hardly surprising that much of the debate about BECCS today is focussed on risk avoidance and mitigation – as much of our Report has been.

But given that understandable concern to ensure that we avoid any really bad outcomes from the expansion in new BECCS investments (outcomes which are all too easy to imagine), we may be missing a trick. Perhaps we should be carving out more space to imagine what the concept of Done Well might mean from a very different, more visionary perspective? A Net Positive vision.

Perhaps we should be carving out more space to imagine what the concept of Done Well might mean from a very different, more visionary perspective? A Net Positive vision.

With such a young industry, there is still an opportunity to raise the bar, to think much more holistically about managing forests both for optimum productivity and for biodiversity, designing in critical co-benefits around water, soil, flood control, recreation, sustainable livelihoods, community engagement and resilience – right from the start. Enhanced by the additional commercial benefits of locally-sited, appropriately-sized, carbon-neutral BECCS plants, managing such critically important stocks of natural capital in such a way would simultaneously build social capital, and give life at the local level to the whole notion of a circular economy.

There will of course be those who say that’s just a pipe dream, that we must reconcile ourselves to forests being managed either for full-on commercial exploitation or for biodiversity, carbon and wilderness protection (just as people argue that farmland must be used either for profit-maximising production, or for biodiversity, water, nature recovery and so on).

We do indeed need to guarantee the absolute integrity of wilderness areas, of Old Growth and High Conservation Value forests. But beyond that, there’s huge potential in thinking more regeneratively about forest management and energy production.

And BECCS may just be the means to open that up. When thinking about Negative Emissions Technologies, people tend to distinguish between technology-based solutions (Direct Air Capture, for example) or bio-based solutions (through new forests, soil carbon, the marine environment, and so on). BECCS is a hybrid Negative Emissions Technology, as

dependent on nature as any of today's Nature-Based Solutions as it is on increasingly sophisticated technology in Carbon Capture and Storage.

If BECCS has to be done (which we're persuaded it does, as laid out in our Executive Summary), then let it be done not just 'well', but 'as well as is humanly possible'.

ENDNOTES

π The Intergovernmental Panel on Climate Change (IPCC) defines Indirect Land Use Change as ‘shifts in land use induced by a change in the production level of an agricultural product elsewhere, often mediated by markets or driven by policies. For example, if agricultural land is diverted to fuel production, forest clearance may occur elsewhere to replace the former agricultural production.’

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† The EU defines the Precautionary Principle as “an approach to risk management, where, if it is possible that a given policy or action might cause harm to the public or the environment and if there is still no scientific agreement on the issue, the policy or action in question should not be carried out”.

See EUR-Lex. n.d. “Precautionary Principle.” Accessed November 17, 2022.

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APPENDICES

APPENDIX 1: High Level Panel: Terms of Reference

1. Project Overview

Will Gardiner, the CEO of Drax, has commissioned Forum for the Future to coordinate a process to investigate what conditions must be satisfied for key stakeholders to support further investment in Bioenergy with Carbon Capture and Storage (BECCS) – establishing explicit ‘conditions for success’ in determining what ‘BECCS Done Well’ would look like.

At the heart of that process will be a High Level Panel, recruited and convened by Forum for the Future, to engage with a number of Expert Witnesses in the field, with a view to answering the following four Inquiry Questions:

Question One: What conditions would need to be complied with to ensure that the sourcing and processing of woody biomass delivers positive outcomes for nature, climate and people?

Question Two: What conditions would need to be complied with to demonstrate that energy from woody biomass makes a positive contribution to decarbonisation, energy security, affordability and a just transition?

Question Three: What conditions would need to be complied with to ensure that BECCS from woody biomass makes a material, ongoing contribution towards Net Zero targets?

Question Four: What are the implications for Drax of these conditions, and for the wider biomass industry, in terms of policy and governance? How will verification work, in an authoritative and transparent way, demonstrating compliance with these conditions?

The High Level Panel will consist of a panel of Independent Experts, who receive oral evidence from a selection of Expert Witnesses. They will deliberate on the evidence before submitting a report and recommendations to Drax. Drax’s CEO has undertaken in advance to respond in detail to that Report, and to implement its Recommendations unless it deems any particular Recommendation to be commercially unviable, in which case it will provide a rationale for that decision.

The High Level Panel will conduct its activities on a strictly independent basis, whilst acknowledging the support of Drax in setting up the initiative in the first place, and in covering Forum for the Future’s costs in managing that process. Panel Members will decide which Expert Witnesses it wishes to invite to present their views, and will have full editorial control of the Final Report and Recommendations

2. High Level Panel Members

2.1. Membership

The High Level Panel will consist of four members, including the Chair. The four members of the Panel will be recruited on the basis of their significant

experience in one of the four Inquiry Question areas, and with sufficient general knowledge to be able to engage seriously with the others.

- 1) Nature-based solutions specialist: Brad Gentry, Yale School of Forestry and Environmental Studies
- 2) Carbon Capture & Storage Specialist: Stuart Haszeldine, University of Edinburgh
- 3) Energy Policy & Governance Specialist: Claire O'Neill, Independent Consultant
- 4) Chair: Jonathon Porritt, Founder Director, Forum for the Future

2.2. Responsibilities

2.2.1. Agreeing Expert Witnesses

Based on recommendations from the Secretariat, Drax and from Panel Members themselves, Panel Members will be responsible for agreeing the list of Expert Witnesses to provide evidence to the Panel.

Every effort will be made to call on a diversity of Expert Witnesses in order to represent all sides of the debate, and to mitigate any suggestion of bias in the analysis and recommendations of the Report.

Panel sessions are attended only by the Panel Members and the Secretariat.

2.2.2. Take Oral Evidence & Questioning

Panel Members will receive oral evidence from the Expert Witness in these evidence sessions. The Panel Members will have the opportunity to draft specific sub-questions for Expert Witnesses to help structure their oral evidence in advance. Panel Members can then question the Expert Witness following their evidence statement.

2.2.3. Review evidence & approve Summaries

Panel Members will be responsible for reviewing and approving the synthesis of evidence sessions drafted by the Secretariat in the form of an Oral Evidence Summary, and approved by the relevant Expert Witness.

2.2.4. Review & approve Report drafts

Panel Members will be responsible for reviewing, amending and approving all drafts of the Report.

2.3. Time commitment

It is anticipated that the Panel will require approximately six to eight working days of time from each member between June – November 2022.

Panel Members will be asked to attend all online Evidence Sessions and three Panel-only sessions, one of which will be in-person at a location in London. All travel expenses will be reimbursed by the Secretariat.

2.4. Honorarium

In recognition of this significant time commitment, a token honorarium will be provided. This is payable either to Panel Members themselves or to an organisation / charity of their choice.

3. Expert Witnesses

3.1.1. Responsibilities

Expert Witnesses will be called to provide an oral statement to the Panel Members on the relevant Inquiry Question for that session. They will be asked to respond to Drax's Preliminary Submission. They will also be given specific questions from the Panel Members in advance to help structure their statements.

Expert witnesses should draw on their knowledge and experience of the topic, and are free to advocate for a particular agenda.

3.2. Time commitment

Each oral evidence session will require one hour for attendance, in addition to the time needed to prepare the oral statement. This time will not be remunerated.

4. Forum for the Future

4.1. Panel Chair: Jonathon Porritt, Founder Director, Forum for the Future

4.1.1. Project design

The Chair is responsible for the design of the Terms of Reference, governance structure and process of the High Level Panel.

4.1.2. Panel Member recruitment

The Chair is responsible for identifying and agreeing Panel Members, and for drafting and extending letters of invitation.

4.1.3. Chairing sessions with Expert Witnesses

The Chair is responsible for designing the agenda for each session, and for facilitating the discussion among Panel Members and Expert Witnesses.

4.1.4. Drafting Report

The Chair will lead on drafting the Report, with the support of the Secretariat. This will be based on the synthesis of the evidence sessions, which are drafted by the Secretariat and approved by the Panel Members.

4.1.5. Lead on launch and communications

The Chair is responsible for leading the design and execution of the Communications Strategy to promote the findings of the Report and its recommendations.

4.2. Secretariat

4.2.1. Process management & facilitation

The Secretariat is responsible for managing the Panel and Evidence Sessions. This involves handling all communications with the participants, briefing the participants, record keeping, and circulating the key documents to the Panel Members and Drax, including the Oral Evidence Summaries and any pre-read materials.

4.2.2. Synthesis & Analysis of Expert Witness Statements

The Secretariat is responsible for synthesising and analysing the insights from each evidence session in the form of an Oral Evidence Summary. These summaries will aim to summarise the key points in the evidence sessions, while highlighting areas of consensus & controversy between Expert Witnesses.

4.2.3. Report drafting

The Secretariat will support the Chair in drafting, editing and proofing the first, second and final drafts of the Report.

4.2.4. Publication & Communications

The Secretariat will support the publication of the Report and Communications Strategy. This will include having the Report designed for publication, and supporting all media outputs and communications.

4.2.5. Financial Accountability

The secretariat is responsible for managing the delivery of the Panel Sessions and the Report within the budget agreed with Drax. It is also responsible for managing the Panel Members' independent Honorarium.

5. Drax

5.1. Preliminary Submission

Drax is responsible for the preparation of a detailed Preliminary Submission responding to the four Inquiry Questions, for consideration by the High Level Panel and all Expert Witnesses.

5.2. Participation

Drax will table their own expert witness to address the questions the Panel have on their written submission. This will occur at the beginning of the process.

5.3. Financial Support

Drax will provide financial support to the Secretariat for the delivery of Panel Sessions and Report, as agreed at the start of the project.

APPENDIX 2: High Level Panel: Biographies

Nature-based solutions specialist

Brad Gentry, Yale School of Forestry and Environmental Studies

Trained as a biologist and a lawyer, Brad Gentry's work focuses on strengthening the links between private investment and improved environmental performance, with a particular focus on increasing investment in natural areas. He has worked on land, water, energy, industrial and other projects in over 40 countries for private (GE, Suez Environment, Working Lands Investment Partners), public (UNDP, World Bank, Secretariat for the Climate Change Convention, UNEP) and not-for-profit (Land Trust Alliance, The Trust for Public Land, the Northern Forest Center, Sustainable CT) organisations. He holds a BA from Swarthmore College and a JD from Harvard Law School.

Carbon Capture & Storage Specialist

Stuart Haszeldine, University of Edinburgh

Stuart has over 35 years research experience in energy and environment; innovating new approaches to oil and gas, radioactive waste disposal, carbon capture and storage, evaluating unconventional hydrocarbons and fracking in the UK, and biochar in soils. Investigation of bio-carbon capture and permanence of storage by mineralisation will develop Net Negative industries. Current work is identifying massive geological storage of hydrogen to annually balance the UK energy system. He is the world's first Professor of CCS and leader of SCCS, the UK's largest academic CCS research group. Stuart provides advice to both UK and Scottish governments. He was elected FRSE in 2002, awarded the Geological Society William Smith Medal in 2011, in 2012 was appointed OBE for services to climate change technologies, and in 2022 was awarded the Energy Medal of the Geological Society.

Energy Policy & Governance Specialist

Claire O'Neill, Independent Consultant

Claire had a 20-year career in consultancy and finance before entering UK politics in 2010. She served as a Transport Minister and then Minister of State for Energy and Clean Growth in the UK Cabinet. She led the development of the UK's Clean Growth and Green Finance Strategies and headed the UK Carbon Capture and Storage taskforce. Claire also created the global Powering Past Coal Alliance (with Canada), negotiated the world's first public-private Offshore Wind Sector Deal and brought forward the country's ground-breaking Net Zero legislation in 2019. She led the UK's winning bid to host COP26 and was appointed COP26 President-Designate until she left politics in 2020 to head the Climate and Energy team at the World Business Council for Sustainable Development (WBCSD), the world's leading corporate sustainability organisation. She now co-chairs the Global Imperatives Advisory Board for WBCSD and has a number of non-executive and Advisory roles. Claire is donating the remuneration for her participation in this Inquiry to Horatio's Garden, a charity that creates and nurtures beautiful gardens in NHS spinal injury centres to support everyone affected by spinal injury.

Chair of the Panel

Jonathon Porritt, Founder of Forum for the Future

Jonathon Porritt, Co-Founder of Forum for the Future, is a 'veteran campaigner' and eminent writer, broadcaster and commentator on sustainable development. He is involved in the work of many NGOs and charities as Patron, Chair or Special Advisor. He was formerly Director of Friends of the Earth (1984-90); co-chair of the Green Party (1980-83) of which he is still a member; a Trustee of WWF-UK (1991-2005) and a member of the Board of the South West Regional Development Agency (1999-2008). He stood down as Chairman of the UK Sustainable Development Commission in July 2009 after nine years of providing high-level advice to Government Ministers. Jonathon received a CBE in January 2000 for services to environmental protection.

APPENDIX 3: Expert Witnesses

The following expert witnesses provided evidence to the Panel:

1. Kevin Anderson, Professor of Energy and Climate Change in the School of Mechanical, Aerospace and Civil Engineering at the University of Manchester.
2. Annette Cowie, Technical Specialist climate policy (Principal research scientist), Climate Research and Development at New South Wales Government, Department of Primary Industries (23rd August 2022)
3. Richard Donovan, Independent Senior Forest Advisor (19th August 2022)
4. Michael Grubb, Professor of International Energy and Climate Change Policy at University College London (15th September 2022)
5. Mike Hemsley, Deputy Director of the Energy Transitions Commission (26th September 2022)
6. Duncan McLaren, Researcher at Lancaster University (14th September 2022)
7. Darren Miller, Vice President of Forestry Programs and Angie Larsen-Gray, Senior Research Scientist at NCASI (23rd September 2022)
8. Michael Norton, Environment Programme Director at the European Academies Science Advisory Council (29th September 2022)
9. Mirjam Roeder, Associate Professorial Research Fellow (Reader) at the Energy and Bioproducts Research Institute (EBRI) at Aston University (5th September 2022)
10. Steve Smith, Executive Director of Oxford Net Zero and CO2RE (25th August 2022)
11. Francis Sullivan, Independent Non-Executive Chair of the Sustainable Biomass Program (12th September 2022)
12. Toby Webb, Founder of the Innovation Forum (12th September 2022)

Josh Burke, Senior Policy Fellow at the Grantham Research Institute on Climate Change and the Environment provided written evidence to the Panel but was unable to provide oral evidence due to COVID19.

The Panel invited an additional 25 experts to contribute, predominantly from the academic and NGO communities; 22 declined for a variety of different reasons; 3 did not respond.

For more information, please download the [Supplementary Material](#) which contains summaries of the Expert Witness Sessions, written evidence submissions, and Drax's Preliminary Submission.

APPENDIX 4: Additional Research Inputs

The following ‘major works’ were reviewed as part of the body of evidence:

Brack, Duncan, Richard Birdsey, and Wayne Walker. 2021. “Greenhouse gas emissions from burning US-sourced woody biomass in the EU and UK.” Chatham House. https://www.chathamhouse.org/sites/default/files/2021-10/2021-10-14-woody-biomass-us-eu-uk-research-paper_0.pdf

Climate Change Committee. 2018. “Biomass in a Low-carbon Economy.” <https://www.theccc.org.uk/wp-content/uploads/2018/11/Biomass-in-a-low-carbon-economy-CCC-2018.pdf>.

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Camia A., Giuntoli, J., Jonsson, R., Robert, N., Cazzaniga, N.E., Jasinevičius, G., Avitabile, V., Grassi, G., Barredo, J.I., Mubareka, S., The use of woody biomass for energy purposes in the EU, EUR 30548 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-27867-2, doi:10.2760/831621, JRC122719

Donovan, Richard Z. 2021. “Biomass Energy: A Climate, Conservation, & Livelihoods Challenge.” Dovetail Partners. <https://www.dovetailinc.org/upload/tmp/1621513772.pdf>

Floyd-Bosley, Mair. 2021. “Supplementary written evidence from Mair Floyd-Bosley, Royal Society for Protection of Birds (RSPB).” RSPB. <https://committees.parliament.uk/writtenevidence/41324/pdf/>

Grubb, Michael. 2022. “Renewables are cheaper than ever – so why are household energy bills only going up?” The Conversation. <https://theconversation.com/renewables-are-cheaper-than-ever-so-why-are-household-energy-bills-only-going-up-174795>

Ketcham, Christopher. 2022. “Logging is destroying southern forests - and dividing US environmentalists.” Grist. <https://grist.org/energy/logging-biomass-nature-conservancy>

Kline, Keith L., Virginia H. Dale, Erin Rose, and Bruce Tonn. 2021. “Effects of Production of Woody Pellets in the Southeastern United States on the Sustainable Development Goals.” MDPI. <https://www.mdpi.com/2071-1050/13/2/821>

Larkin, Alice, Jaise Kuriakose, Maria Sharmina, and Kevin Anderson. 2018. “What if negative emission technologies fail at scale? Implications of the Paris Agreement for big

emitting nations." *Climate Policy* 18 (6): 690-714.
<https://doi.org/10.1080/14693062.2017.1346498>

Mander, Sarah, Kevin Anderson, Alice Larkin, Clair Gough, and Naomi Vaughn. 2017. "The Role of Bio-energy with Carbon Capture and Storage in Meeting the Climate Mitigation Challenge: A Whole System Perspective." *Energy Procedia* 114 (July): 6036 - 6043.
<https://doi.org/10.1016/j.egypro.2017.03.1739>

Matthews, Robert, Geoff Hogan, and Ewan Mackie. 2018. "Carbon impacts of biomass consumed in the EU: Supplementary analysis and interpretation for the European Climate Foundation." In *The Research Agency of the Forestry Commission*.
<https://europeanclimate.org/wp-content/uploads/2018/05/CIB-Summary-report-for-ECF-v10.5-May-20181.pdf>

Matthews, Robert, Geoff Hogan, and Ewan Mackie. 2019. "Feasibility study on sustainability criteria and the effect of wood pellet demand on forest carbon stock: Part A - literature review." The Research Agency of the Forestry Commission.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/979194/biomass-carbon-stock-impacts-literature-review.pdf

McLaren DP, Tyfield DP, Willis R, Szerszynski B and Markusson NO (2019) Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions. *Front. Clim.* 1:4. doi: 10.3389/fclim.2019.00004

Muttitt, Greg, Charlie Kronick, and Louise Rouse. 2021. "Net Expectations: Assessing the role of carbon dioxide removal in companies' climate plans." Greenpeace.
<https://www.greenpeace.org.uk/wp-content/uploads/2021/01/Net-Expectations-Greenpeace-CDR-briefing.pdf>

NCASI. 2020. "NCASI Review of Carbon Implications of Proforestation."
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Petrokofsky, Gillian, Oliver Hooper, Leo Petrokofsky, Alice Grant, William J. Harvey, and Katherine Willis. 2021. "What are the impacts of the wood pellet industry on biodiversity in Southeastern USA? A systematic evidence synthesis." *Forest Ecology and Management* 483, no. 1 (March). <https://doi.org/10.1016/j.foreco.2020.118773>

Quiggin, Daniel. 2021. "BECCS deployment The risks of policies forging ahead of the evidence." In *Chatham House*.
<https://www.chathamhouse.org/sites/default/files/2021-09/2021-10-01-beccs-deployment-quiggin.pdf>

Roundtable on Sustainable Biomaterials. 2021. "RSB Standard Amendment RSB requirements for woody biomass." RSB.
https://rsb.org/wp-content/uploads/2021/12/RSB-SA-01_v1.0-RSB-Standard-Amendment-Woody-Biomass.pdf

Shaw, Sara, Nele Marien, and Lucy Cadena. 2021. "A Leap in the Dark: The dangers of bioenergy with carbon capture and storage (BECCS)." Friends of the Earth.

<https://www.foei.org/wp-content/uploads/2021/04/Friends-of-the-Earth-International-BECCS-English.pdf>

Smith, Stephen M. 2021. "A case for transparent net-zero carbon targets." *Communications Earth & Environment* 2 (24). <https://doi.org/10.1038/s43247-021-00095-w>

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Stoddard, Isak, Kevin Anderson, Stuart Capstick, Wim Carton, and Joanna Depledge. 2021. "Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?" *Annual Review of Environment and Resources* 46 (1): 653-689. <https://www.annualreviews.org/doi/abs/10.1146/annurev-environ-012220-011104>

Woodberry, Leo, and Danna Smith. 2021. "The Nature Conspiracy." <https://johnmuirproject.org/wp-content/uploads/2022/04/The-Nature-Conspiracy-Magazine.pdf>

World Bioenergy Association. 2021. "Glasgow Declaration on Sustainable Bioenergy." <https://sustainablebioenergy.org/wp-content/uploads/Glasgow-Declaration-on-Sustainable-Bioenergy.pdf>