Author Details	
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DEADLINE D3 SUBMISSION

I am an independent researcher and environmental consultant, working at the intersection of science, policy, and law, particularly relating to ecology and climate change. I work at a consultancy called Climate Emergency Policy and Planning (CEPP).

In so far as the facts in this statement are within my knowledge, they are true. In so far as the facts in this statement are not within my direct knowledge, they are true to the best of my knowledge and belief.

Contents

1 PROCEDURAL ISSUES

1.1 Rule 17 letter, 10th September 2024

1 In response to the ExA's letter on the recent guidance on AI, I confirm that I have not used AI to create or alter any part of my documents, information or data, submitted to this Examination to date. I note the requirement to clearly identify the use of AI in any subsequent submissions.

2 INTRODUCTION

2.1 Deadline 3 (D3)

2 This is my submission for Deadline 3. It comprises:

- notification to the ExA of two further issues, discussed in the next main section;
- response to the Applicant's responses on ExQ1.

2.2 ES Chapter 19

3 ES Chapter 19 is part of the Environmental Statement ("**ES**") under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the "**2017 regulations**"). This document will be simply referred to "**ES**" below.

2.3 Appendices

4 For clarity, I continue the alphabetic sequencing of Appendices from my D2 WR submission (so appendices for this document start at "S").

3 TWO FURTHER ISSUES

3.1 Upstream amine solvent emissions

5 I have identified this issue as a material issue for the EIA since my WR submission at deadline D2.

6 Under "Determining Operational Effects" at ES 19.5.17, the Applicant identifies amines in the carbon capture process as an operational effect of the operating the H2 Teesside plant, but states that the emissions would be "immaterial":

> *"There is currently no information available for the quantities of amines and other chemicals required for the carbon capture process, but this is expected to be immaterial to the overall footprint and less than 1% of total emissions as it is a closed loop system for amines so raw material procurement should be minimal."*

7 However, recent research based on an expert review of Europe's Blue Hydrogen plans (see Appendix S[1]) by Professor Christophe Coutanceau at the Institute of Chemistry of Poitiers and the French National Centre for Scientific Research (CNRS) indicates the emissions from amine-based solvents used in CCS are not immaterial, nor less than 1% of the total emissions[2].

8 I respectfully request that the ExA requests that the Applicant:

- To revisit its statement at ES 19.5.17;
- Provide the examination with the tonnage of solvent that will be used in the closed loop system;
- Inform the examination if any addition (ie: replenishment) of solvent may be required during the lifetime of the project;
- Provide the examination with "full knowledge" reasonable worst-case analysis of the likely significant effect and climate impact of the amine solvents;
- Provide updates to Tables 9-7, 9-8 and 9-9 on the operational GHGs emissions associated with amine solvents;
- Provide any further updates and information relevant to the EIA assessment.

3.2 Hydrogen leaks from production, storage and transport facilities

9 I have identified this issue as a material issue for the EIA since my WR submission at deadline D2. Recently reported research, by <u>direct detection and monitoring,</u> shows leakage of hydrogen from a hydrogen facility to be at a much greater level than previously assumed.

10 Under "Uncertainty in Impact Analysis" at ES 19.5.76, the Applicant discusses "Hydrogen Fugitive Emission[s]". The Applicant acknowledges that hydrogen has a global warming effect. At ES 19.5.77 under "Short lived GHG Gases", the Applicant notes:

> *"… while a UK Government study suggests <u>H2 would have a GWP of 33 in a 20-year timespan</u> instead of 11 (Warwick, et al., 2022)."*

11 The BEIS/DESNZ "Warwick" research is provided at Appendix T. In the quote above ("instead of 11") the applicant means that the 100-year GWP is 11. Note, that like for methane (and discussed in detail in my WR [REP2-046]), the 20-year GWP of 33 is <u>the more</u>

[1] Published October 12th 2024.

[2] The figures in Appendix S would suggest emissions from amine solvent production are more likely to be 3% - 5% of the total lifecycle footprint of blue hydrogen plants over 25 years (accounting for the fact that not plants would use amine solvents)

scientifically accurate (ie: "full knowledge") description of the impacts of hydrogen on the atmosphere and on the climate, as hydrogen is a short-lived indirect GHG/

12 Despite the evident potency of hydrogen as an indirect GHG, the Applicant does not identify, nor describe, the level of downstream hydrogen emissions from the production plant, storage and subsequent transport to end user applications. Instead the Applicant states that hydrogen is not recognised in the Kyoto Protocol gases and for this reason it is not included in the EIA. The Kyoto Protocol was adopted on 11 December 1997 and the Applicant thus bases its EIA on scientific knowledge that is 27 years out-of-date (ie: the EIA is not "full knowledge").

13 And as discussed in my WR [REP2-046], the environmental statement and EIA are required to identify and describe the likely significant effects of the project based on "full knowledge" "as can be reasonably obtained", including possible "future effects on the environment" and "whether they are likely". A schema (ie the Kyoto Protocol list of GHGs) adopted under 27-year-old science is not an adequate reason to ignore the effects from what is now known, and is therefore knowledge that can reasonably be obtained, about the potency of this indirect GHG.

14 Despite not identifying and describing any effects from the potential downstream leakage of hydrogen, the applicant then states that it will attempt to mitigate them:

> *"…so, in line with the Low Carbon H2 standard, the operation of the Proposed Development will minimise cold venting and fugitive emissions of H2 throughout the operation."*

15 As the Applicant has not identified the effects, it is impossible to know how effective this mitigation strategy might, or might not, be. There is no baseline description against which to measure the effectiveness of the suggested mitigation. Nor is there any meaningful description of the notional mitigation: it would be expected that cold venting and fugitive emissions would be "minimise[d]" anyway. There is no evidence of any mitigation efforts beyond what would be in the design.

16 However, it is extremely relevant that just last week, the science journal Nature published a paper (Appendix U) on the direct detection and monitoring of hydrogen leakage during production, transport, and consumption at a Green hydrogen site in Holland. The abstract of the paper states:

> *"Projections towards 2050 of the global hydrogen (H_2) demand indicate an eight-fold increase in present-day hydrogen consumption. Leakage during production, transport, and consumption therefore presents a large potential for increases in the atmospheric hydrogen burden. Although not a greenhouse gas itself, hydrogen has important indirect climate effects …. Our emission estimates indicate current loss rates up to 4.2% of the estimated production and storage in these facilities.* ***This is sufficiently large to urgently flag the need for monitoring and verification of H_2 emissions for the purpose of understanding our climate change trajectory in the 21st century.****"*

17 This clearly indicates that these authors are deeply concerned by hydrogen leakage from production, storage and transport facilities, and that it can have a significant effect and climate impact.

18 I respectfully request that the ExA requests that the Applicant:

- To revisit its statements at ES 19.5.76 and 19.5.77;
- Provide the examination with "full knowledge" reasonable worst-case analysis of the likely significant effect and climate impact of hydrogen leakage from production, storage and transport for H2 Teesside;
- Provide updates to Tables 9-7, 9-8 and 9-9 on the operational GHGs emissions associated with hydrogen leakage;
- Provide any further updates and information relevant to the EIA assessment.

4 RESPONSE TO APPLICANT'S RESPONSE TO EXQ1

19 At deadline D2, the Applicant provided document "8.11.5 Response to ExQ1 Climate Change" [REP2-023]. I have these comments on the document.

4.1 Q1.5.1

20 A delay to Phase 1 and/or Phase 2 construction does have an impact on the comparison of the GHG emissions from the project with the relevant CBDP Sectoral Carbon Budget Projections in ES Table 19-11. This is discussed further under Q1.5.9 below.

4.2 Q1.5.2

21 The applicant has responded that "*all significant sources of emissions … have been considered*".

22 I just note that this clearly is not true, and the ExA is referred to my deadline D2 WR and to this document, for a comprehensive appraisal on a "full knowledge" reasonable worst-case EIA of all the significant sources of emissions, including many aspects omitted by the Applicant in its "not full knowledge" ES chapter 19.

4.3 Q1.5.3

23 The ExA is respectfully asked to request that the EA, UKSHA and the LAs to consider the evidence provided in my WR [REP2-046]; for example, that carbon capture rates have never been achieved at greater than 80% for the three existing blue hydrogen plants in the world.

24 The EA, UKSHA and LAs should provide their views as to how that would affect the proposed permitting.

25 In the case of the Environment Agency, the ExA is requested to ask it how the recent evidence presented in my WR would change the documents quoted later by the Applicant in response to Q1.5.6:

(i) "Post-combustion carbon dioxide capture: emerging techniques", Environment Agency, 2021, and;

(ii) "Hydrogen production with carbon capture: emerging techniques", Environment Agency. 2023.

26 Although the applicant has said that the Environment Agency permit will monitor the carbon capture rate, I note that the document 9.2 [REP1-023] "Statement of Common Ground between H2 Teesside Limited and the Environment Agency" does not list the carbon capture rate as a matter under section 4.0 "Matters under Discussion". It is a huge omission that GHG emissions from the project are not mentioned at all in the SOCG document.

27 The ExA is respectfully requested to require the Applicant and the EA to update the SOCG [REP1-023] to demonstrate how carbon capture rates are to be monitored under the permitting proposals.

28 The ExA is requested to require the Environment Agency to provide the examination with information on how it would monitor the natural gas supply to the H2Teesside plant for compliancy with the LCHS standard.

29 Further, the ExA is requested to note the key points made in my WR [REP2-046]:

(xiii) "I request that the ExA considers if a DCO provision can be drafted in the H2Teesside DCO so that a minimum carbon capture rate is secured in the DCO itself similar to similar provisions already extant in the Net Zero Teesside and Keadby 3 DCOs. The capture rate should be 95% reflecting the assumptions in Applicant's ES.

(xiv) I request that the ExA also considers if a similar provision to be drafted in the H2Teesside DCO so that the natural gas supply to the H2Teesside plant must be compliant with the LCHS standard."

4.4 Q1.5.4

30 The appeal of the legal challenge to the NZT DCO has been listed for a hearing at the Court of Appeal on March 4th and 5th 2025.

4.5 Q1.5.5

31 On fugitive hydrogen emissions, please see the section above "Hydrogen leaks from production, storage and transport facilities".

32 As above, the Applicant has first failed to identify and describe the fugitive hydrogen emissions. Its mitigation plan (given as "to minimise cold venting") is completely inadequate as it does not address all the sources of possible leaks (but just one potential source of leaks), and the scale of what is to be mitigated is unknown as it has not been identified in the first place.

33 The Applicant has given no indication of when proper plans incorporating measures set out in the LCHS will be produced. I request that ExA requires the information discussed in the first two paragraphs of the answer to Q1.5.5 to be provided to the examination.

34 In the paragraph referring to ES 19.5.76, I have already discussed above why the Kyoto Protocol list of GHGs, adopted under 27-year-old science, is not an adequate reason to ignore the effects from what is now known, and is therefore knowledge that can reasonably be obtained, about the potency of hydrogen as an indirect GHG.

35 The sentence "*Given this, as a hydrogen emissions do not feature within UK Carbon budgets or the LCHS, there was no basis on which to base the significance of fugitive hydrogen emissions …*" makes no sense and is not compliant with the EIA regulations. This is because for EIA purposes the GHG emissions that need to be identified, described and assessed are the total ("full knowledge" reasonable worst-case) operational emissions. The Carbon Budgets and the LCHS are not relevant to scoping what goes into the EIA assessment. The Carbon Budgets are just national targets and say nothing about EIA of an individual project, such as H2 Teesside. As far as the LCHS is concerned, they again say nothing about EIA of an individual project. And the Applicant itself lists both LCHS applicable and LCHS non-applicable emissions (distinguished in italics) for the purposes of EIA in Tables 9-7, Table 9-8 and Table 9-9 already setting a precedent that is counter to the false logic of this sentence.

36 At 19.5.67, the applicant estimates the operational emissions for the 25-year Phase 2 period at 19,133,421 tCO2e "over 25 years from the completion of Phase 1". Whilst I have shown in my WR that this figure is a serious underestimate [REP2-046], what is required for fugitive hydrogen emissions is that they are included as another type ("ITEM" in the Tables) of emissions in Tables 9-7, 9-8 and 9-9. This is why I have requested above that the ExA requests that the Applicant "provide updates to Tables 9-7, 9-8 and 9-9 on the operational GHGs emissions associated with hydrogen leakage". Once this is done, then these emissions may form part of a later EIA assessment step.

4.6 Q1.5.6

37 The ExA are requested to refer to my WR [REP2-046] on this question for detailed responses.

38 On the claim of 95% carbon capture, I presented significant recent data that this claim is not even remotely substantiated by analysis of real-world CCS plants around the world.

39 The applicant relies on two EA documents incorrectly stated as Best Available Technology (BAT) documents.

40 With respect to the document "Post-combustion carbon dioxide capture: emerging techniques", Environment Agency, 2021 which is a webpage[3] with no available PDF version:

(i) On 27th March 2024, the document title was amended as noted on the website "*Updated the guidance in several sections to reflect feedback from stakeholders including changing the title from 'best available techniques' to 'emerging techniques'*." This indicates that stakeholder feedback did not consider that best available techniques yet exist.

(ii) The document does not say that 95% capture is achievable. It states "*[y]ou should aim to design your plant to achieve a CO_2 capture rate of at least 95% during normal operating conditions, although operationally this can vary, up or down.*". The evidence from around the world in my WR indicating that this is more "down", and significantly down.

(iii) As above, the ExA is respectfully requested to ask the EA how the recent evidence presented in my WR would change this document. It is an understatement to say the document is optimistic against the available evidence on the ground of carbon capture rates.

41 With respect to the document "Hydrogen production with carbon capture: emerging techniques", Environment Agency, 2023 which is a webpage[4] with no available PDF version:

(i) This document was only ever published at the status of "emerging techniques" (ie: not BAT);

(ii) It states "*As a minimum, you should achieve an overall CO_2 capture rate of at least 95%, although this may vary depending on the operation of the plant.* "

42 On both documents, the 95% capture rate is discussed as an aspiration, no evidence is given that it can be achieved. Certainly, no evidence is given that it has ever been achieved, which is consistent with the evidence provided in my WR which demonstrates that it never has.

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[3] https://www.gov.uk/guidance/post-combustion-carbon-dioxide-capture-best-available-techniques-bat, Last updated, 27 March 2024 version.

[4] https://www.gov.uk/guidance/hydrogen-production-with-carbon-capture-emerging-techniques, Published, 3 February 2023 version.

43 Please note my WR [REP2-046] requests:

> *(xv) "I request that the ExA considers if a DCO provision can be drafted in the H2Teesside DCO so that a minimum carbon capture rate is secured in the DCO itself similar to similar provisions already extant in the Net Zero Teesside and Keadby 3 DCOs. The capture rate should be 95% reflecting the assumptions in Applicant's ES.*
>
> *(xvi) I request that the ExA also considers if a similar provision to be drafted in the H2Teesside DCO so that the natural gas supply to the H2Teesside plant must be compliant with the LCHS standard."*

44 I have provided significant evidence that the Well-to-Tank (WTT) emission factor for upstream methane emissions is a severe underestimate, please see my WR [REP2-064].

4.7 Q1.5.7

45 The applicant has failed to list "Amine solvent emissions" as an upstream effect from the project. In the section above "Upstream solvent emissions", I give reasons why these should be included, including recent evidence as to the scale of these emissions being very material.

46 The applicant has failed to list "Fugitive Hydrogen emissions" as a downstream effect from the project. In the section above "Hydrogen leaks from production, storage and transport facilities", I give reasons why these should be included, including very recent scientific evidence in the journal Nature, from direct detection and monitoring at a hydrogen site, as to the scale of these emissions being very material.

47 On "the beneficial use of hydrogen as a replacement gas supply for offtakers", I request the ExA refers to section 9.4 "The hydrogen product" of my WR [REP2-046]. This makes a compelling case why the applicant cannot legitimately make an <u>additional</u> significance assessment based on "conjecture and speculation" about the use of its proposed product hydrogen, including stating:

> *"However, the Applicant has provided no substantive information of the possible use of the product hydrogen, just a few sketchy lines: it certainly has not provided a "full knowledge" GHG assessment of the emissions, and how the emissions could be saved, underwritten by solid evidence of its feasibility."*

48 The situation with respect to the hydrogen product is quite different to the Finch case where the GHG emissions from combusting the extracted oil were known[5]. In this case, the GHG emissions of possible substituted processes are <u>not</u> known, and the Whitehaven coal case shows that any "substitution effect" must be determined from "full information" of the two

[5] See the Finch Supreme Court judgment, paragraph 81. A council officer at Surrey County Council, Dr Jessica Salder, had calculated "*an estimated total of 10.6 million tonnes of CO2 emissions over the lifetime of the project*".

effect which it is claimed balance each other out. As I also stated in my WR, the "full knowledge" GHG effects of the project itself have not been identified and described, let alone the effects of any substituted processes.

4.8 Q1.5.9

49 The Applicant's response showing its derivation of the figure 10,778,563 tCO2e answers my question at my WR [REP2-046], bullet 130 (i).

50 Whilst the examination now knows the calculation used, it is a very confusing way to have done it. The Applicant bases its EIA assessment on the 25-year Phase 2 operation period. However, for the comparison with the Relevant CBDP Sectoral Carbon Budget Projections in Table 19-11, the Applicant's calculation has introduced "hybrid" numbers which are a mixture of Phase 1 (Table 19-8) and Phase 2 (Table 19-9) data. This has actually confused the Applicant itself too when it reveals further down the "error" associated with the T&S unavailability data where it used only Phase 2 data.

51 In any case, using the hybrid numbers is incorrect for the comparisons with <u>both</u> the 5th carbon budget (2028[6]-2032) and 6th carbon budget (2033[7]-2037). The project is most likely to be running as Phase 1 for most of the 2028-2032 period, so the hybrid data will produce an overestimate of the sector shares. Whilst, for 2033-2037, the project may be expected to be running as Phase 2, so the sector share will be an underestimate.

52 In my view, it is preferrable to use the 25-year Phase 2 operation period data (based on Table 9-9), as it is used for the rest of the EIA. This is simpler and aligns with the approach for the rest of the EIA. It provides a more accurate (ie: less of an underestimate) sector share result for the 6th carbon budget, and subsequent carbon budgets. Then it merely needs to be noted that the 5th carbon budget comparison may be an overestimate as it is not clear how much of the project is Phase 1 and how much Phase 2 for that budget period.

53 However, <u>the most important point</u> on the comparison with the Relevant CBDP Sectoral Carbon Budget Projections is that figures used by the Applicant are severe underestimates (whether the figures are hybrid or based on the 25-year Phase 2 data) because the data in Table 19-8 and Table 19-9 are not a "full knowledge" and reasonable worst-case description of the GHG emissions from the project in the first place.

54 Section 9.1 of my WR [REP2-046] makes the comparison based a "full knowledge" and reasonable worst-case description of the GHG emissions. I find in section 9.1 that:

- The reasonable worst-case 5-year emissions for H2Teesside for the Fuel Supply sector (<u>based on Phase 2 25-year emissions</u> ie: Table 19-9) are 16,319,280 tCO2e (cf: 2,244,215 tCO2e for the Applicant's data). This means that the WTT emissions from

[6] The 5th carbon budget runs from 2028-2032 <u>NOT</u> 2027-2032 as Table 19-11 states.

[7] The 6th carbon budget runs from 2033-2037 <u>NOT</u> 2032-2037 as Table 19-11 states.

H2Teesside are the equivalent of 34% (reasonable worst-case) of the fuel supply sector residual emissions for the 6th carbon budget.

- As noted, this shows that the climate impact of the project under a reasonable worst-case is very large in terms of the combined territorial and consumptions emissions when compared the UK allocation of fuel supply emissions in the 6th carbon budget.

- For the power sector emissions (based on Phase 2 25-year emissions ie: Table 19-9), the sector share in the 6th carbon budget is 8.61% for the 80% capture (reasonable worst case)[8].

5 SUMMARY

55 I have respectfully requested that the ExA request various information from the Applicant and some other IPs. In summary, my requests are:

(i) that the Applicant:

- To revisit its statement at ES 19.5.17;

- Provide the examination with the tonnage of solvent that will be used in the closed loop system;

- Inform the examination if any addition (ie: replenishment) of solvent may be required during the lifetime of the project;

- Provide the examination with "full knowledge" reasonable worst-case analysis of the likely significant effect and climate impact of the amine solvents;

- Provide updates to Tables 9-7, 9-8 and 9-9 on the operational GHGs emissions associated with amine solvents;

- Provide any further updates and information relevant to the EIA assessment.

(ii) that the Applicant:

- To revisit its statements at ES 19.5.76 and 19.5.77;

- Provide the examination with "full knowledge" reasonable worst-case analysis of the likely significant effect and climate impact of hydrogen leakage from production, storage and transport for H2 Teesside;

[8] Compared to 3.76% (95% capture – applicant's data)

- Provide updates to Tables 9-7, 9-8 and 9-9 on the operational GHGs emissions associated with hydrogen leakage;

- Provide any further updates and information relevant to the EIA assessment.

(iii) that the EA, UKSHA and the LAs to consider the evidence provided in my WR [REP2-046]; for example, that carbon capture rates have never been achieved at greater than 80% for the three existing blue hydrogen plants in the world. The EA, UKSHA and LAs should provide their views as to how that would affect the proposed permitting.

(iv) In the case of the Environment Agency, the ExA is requested to ask it how the recent evidence presented in my WR would change the documents quoted later by the Applicant in response to Q1.5.6:

- "Post-combustion carbon dioxide capture: emerging techniques", Environment Agency, 2021, and;

- "Hydrogen production with carbon capture: emerging techniques", Environment Agency. 2023.

(v) to require the Applicant and the EA to update the SOCG [REP1-023] to demonstrate how carbon capture rates are to be monitored under the permitting proposals.

(vi) to require the Environment Agency to provide the examination with information on how it would monitor the natural gas supply to the H2Teesside plant for compliancy with the LCHS standard.

(vii) to require the Applicant provide the information discussed in the first two paragraphs of the answer to Q1.5.5 (re: proper plans incorporating measures set out in the LCHS)

6 SIGNED

Dr Andrew Boswell,
Climate Emergency Policy and Planning, October 21st, 2024

56 For clarity, I continue the alphabetic sequencing of Appendices from my D2 WR submission (so appendices for this document start at "S").

7 APPENDIX S: DeSmog article, October 12th 2024, on blue hydrogen emissions (including Upstream solvent emissions)

"Europe's Blue Hydrogen Plans Risk Generating Annual Emissions on par With Denmark", Aline Nippert, DeSmog, October 12th 2024.

Downloaded from: https://www.desmog.com/2024/10/12/europes-blue-hydrogen-plans-risk-generating-annual-emissions-on-par-with-denmark/

Includes Analysis by Professor Christophe Coutanceau, Institute of Chemistry of Poitiers: Materials and Natural Resources, and co-lead of a hydrogen working group at the French National Centre for Scientific Research (CNRS).

Supplied as separate document

8* APPENDIX T: Warwick, N. et al. (2022). *Atmospheric implications of increased Hydrogen Use.

"Atmospheric implications of increased Hydrogen use"
Nicola Warwick, Paul Griffiths, James Keeble, Alexander Archibald, John Pyle, University of Cambridge and NCAS and Keith Shine, University of Reading

Downloaded from:
https://assets.publishing.service.gov.uk/media/624eca7fe90e0729f4400b99/atmospheric-implications-of-increased-hydrogen-use.pdf

Supplied as separate document

9 APPENDIX U: Nature, Scientific Reports, October 15th 2024, Westra, I.M., Scheeren, H.A., Stroo, F.T. *et al.* First detection of industrial hydrogen emissions using high precision mobile measurements in ambient air.

Westra, I.M., Scheeren, H.A., Stroo, F.T. *et al.* First detection of industrial hydrogen emissions using high precision mobile measurements in ambient air. *Sci Rep* **14**, 24147 (2024). https://doi.org/10.1038/s41598-024-76373-2