Full submission at deadline 2 by Leeds Trades Union Council

(8,100 words, summary supplied)

As stated in our initial submission, it is the policy of Leeds Trades Union Council to support a just transition for workers from high emissions industries into jobs that can actively reduce greenhouse gas emissions whilst providing secure incomes and benefits for our communities. We therefore focus on the claims in Drax's Needs and Benefits Statement (Document Reference Number 5.3) that its BECCS proposal is vital for meeting statutory emissions reduction targets, and will support employment and economic development in the area and wider region.

A) Predictions of jobs numbers

1) Introduction

In its Needs and Benefits Statement (Doc 5.3), and also in its response to Relevant Representations querying the jobs forecasts (Doc 8.3, para 13.1) the Applicant stresses the alleged importance of the proposed development to the wider development of the Humber industrial region (as part of the Zero Carbon Humber project) and the East Coast Cluster of which this is part.

The Applicant states that consideration of such benefits is needed to balance acknowledged negative impacts of the proposed scheme (Needs and Benefits Statement, Application Doc 5.3, para 2.1.10). The National Policy Statement for Renewable Energy Infrastructure (EN-3), for example, refers to there being a greater number of "negative effects" associated with biomass and energy from waste compared with energy from wind power.

Therefore, in an examination of whether the retrofit of carbon capture at Drax would meet the overarching requirements of increasing the supply of *sustainable* and *low carbon* energy and reducing the amount provided by fossil fuels (cf EN-1 1.7.2; Draft EN-1 2.3.4) it is both important and relevant to scrutinise the claims made both for the Drax installation itself and for this wider development, and the role that BECCS at Drax would occupy.

Furthermore, predictions of social and economic benefits resulting from employment opportunities cannot be meaningfully supported without a critical appraisal of the various technologies involved, since it is upon these that not only the ultimate legality of such technologies rests (ie compliance with the Climate Change Act 2008 (2050 Target Amendment Order 2019), the UK's Nationally Determined Contributions, and the Sixth Carbon Budget target of 78% emissions cuts by 2035) but also the consequent reliability of jobs projections based on this pathway.

2) Forecast of jobs at Drax

The Executive Summary of the report commissioned by Drax from Vivid Economics, as it appear on Drax's website (posted 18th November 2020) includes a table containing the following projected jobs figures for the *peak* of the construction phase:

- Direct jobs - 4,942

- Indirect jobs - 2,122
- Induced - 3,240
- Total - 10,304

In its response to the Relevant Representations (Doc 8.3, para 13.1) the Applicant appears to dispute the existence of these figures, which indeed do not appear in the version of the Vivid Economics report provided as an Appendix to the Needs and Benefits Statement. This is a little surprising since the figure of 10,000 plus jobs has appeared frequently in press reports supportive of Drax's plans. It is therefore pertinent to note that the figures cited in the Applicant's Response refer to the *average* job numbers for the period 2024-28. They are: 4,000 direct, 1,600 indirect, and 2,500 induced jobs, giving a total of 8,100.

Taking the two sets of figures together, it is clear that the job numbers for much of this 5 year period will be substantially less than the averages quoted - and indeed, the Vivid Economics report shows significantly lower figures for the years 2024, 2026 and 2028 - something not made clear in the Needs and Benefits Statement nor, it must be said, in media reports suggesting that 10,000+ jobs are to be created.

Comparing the peak jobs numbers with the numbers given for the operations and maintenance phase, it is correct to state that once the relatively brief construction phase is complete the total number of jobs dwindles from a peak of roughly 10,000 to a little over 3,000 - despite the Applicant's comment (in 8.3, para 13.1) that this is "not reported" in the Needs and Benefits Statement. The number of direct jobs predicted dwindles from 4,940 to "up to" 375, *with no redeployment plans mentioned for the thousands of remaining workers*. Indirect and induced jobs correspondingly drop to 960 and 1,800 respectively. This projected drop poses a major concern for local and regional communities, which

In response to these concerns, the Applicant states (Doc 8.3, para 13.1) that the jobs

> "are part of a new low carbon industry throughout the Humber and East Coast Cluster…… Much of the training, skills and qualifications required for jobs on the BECCS project will be directly relevant to other CCUS projects in the East Coast Cluster."

That is, the Applicant's claim of employment and economic benefits relies heavily upon the assumption that the region will follow the industrial/energy pathway assumed in the report, and implies that jobs - at least the skilled construction and manufacturing jobs - will not disappear but simply move around the region as this development occurs.

Even if this were the case, it would be little comfort to local workers in hospitality, retail etc (the induced jobs) who will experience a crash in business and are unlikely to relocate to Teesside as a result! It would also seem to imply that there is very significant double counting of jobs, if we are to suppose that many of the jobs in other parts of the region are performed by the same worker who has simply moved from A to B, potentially displacing workers in other parts of the region.

However, looking again at the Vivid Economics report, it appears that the peak employment figures across the whole Humber and Teesside regions apply to roughly the same time period as those for Drax itself, with a second lesser peak during the 2030s due to the projected deployment of autothermal reduction hydrogen production at Saltend. Thus, the drop in employment at Drax is only partially compensated for elsewhere, and indeed simultaneous build-out of the other projected installations would tend to generalise this “boom and bust” pattern across the Humber and Teesside regions, contrary to the need to “level up” and protect communities affected by industrial transitions.

Nevertheless, on the basis of the Applicant’s own claims in relation to jobs supported and created, it is clearly relevant to take into account the entire projected pathway for the region and question whether those other CCUS projects are likely to materialise as projected.

Economic analysis of employment impacts is always open to professional disagreement, but the Vivid Economics analysis on which the Applicant’s argument for economic benefit rests, is exceptional in the extent of the “unknowns” in the scenario examined - hypothetical scenarios which are nevertheless treated as established fact. The paper analyses not the impacts of an existing project or sector, or even the proposed extension of an economic activity whose effects are fairly well understood, but the impacts of multiple interdependent developments some of which so far exist only on paper, including some technologies still in development and subject to potential technological, legal and social obstacles (for example issues around public acceptance, for example the CO2 pipeline or the proposed use of hydrogen in domestic boilers) - yet assumes they will be rolled out as envisaged, and on the assumed timetable. This can hardly be described as objective.-

3) Local Jobs?

As far as local jobs are concerned, the picture appears even muddier. We refer the ExA to the draft Section 106 Agreement (Document 7.1, amended version) and in particular the *exclusions* which apply to the proposed Local Employment Scheme (“contracts not caught by the scheme” - Doc 7.1, Section 1.2.1). We quote exclusions (a) and (b) in full, as the effect of these clauses will be to avoid any obligations regarding the local provision by contractors of high quality construction and engineering roles:

> (a) the main contract for the design, engineering, procurement, construction, installation, completion, commissioning and testing of the Proposed Scheme (the EPC Contract);
>
> (b) any long term service agreement (LTSA) contract with the technology provider of the carbon capture technology relating to the design, build and ongoing maintenance of the carbon capture equipment, and any other LTSA contracts in respect of other elements of the Proposed Scheme (the LTSA Contracts)

In addition, it seems highly unlikely that the aim of procuring 80% of construction materials and services from the UK supply chain (Doc 5.3, para 5.2.6) will be met, and the Applicant does not cite the reasoning for believing this is realistic.

Contracts which *are* in scope of the Local Employment Scheme are only required to be *advertised* locally, and for at least two contractors to be *invited to tender* with no further obligations to offer employment; and Drax is only required to “use reasonable endeavours to procure that the contractors engaged in the construction of the Proposed Scheme assist in the implementation of the Local Employment Scheme (para 1.2.4), and “use reasonable endeavours to procure that the contractors engaged in the construction of the Proposed Scheme interview and, if appropriate, recruit suitably qualified applicants as part of the Local Employment Scheme…" (para 1.2.7) Para 1.2.8 concludes

> "... nothing shall require Drax to award any contract for the construction or operation of the Proposed Scheme to any such company".

These seem very shaky grounds for the claims for opportunities for local people (Doc 5.3, ch 6). As regards training opportunities, the Heads of Terms for the Section 106 agreement does not mention training and Para 6.1.3 of Doc 5.3 (Needs and Benefits) states only that "*Dependent on the contractor appointed*" such opportunities "*may*" be available to local people. This does not provide adequate assurance that significant employment or training benefits will be realised - indeed any local jobs are likely to be the lower-skilled, lower-paid and insecure jobs (see Doc 5.3, para 5.2.6)

What we would really need to see would be a full breakdown of the distribution of directly employed and contracted roles, and assurances regarding the pay and conditions (including support for training and development) of contracted workers, as a condition of awarding such contracts.

It is also pertinent to note that even the "up to" 375 direct jobs projected for the operations and maintenance phase (Doc 5.3, para 5.2.8) is very much open to question as advances in automation are likely to drive this number down, especially with regard to the more technical and higher-paid roles. We can cite other infrastructure applications where the projected increase in jobs has proved to be very much inflated, in part due to automation, and in part to issues such as double counting of induced jobs and misattribution of induced and indirect jobs to particular developments or particular localities or regions. For one useful discussion of this, see a paper by economist Brendon Sewill, published by the Aviation Environment Federation (2009): *Do Airports Create More Jobs*

Furthermore, Drax does not make clear what proportion of the jobs on site in the operational phase will actually be attributable to the addition of the carbon capture (see Doc 5.3, para 5.2.8) as the wording is ambiguous on this point, giving rise to the suspicion that it may be very few.

4) Vagueness of jobs projections and lack of comparison scenarios

In the Applicant's Needs and Benefits Statement (Doc 5.3) there appears to be considerable conflation of the terms ``supported" and "created" in relation to jobs. For example, where the Vivid Economics report refers to an average of 4,000 direct jobs "supported" during the construction phase, the Needs and Benefits statement, at para 5.2.7, refers to direct, indirect and induced jobs "generated" in this phase - clearly implying that they will be additional to any existing jobs (where? - in the local economy; the regional economy….? This is not specified, and it is surely relevant to the question of potential double-counting of jobs). At 5.2.8, the Needs and Benefits Statement is a little clearer about the status of the direct jobs during the operational phase ("a combination of retained and new jobs"), though it fails to specify in what ratio. However, it goes on to state that in the operational phase "a total of 960 indirect and 1,800 induced FTE jobs will be *created* [my italics]", whilst the Vivid Economics report retains the term "supported" - a term which sidesteps potential issues of conflating retained and additional jobs, double-counting, misattribution of job creation to specific projects, or the need to quote comparison scenarios.

The term GVA (Gross Value Added - referenced in para 5.2.4) would seem, on the surface, to necessarily imply *additional* economic activity. However, the government (at https://www.ons.gov.uk/economy/grossvalueaddedgva) defines GVA only as “the value generated by any unit engaged in the production of goods and services” - that is, there is no reference to any comparator activity or scenario. Like the estimates of jobs numbers, it fails to take into account what other sources of economic activity may be displaced or - perhaps more significantly - foregone, and fails to refer to any comparison scenarios or justify why this one is regarded as optimal.

In reality, we believe that there are other employment pathways which are not only possible, but preferable and indeed necessary in terms of the overriding imperative to decarbonise the economy, and in a manner which brings social benefits.

It will therefore be pertinent to consider alternative scenarios against which the value of the Applicants’ claims may be measured; that is, whether there are better ways of creating more and higher quality local jobs which at the same time contribute more significant social and environmental benefits.

<u>5) Failure to consider comparison scenarios - the climate jobs we really need</u>.

Climate and energy think-tank that BECCS at Drax will require £31.7bn of public subsidy over 25 years (see post on the Ember website, [redacted], written by Phil MacDonald, Chief Operating Officer, 25 March 2022, last accessed 22/2/23). Whilst it may not be the Inspector’s role to examine the cost-effectiveness of the project, we believe it pertinent to the claims being made for economic benefits that, on these figures, the 375 permanent jobs after construction - if indeed these materialise - would be costing the taxpayer not far short of £3 billion each every year, to generate only a fraction of the UK’s energy needs.

This is money which could be spent on creating thousands of jobs bringing down the cost of energy by rapidly building out genuine renewables such as offshore and onshore wind, solar, tidal, hydro and geothermal projects and new long-duration storage solutions; slashing the energy needs of households with a programme of homes retrofit, or supporting those high-emitting industries around the Humber to decarbonise their processes without recourse to continued or expanded gas extraction.

We believe that the employment and social benefit claimed by the applicant is undermined by the failure to compare their projections with such alternatives, or to consider the many far more labour intensive areas of skilled work in which people need urgently to be trained and deployed to achieve a genuine low carbon economy in a way that is beneficial to local communities and distributes employment opportunities properly across the region, creating more stable and sustainable local employment. Many of these are far more certain in terms of emissions reductions, and needed for meeting the challenges of an already-changing climate: for example regenerative land management, forestry and food growing, recycling/reclamation of materials, building and operating an excellent sustainable public transport system, or deep retrofit of the region’s housing stock for energy efficiency and protection against extreme heat.

This is not only a question of ensuring that people have good and secure jobs, important as that is; it is about the enormity of the challenge of building the size of workforce needed to cut emissions at the speed and scale necessary.

One useful example is provided by figures submitted to BEIS this spring by Tamworth Borough Council in conjunction with contractor EQUANS for medium retrofit (external wall insulation, loft insulation, new windows, doors and ventilation). These indicate that public investment of £31.7b on this sort of work would equate to over half a million job-years, retrofitting 27,000 homes per year on average and saving around 5.3 TWh per year - just in one large town.

Figures like these are consistent with calculations made on behalf of the Campaign Against Climate Change Trade Union Group, and published in the Technical Companion to the booklet "Climate Jobs: Building a Workforce for the Climate Emergency" (CACCTU 2021). Here we estimate that, to insulate all the UK's homes to a standard that roughly halves energy demands from space heating in the domestic sector (currently the single biggest source of UK emissions after road transport) would require training and building a workforce of 2 million over the next ten years - predominantly additional to existing construction-related jobs - who would subsequently *continue* in employment bringing, and maintaining, all homes to the highest possible standard of energy efficiency. Converting all suitable homes to heat pumps and adding solar pv, solar collectors and storage as appropriate, would require tens of thousand more technicians, and around 1.5 million further jobs would be required in supply chains. This, combined with decarbonisation of the grid, would bring buildings emissions down by around 95%.

Likewise, several hundred thousand workers would be needed, UK-wide, to build, maintain and operate the genuinely comprehensive, accessible and sustainable public transport system needed to slash emissions from road transport whilst also slashing the appalling rate of premature death from diseases due to traffic pollution.

We would like to see proper quantification of the green jobs opportunities *foregone,* as well as the foregone emissions cuts, through the focus on subsidising BECCS at Drax at the expense of other sectors and other decarbonisation pathways.

B) Dependency of jobs numbers on viability of BECCS as a negative emissions technology: the relevance of whole lifecycle considerations and challenges to carbon neutrality assumptions.

1) Rationale for questioning carbon neutrality assumption as part of the BECCS examination

We acknowledge that it is not the role of the ExA to challenge current government policy, which accepts in principle the carbon neutrality of industrial scale biomass burning, and therefore treats any emissions captured as "negative emissions. This assumption underpins, for example, the government's current Biomass Policy Statement https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1031057/biomass-policy-statement.pdf and recent Consultations into Business Models for Power BECCS https://www.gov.uk/government/consultations/business-model-for-power-bioenergy-with-carbon-capture-and-storage-power-beccs Put more precisely, calculations of lifecycle emissions from woody biomass burning, whilst including supply chain emissions such as processing and transportation as well as construction emissions, are enabled under this policy to give a zero value to the smokestack emissions themselves, on the assumption that CO2 emitted at the smokestack is compensated by that sequestered as trees re-grow.

Notwithstanding the above situation, we believe there are overarching grounds in policy for including considerations of the sustainability and carbon neutrality of woody biomass burning in this examination.

- As detailed in the Needs and Benefits statement (Doc 5.3), the Planning Act 2008 (Section 104 (7)) sets out exceptions to the procedure of assessing the application only against current National Policy Statements, and these include if the application would "lead to the UK being in breach of its international obligations", "be unlawful" or "result in adverse impacts from the development outweighing the benefits". We submit that a proper examination of the lifecycle emissions, including the sourcing, processing and transportation of the wood pellets and the efficiency of the CCS, would demonstrate that these three exceptions are highly relevant to this application.

- As we argued in our submission to the Preliminary Meeting, and continue to argue, we deem it inappropriate for this Application to be examined at this time in view of the potential instability of national policy. The government's Net Zero Strategy has already been ruled in breach of the Climate Change Act as it fails to quantify the emissions reductions expected to be achieved from each sector, and it is likely that emerging NSPs relying on biomass and/or carbon removals will be subject to similar legal challenge. Despite the requirement to assess NSIP applications against *existing* policy (at the time of the application being accepted) we believe at the least that policy drafted twelve years ago cannot provide sufficient guidance for the ExA to determine whether the Application meets overarching legal and planning policy requirements, in such a rapidly developing and contentious field.

- The increasing weight of scientific evidence against the carbon neutrality assumption gives rise to reasonable concerns that policy incorporating these assumptions may be abandoned, as relying on BECCS is in fact likely to make it impossible to comply with the overarching legal requirements of the Climate Change Act 2008 (2050 Target Amendment Order 2019), the UK's Nationally Determined Contributions (which presumably constitute an international obligation within the meaning of the Planning Act 2008), and the Sixth Carbon Budget target of 78% emissions cuts by 2035. We reference some of this evidence in section C of our Representation.

- Should future policy differ (as we believe is demanded by the science) from what is assumed by the Vivid Economics report, this will have major implications for the training and employment needs of the workforce and seriously undermine the applicant's claim for extensive economic and social benefit. This is especially so since these projections involve dramatically optimistic estimates of scaling up of employment across the UK associated with this technological pathway (Vivid Economics 2021, appended to Doc 5.3). We therefore refer the ExA (in remaining sections of our Representation) to some of the many sources of evidence on which we base our concerns.

2) Rationale for examining the use of biomass at Drax, as part of the BECCS examination

We also acknowledge that the use of biomass as a fuel at Drax power station is an existing consented operation and as such ostensibly lies outside the current application (Doc 5.3, footnote to p2, and Doc 8.3 Introduction). Nevertheless, we believe there are several grounds for arguing that the accuracy of the carbon neutrality assumptions is a "matter of importance and relevance" to the current inquiry (ie, within the meaning of Section 104(2)(d) of the Planning Act 2008).

- The Applicant has argued repeatedly that, since the application is for the carbon capture retrofit only, the evidence relating to the burning of biomass is irrelevant. The Applicant argues that since biomass is being burned already, and can continue to be burned regardless of whether consent is obtained for carbon capture, any application of carbon capture to any fraction of its smokestack emissions can only represent a relative benefit regardless of how smokestack emissions are accounted. This argument is transparently flawed, as the burners which are proposed to be retrofitted would be nearing the end of their design life by the time the proposed CC was added. The application is in effect an application not just for the CC retrofit but for a new BECCS installation as a whole. At the least, the business case for continued biomass burning, beyond the expiry of the current subsidy arrangements, depends upon the ability to attract further subsidies (eg in the form of favourable CfDs), income in the form of "negative emissions" sales in an ETS, and on the confidence of investors in its long-term viability, which in turn rest upon the technological case for BECCS *as a whole.*

- The argument that given the existing consent for biomass burning the retrofit of carbon capture can only be a benefit takes no account of the wider impacts of such a development. One such impact is due to the fact that carbon capture carries a significant energy penalty, and Drax has made clear in its responses to Relevant Representations (Doc 8.3, para 10.1) that it will not be increasing the quantity of biomass burned to compensate for this. Based on Drax's own figures, this will remove 369 MW net electrical capacity from the National Grid. This is contrary to both EN-1 and the draft EN-1 which both require developments to *increase* the supply of renewable-produced electricity.

  Furthermore, it is likely that the shortfall will be made up by fossil-fuel based generation, again contrary to government policy which is to increase the proportion of renewable produced energy in the system (and to reduce dependency upon imported gas). The possibility of such shortfalls being made up by CCS -"mitigated" gas and/or "blue hydrogen" (eg from installations within the East Coast Cluster) presents an even more problematic scenario given that each of these carries a similar energy penalty and is associated with significantly increased methane emissions (a gas with a global warming potential more than 80 times that of CO2 over the crucial 20 year timescale).

- In its Response to Relevant Representations citing the energy penalty (Doc 8.3, para 10.1 and 10.8) the Applicant justifies the reduction in energy supplied on the basis that it will be providing "two products" - electricity and negative emissions. Presumably their argument is that the missing portion of the energy is not lost, but is simply being used, to make a new product (negative emissions). In other words, they assert that the project is different in kind from a power station without carbon capture. If this is the case, BECCS must logically be treated as a project in its own right, and all factors (both upstream and downstream) contributing to the quantifying of these "negative emissions" must be taken into account.

- Based on its consultation on business models for power BECCS, https://www.gov.uk/government/consultations/business-model-for-power-bioenergy-with-carbon-capture-and-storage-power-beccs and also the consultation on business models for engineered greenhouse gas removals https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1087918/greenhouse-gas-removals-business-models-consultation.pdf to which it is complementary, it is clear that the government treats BECCS, and carbon removals (aka Negative Emissions Technologies) as technologies in their own right. Such a designation clearly encompasses all aspects of the lifecycle including the sourcing of biomass, necessitating a rigorous method of quantifying and verifying impacts on forest and land carbon sequestration. We would argue that the Application cannot properly be examined until such methods are in place. The texts of the above consultations, and in particular the consultation on Negative Emissions Technologies, confirm that the government itself accepts that more work is required on monitoring and verification of sustainability of woody biomass sourcing.

- The government has yet to confirm a business model for power BECCS, but sets out its preference for a separate contract for difference for power generated and for negative emissions produced, and the additional option of tradeable NEs (eg which could be purchased as offsets by high emissions businesses). Obviously these mechanisms depend crucially on establishing an accurate way of measuring purported negative emissions, and the ability to do so must form a central part of the Inspector's examination. Likewise, the ability to justify the energy penalty by reference to the production of a new product ("negative emissions") depends upon being able to prove that any negative emissions produced on site outweighed any resulting additional emissions (measured as CO2e per kWh of electricity produced) as a result of this energy penalty, whether in the biomass supply chain or in other parts of the wider energy system. This would only be possible by scrutinising *comprehensively* the lifecycle emissions of the BECCS process viewed as a whole, including revisiting both the efficiency and the sustainability of Drax biomass *per se* in the light of up-to-date evidence.

- Our reading of the power BECCS business model consultation suggests that a measure of carbon captured will be allowed to stand proxy for a measure of negative emissions, provided a suitable threshold for supply chain emissions per unit generated is not exceeded; but it is also made clear that the "energy penalty" from carbon capture (ie the reduction in overall conversion efficiency) will impact the setting of the supply chains emissions threshold (ie allowing a higher level of CO_2e per kWh supplied), as will the efficiency of the capture and storage. This again supports the view that all elements of the lifecycle are pertinent to evaluating the application irrespective of whether biomass without carbon capture has previously been consented.

C) Emissions from industrial scale biomass (wood chip) burning

1) Overview

The designation of industrial scale woody biomass burning as carbon neutral is based upon an assumption that the carbon released by burning is compensated by that sequestered during re-growth of trees, A moment's consideration will show that this is fallacious on a number of grounds, the first being that trees do not regrow overnight, but rather take decades or longer to grow, therefore generating a "carbon debt" with a "payback" period of decades to centuries - that is, over a timescale relevant to Net Zero obligations (and averting the worst global heating scenarios), industrial scale wood burning increases emissions.

Even if, as Drax claims, the majority of the wood burned is not from whole trees (for example, if it is from tree tops or branches), there is still a loss of sequestration capacity relative to what would have existed if the wood had not been burned. However, research and journalistic investigation has demonstrated that much of the wood is from clearcutting of natural, including primary, forest - a practice which always reduces the amount of carbon sequestered relative to any crop plantations that may replace them. Additional growth of mature trees sequesters far more carbon, both above and below ground, than growing new trees.

For BECCS to produce negative emissions the lifecycle net emissions (or loss of sequestration capacity) from the removal and burning of the wood plus other supply chain emissions and emissions resulting from wider changes in the energy system, needs to be less than what the carbon capture can remove at the smokestack. On the basis of the payback model, which states that the carbon emitted is gradually paid back over a period of "decades to centuries", there will indeed be some period during which the lifecycle emissions from biomass burning without CCS will be fewer than what is re-captured *with* CCS. However, this marginal improvement will occur far too late to mitigate the impacts of the initial combustion.

However, in reality the scenario is *very much* worse than this because the theoretical calculation of the payback period is based on a *one-time* release of sequestered forest carbon. In practice, that debt will only ever be *repaid* if forest carbon release ceases immediately, and the debt will only *remain stable* if further release is kept at the same rate as sequestration through re-growth (ie, very small scale). What actually happens, then, is that the debt is constantly increased, even regardless of replanting.

Such arguments of course need to rest on complex modelling and empirical confirmation, which may be found in a number of reports:

2) John D. Sterman, Lori Siegel and Juliette N Rooney-Varga (2018) in Environmental Research Letters 13 (2018) 015007 [redacted]

We quote from the paper's abstract:

> *We simulate substitution of wood for coal in power generation, estimating the parameters governing Net Primary Production and other fluxes using data for forests in the eastern US and using published estimates for supply chain emissions. Because combustion and processing efficiencies for wood are less than coal, the immediate impact of substituting wood for coal is an increase in atmospheric CO2 relative to coal. The payback time for this carbon debt ranges from 44–104 years after clearcut, depending on forest type—assuming the land remains forest. Surprisingly, replanting hardwood forests with fast-growing pine plantations raises the CO2 impact of wood because the equilibrium carbon density of plantations is lower than natural forests.*

And from the Discussion and Conclusion section:

> *…….growth in wood harvest for bioenergy causes a steady increase in atmospheric CO2 because the initial carbon debt incurred each year exceeds what is repaid. With the US forest parameters used here, growth in the wood pellet industry to displace coal aggravates global warming at least through the end of this century, even if the industry stops growing by 2050.*

Note that the authors stress they use the most favourable assumptions in their model, eg assuming that harvested wood is allowed to regrow as forest and encounters no subsequent damage. In reality these conditions are unlikely to hold.

3) Report prepared on behalf of the Spatial Informatics Group, on The Carbon Impacts of UK Electricity Produced by Burning Wood Pellets from Drax's Three U.S. Mills

This report, prepared in 2019 on behalf of the SIG for the US Southern Environmental Law Center (SELC) and National Wildlife Federation (NWF), comprises lifetime carbon analyses for the use of wood pellets from Drax's own three US mills. The analysis demonstrates that even under the most generous assumptions regarding the sourcing of wood for these mills, burning wood pellets from Drax's own US mills for electricity in the UK increases carbon dioxide concentrations in the atmosphere for well over 40 years when compared to the emissions profile of either the UK's 2018 electricity grid mix or the UK's targeted electricity grid mix (ie, with a higher proportion of renewables) for 2025. That is, wood biomass, however sourced, is not carbon neutral within a timescale relevant to the UK's statutory net zero target. See [redacted] and a summary Factsheet [redacted]

4) Report by Stand Earth - *Investigation into Canada's growing wood pellet export industry threatens forests, wildlife and our climate*, published 2020, updated 2022

Report discussing the danger to vital forest carbon sinks and ecosystems in British Columbia and elsewhere, through practices including clearcutting of mature trees in primary forest for pellet mills operated by Pinnacle (now owned by Drax) and Pacific Bioenergy, also a Drax supplier. Pinnacle's own website states that "managed" forests are routinely clearcut at harvest. See [redacted]

5) Report by the Sierra Club of British Columbia - *Clearcut Carbon: A Sierra Club BC report on the future of forests in British Columbia, December 2019* by Jens Wieting, Senior Forest and Climate Campaigner, with mapping analysis by David Leversee

This report discusses the huge emissions associated with such logging and foregone carbon sequestration (quantified on pages 3 and 4). Even with immediate replanting of a clearcut mature forest, it takes at *least 13 years* before the carbon sequestered by the new growth even *begins* to surpass what is still being released as a result of the clearcutting. This is from the clearcutting alone, not including carbon emitted during use, processing or burning of the wood.

D) Efficiency of carbon capture

1) Overview - the EEFA Report

Notwithstanding the Applicant's assertion (eg in Document 8.3, paragraph 10.2) that carbon capture is a tried and tested technology developed over 45 years, it is the case that despite this experience there are *no* instances where a power CCS installation has achieved anywhere close to the capture rates envisaged by Drax.

A comprehensive report by the Institute for Energy Economics and Financial Analysis (*"The Carbon Capture Crux: Lessons learned"* by Bruce Robertson and Milad Mousavian, Sept. 2022, and see [redacted]) shows that "successful" applications of carbon capture have been mostly in the gas processing sector. These are the typical applications used to "greenwash" gas production, as the downstream emissions from burning (and leakage) of gas are not counted. Indeed the model is not aimed at preventing emissions so much as producing CO2 as a commodity, mostly for use in enhanced oil recovery either by the same or another company. This model has the paradoxical effect of benefiting from higher levels of both gas and oil extraction and therefore of continuing high levels of demand for these products - contrary to UK policy to reduce the proportion of fossil fuels in the energy mix and pursue decarbonisation of industrial operations and energy consumption on the demand side. It is worth noting that BECCS likewise carries this perverse economic incentive to increase burning of woody biomass.

The IEEFA study further demonstrates (in Section 3, p36 onwards) that power CCS (ie post-combustion at power stations) has been the *least* successful type of application. In fact (I quote):

> "…..carbon capture has shown a track record of technical failures since 2000. Close to 90% of proposed CCS capacity in the power sector has failed at the implementation stage or was suspended early"

It is highly misleading to conflate power CCS with other applications of carbon capture when typical efficiencies vary widely for different applications, and the technological challenges and costs differ.

2) Petra Nova

In its Responses to Relevant Representations (8.3, para 10.4) the Applicant states that "the vendor [ie, MHI, producer of the KS21 solvent] has proven this type of CCS technology at scale with various facilities including the Petra Nova Project based in Houston, USA." In fact, though, the experience of the Petra Nova plant is not encouraging. The plant was originally expected to capture at least 1.4 million metric tons of CO2 annually (which is only 33% of carbon emission from unit 8 of the powerplant), or a total of 4.2 million metric tons from 2017 to 2019. However, in practice over the three years of its operation (ie before being mothballed due to unsustainable expense), it fell short of even this low target by 17%.

3) Boundary Dam

The only existing post-combustion power CCS plant in the world is Boundary Dam coal powered plant in Canada. According to the IEEFA (2022) study using data up to and including 2021 (I quote):

> "The initial goal of the project was capturing about 1 million metric tons of CO2 each year or 3200 tonnes daily. However, the plant has captured an average of slightly more than 615,000 metric tons annually. Data published by SaskPower, the operator of the project, suggests that the Boundary Dam 3's average CO2 capture rate to date is about 50%, not the targeted 90%".

An update published on SaskPower's own blog (BD3 Status Update: Q4 2022, January 23, 2023) [redacted] provides some more recent data:

"While online, the facility had a daily average capture rate of 2,631 tonnes in Q4, with a peak one-day capture of 2,874 tonnes. This resulted in an emissions intensity of 383.2 tonnes of carbon dioxide per gigawatt hour……"

Whilst not (in this piece) giving this as a percentage of emissions captured, SaskPower's BD3 Status Update: Q2 2022, uploaded July 22, 2022 [redacted] states that:

"the approximate emissions intensity of a conventional coal unit is 1,100 t CO2/ GWh."

Taken together, these figures suggest that even in its best year so far, the reduction in emissions intensity from the addition of carbon capture did not exceed 65%. Arguably the emissions intensity of the electricity generated is as important a measure as the absolute capture rate, since the energy penalty due to energy requirements of the CC negates much of whatever emissions reduction is attributable to it.

The capture rate itself, however, is very far below SaskPower's projections, which presumably, like Drax's, were based on small-scale trials demonstrating theoretical effectiveness.)

4) Tyndall Centre Report

Given that the trials at the Drax Sorbent Incubation Facility (referenced at Doc 8.3, para 10.2) are very small scale, even with latest sorbent technologies it would appear foolhardy (and not consistent with experience of other projects) to assume that the capture rate in the real world will approach that achieved in such trials.

Even at much higher capture rates, according to research by the Manchester University Tyndall Centre for the International Institute for Sustainable Development (Calverley, D., & Anderson, K. (2022). *Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets*), the residual emissions in addition to the lifecycle emissions render this power CCS unsuitable for rapid decarbonisation:

"**3.3.2 The very high lifecycle emissions of CCS.**
While it may be possible to reduce operational emissions of CO2 by around 90%, this still leaves a significant residue of CO2 released to the atmosphere. Given the need for all GHGs to be eliminated globally, with only residual emissions from agriculture remaining, then the high lifecycle emissions associated with CCS (typically 100–300 gCO2e/kWh) make it unsuitable for all but very marginal roles".

And at 3.3.3

"A tonne emitted from CCS is a tonne that cannot be emitted elsewhere. A further consideration in terms of CCS within the energy system is how low or zero-CO2 options for power generation are far more advanced than are the alternatives for fossil fuels in other sectors, particularly transport. Consequently, every tonne of CO2 emitted from a power station (even with CCS) is a tonne that cannot be emitted from transport or industry. Since electricity

> generation has many more options for easier and earlier decarbonisation, this misappropriation of the scarce carbon budget works against a system-level transition to zero carbon energy".

Note that, in common with the authors of the IEEFA report, the authors consider that CCS may be needed for some marginal applications in industry, eg for manufacture of cement, but this should not be confused with the use of CCS to displace the adoption of 100% renewables (wind, water, sun, geo) in power generation. *Even if we were to accept that large-scale biomass burning can be sustainable and carbon neutral, this general conclusion is still relevant as Drax positions its BECCS application not only as having merit as a stand-alone project, but as advancing the adoption of CCS technologies in general. This, we believe, poses a major threat in terms of both its inherent inefficiency and in terms of foregone emissions reduction from alternative pathways.*

5) "Blue Hydrogen"

We refer to this briefly although it is ostensibly not part of the DRAX application, since it pays such a major part in the Zero Carbon Humber cluster which the Applicant argues to be a vital context for considering the Needs and Benefits of its proposal. BECCS at Drax has a direct role in this scenario, inasmuch as the "negative emissions" produced are expected be marketed (supported through CfD) as offsets to compensate for the residual emissions from blue hydrogen and from its industrial use.

The Vivid Economics report appended to the Needs and Benefits statement (Doc 5,3) states that, for the purposes of the report, the Humber Cluster comprised:

- Two Drax BECCS units of 0.66 GW each, deployed as a staggered pair in 2027-2028
- Hydrogen production including 0.6 GW Equinor Autothermal reformer in 2026, as well as additional production capacity to allow for Hydrogen demand from transport and buildings. In total, 6.5 GW of Hydrogen production is deployed by 2030
- Gas-CCS at Immingham VPI (post-combustion retrofit) of 1.0 GW and one 100% decarbonised gas turbine at Keadby 3, coming online by 2030. Total gas-CCS capacity is 1.8 GW in the cluster by 2030*
- Hydrogen use in industrial processes from the Equinor ATR unit
- ~6 MtCO2-e per annum of industrial CCS in the Humber

Our understanding is that the current plans for Zero Carbon Humber and the complementary Humber Zero centred on VPI Immingham vary somewhat from this scenario, but are nevertheless very strongly centred on what the Zero Carbon Humber website terms the "hydrogen economy".

"Blue hydrogen", that is hydrogen produced from natural gas by either steam or autothermal reformation, has a significant CO2 equivalent footprint. Whilst ATR may be more efficient in terms of carbon capture, both processes result in significant greenhouse gases emissions (CH4 , CO2 , N2 O) as well as other gases with global warming potential (NOx and H2). In addition, upstream emissions of methane from leaks during extraction and transportation of natural gas are significantly increased due to the energy penalty associated with the technology. Methane has a global warming potential more than 80 times that of CO2 over the crucial 20 year timescale. Research by Howarth and Jacobson (Robert W. Haworth and Mark Z. Jacobson, *How Green is Blue Hydrogen,* Energy Science and

Engineering, August 2021 - [redacted] [open access]) shows that even with low figures for fugitive methane emissions, the overall global warming potential of blue hydrogen can be greater than for unmitigated gas.

Some proponents of hydrogen suggest that blue hydrogen is an interim technology, to be displaced by "green hydrogen", ie hydrogen made by electrolysis of water using renewable-produced electricity, Whilst there is undoubtedly a role for green hydrogen, eg in some industrial processes and for storage of renewable-produced electricity at times when supply exceeds demand, the low conversion efficiency (electricity to hydrogen, and hydrogen to electricity) and its consequently high energy demand means its use must be restricted to those necessary applications. Worryingly, the excessive marketing ambitions for hydrogen (eg the inappropriate and wasteful proposal to use it for home heating) therefore means there is a risk of blue hydrogen technologies being "locked in", blocking progress in decarbonising industries, prolonging and increasing the use of natural gas and potentially increasing emissions, contrary to the targets set in the Climate Change Act (2008, 2050 Target Amendment 2019) and the overarching requirements to increase the supply of *sustainable* and *low carbon* energy and reducing the amount provided by fossil fuels (cf EN-1 1.7.2; Draft EN-1 2.3.4).

6) The pipeline and storage

As the applicant states (eg in Doc 8.3, para 11.1) the Humber Low Carbon Pipeline will be the subject of a separate planning application and ostensibly out of scope for this one; furthermore, it is accepted that it is not unusual for connected component projects within a larger project to be examined separately. Nevertheless, not only is the pipeline contentious in its own right, but part of the rationale for the current application appears to be the supply of a steady quantity of CO2 to the pipeline, as a more erratic or intermittent supply would make it difficult to determine the necessary materials characteristics for pipeline safety (ie prevention of leaks or corrosion).

That is, it will be necessary to run the BECCS units as baseload, which means that at periods of low demand-to-supply ratio, biomass burning would continue whilst wind generation (for example) would be curtailed. It locks in a requirement for a steady high output of CO2, requiring continuous operation in contrast to its current mid-merit status. Therefore, questions must be raised about Drax's claim that it will not be increasing the amount of woody biomass burned. It also raises technological questions about what happens in the case of an outage, or closure for maintenance, if client installations downstream of Drax on the pipeline are reliant on Drax's output.

The Applicant states (Doc 8.3, 11.1) that the examination of the pipeline will include a cumulative assessment of impacts, which the Applicant is not yet in a position to carry out as the details of the pipeline were not known. Given the interdependency of the two projects, it does not appear to us that the current application can be properly examined until it is possible to assess the interaction of impacts, and how the interface between the two projects is to be managed.

Without going into details of the potential technical obstacles, it is at least pertinent to ask

- Are technical knowledge and experience, and relevant regulations, at a stage where the safety of the proposed pipeline can reasonably be assessed, or might this reasonably be considered to be a dangerous experiment? Clause 2.9.2 of Volume 1 of National Grid's EIA Scoping Study indicates that it intends to design the CO_2 pipeline to a (2015) British Standard. This would be contrary to Health and Safety Executive guidance on Major Hazard Potential of CCS https://www.hse.gov.uk/carboncapture/major-hazard.htm#Design which states:

> "Detailed standards and codes of practice written specifically for the design and operation of dense phase or supercritical CO_2 plant and pipelines are still being developed. However, although general process engineering and pipeline standards exist (such as those for natural gas) that may be applied to CCS these may not be sufficient to ensure adequate containment for CO_2 under all conditions".

- What precautions are required in terms of emergency responses should a leak or rupture occur? (eg taking into account that first response machines and vehicles requiring oxygen cannot operate where CO_2 levels are high).
- Where will the responsibility fall for determining levels of impurities (eg H_2S, SO_2 and water) – eg by client installations, or by National Grid – and how will this be managed given the multiple inputs and variable inputs?

As regards the separate storage application, a globally agreed system to monitor, report and verify that no CO_2 escapes from such storage sites has yet to be proposed, but would be essential given the need for credible global carbon accounting procedures.

The centrality of permanent storage is so crucial that we consider that adjudication of planning applications for the upstream components of the Zero Carbon Humber project should not continue until a planning application for the storage component (including thorough site characterisation and agreed MVR processes) has been adjudicated.