H2Teesside Project

Planning Inspectorate Reference: EN070009

Land within the boroughs of Redcar and Cleveland and Stockton-on-Tees, Teesside and within the borough of Hartlepool, County Durham

The H2 Teesside Order

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TABLE OF CONTENTS

1.0 INTRODUCTION AND CONTEXT 2
2.0 UPSTREAM CHEMICAL SUPPLY CHAIN EMISSIONS 3
3.0 FUGITIVE HYDROGEN FROM PRODUCTION, STORAGE AND TRANSPORT FACILITIES 6
4.0 RESPONSES TO APPLICANT'S RESPONSE TO EXQ1 10
4.1 Q1.5.1 10
4.2 Q1.5.2 10
4.3 Q1.5.3 and 1.5.6 10
4.4 Q1.5.4 11
4.5 Q1.5.5 11
4.6 Q1.5.7 11
4.7 Q1.5.9 11
5.0 CONCLUSION 12
6.0 REFERENCES 13

TABLES

Table 1: Estimated emissions from the chemical supply chain 4
Table 2: Fugitive hydrogen emission rates and selected scenarios for Proposed Development (Frazer-Nash, 2022) 8
Table 3: Emissions resulting from Fugitive Hydrogen (H_2 EF = 11 kgCO_2e/kg) 8

1.0 INTRODUCTION AND CONTEXT

1.1.1 This document sets out the Applicant's response to the Deadline 3 submissions of Climate Emergency, Planning and Policy ('CEPP') (REP3-017).

1.1.2 Given the nature of CEPP's representations, this response is presented in narrative, rather than tabular form, responding to the main points and themes raised.

1.1.3 CEPP's representation focuses on 2 points beyond those raised in their Deadline 2 submission (REP2-046): upstream amine solvent emissions and hydrogen fugitive emissions from production, storage and transport facilities. CEPP has also responded to the Applicant's responses to EXQ1 (REP2-023). These points are addressed in order through this narrative.

1.1.4 This response demonstrates that:

- the Applicant's approach to amine emissions is robust – the emissions involved are immaterial;
- it is not appropriate to include fugitive hydrogen emissions in the assessment, but in any event, CEPP's figures are based on incorrect technology, and fugitive hydrogen emissions would not affect the overall evaluation of GHG impact or conclusion of the assessment as presented in the ES chapter (APP-072); and
- it is robust to rely on a 95% capture rate in the ES.

2.0 UPSTREAM CHEMICAL SUPPLY CHAIN EMISSIONS

2.1.1 Section 3.1 of CEPP's Deadline 3 submission (REP3-017) claims that upstream emissions from amine consumption would not be immaterial and are underestimated by the Applicant. This claim is not well-founded. Amines would make an immaterial contribution to emissions from the Proposed Development as identified in paragraph 19.5.17 of the ES (APP-072).

2.1.2 The Low Carbon Hydrogen Standard (LCHS) sets a 'Materiality' level, below which Emission Sources may be categorised as 'Immaterial Emission Sources' and therefore excluded from the GHG Emission Intensity Calculation Methodology. Paragraph 5.75 of the LCHS states that "if a single Emission Source contributes <0.2 gCO_2e/MJLHV Hydrogen Product and in total all the Immaterial Emission Sources contribute <1.0 gCO_2e/MJLHV Hydrogen Product, the single Emission Source in question may be considered as an Immaterial Emission Source and may be excluded from the GHG Emission Intensity Calculation Methodology".

2.1.3 As discussed in the Applicant's response to CEPP's Deadline 2 submissions (AS-040), the LCHS is an appropriate reference point for the consideration of the scope of the assessment undertaken for the Proposed Development.

2.1.4 To illustrate this, and for the purposes of this submission, an estimate has been made of quantities of chemicals (including amines) that would be required in the closed-loop system proposed as part of the Proposed Development, as detailed below in Table 1, and the associated carbon impacts that would arise from their use for the operation of the Proposed Development. These lifetime quantities include both upfront requirements and figures for replenishment over 25 years.

2.1.5 Worst-case quantities of chemicals required have been estimated by the Applicant for Phase 1 of the Proposed Development. These quantities have been doubled to reflect the operation of Phases 1 and 2 together. These estimated quantities are set out in Table 1 below.

2.1.6 The Inventory of Carbon and Energy (ICE) and Department for Energy Security and Net Zero (DESNZ) databases that were used to identify emission factors for construction materials and fuels do not provide emission factors for chemicals. Emission factors have therefore been sourced from an industry standard database for sectors beyond construction and fuels, ecoinvent v3[1]. This is a standard database that is recognised for use in greenhouse gas reporting for global and average emission factors for different products (Greenhouse Gas Protocol, 2024) However, not all chemicals required for operation have a specific emissions factor available within that database. Where this is the case, a proxy emissions factor from that database, based upon the core chemical composition, has been selected. Table 1 below states where a proxy emissions factor has been used.

[1] Ecoinvent database - https://ecoinvent.org/database/

Table 1: Estimated emissions from the chemical supply chain

CHEMICAL	LIFETIME QUANTITY (TONNES)	LIFETIME EMISSIONS (TCO_2E)
Amine(Diethanolamine used as proxy)	952	4,165
Sulphuric Acid	9,287	1,081
Corrosion Inhibitor -3DT179 (Succinic acid used as proxy)	984	13,733
Scale Inhibitor - 3DT120 (Diethylenetriaminepentaacetic acid used as proxy)	593	3,936
Sodium Hypochlorite	1,966	4,994
Bromine	276	1,624
Ammonia (Aqueous)	8,212	4,974
	Total	**34,507**

2.1.7 As stated in paragraph 19.5.17 of the ES (APP-072), these are significantly less than 1% (0.18%) of the overall operational emissions presented in paragraph 19.5.67 of the ES (APP-072) and are significantly below the $0.2gCO_2e/MJ_{LHV}$ threshold set out in the LCHS.

2.1.8 The figures presented in appendix S of the CEPP submission (REP3-014) appear to assume continuous production of amine-based solvents on a total-loss basis, rather than a closed loop system which can re-use the chemicals, as is proposed for the Proposed Development. For this reason, they plainly do not constitute a reasonable worst-case scenario for the upstream amine solvent emissions or a meaningful basis for an assessment of chemical demand. The figures in Table 1 above do represent a reasonable worst-case assessment based on the information reasonably available at this time, and demonstrate that these emissions are immaterial.

2.1.9 In paragraph 8 of its Deadline 3 submission (REP3-017) CEPP requests that the Applicant:

- revisits its statement from paragraph 19.5.17;
- provides the examination with the tonnage of solvent that will be used in the closed loop system;
- provides the examination with full knowledge worst-case analysis of the effect and impact of amine solvents;
- provides updates to tables 9-7 to 9-9 of the ES (APP-072); and
- provides any other further information relevant to the EIA assessment.

2.1.10 The Applicant has addressed these requests as follows:

- the Applicant has demonstrated that the statement in 19.5.17 of the ES that amines are an immaterial part of the emissions from the Proposed Development is correct;

- the Applicant has provided tonnage of solvent that will be used in the closed loop system;
- the Applicant has provided an appropriate and reasonable worst-case analysis of the effect and impact of amine solvents;
- the Applicant does not believe it is necessary to update tables 9-7 to 9-9 of the ES (APP-072) as the emissions associated with amines are immaterial as stated in the original assessment; and
- there is no further information or updates required for the EIA.

3.0 FUGITIVE HYDROGEN FROM PRODUCTION, STORAGE AND TRANSPORT FACILITIES

3.1.1 CEPP's Deadline 3 submission (REP3-017) claims that fugitive hydrogen emissions from production, storage and transport have a significant effect and impact and should be accounted for in the Applicant's ES. It suggests a 20-year timeframe for Global Warming Potential (GWP) should be used in this assessment, and a rate of 4.2% based on figures from Appendix U (REP3-016). CEPP's suggestions are not well-founded, for the reasons given below.

3.1.2 In paragraph 18 of its Deadline 3 submission (REP3-017) CEPP requests that the Applicant:

- Revisits its statements at 19.5.76 and 19.5.77;
- Provides the examination with a full knowledge assessment of impacts from hydrogen production;
- Provides updates to tables 9-7 to 9-9 of operational emission with fugitive hydrogen emissions; and
- Provides any other further updates and information to the EIA assessment.

3.1.3 The Applicant responds as follows:

- The statements at 19.5.76 and 19.5.77 are correct. As hydrogen is not a recognised GHG for the purposes of carbon budgets or the LCHS, there is no metric against which to contextualise hydrogen emissions, which is the approach set out in IEMA Guidance.
- The Applicant provides a reasonable worst-case scenario assessment of the potential impact of fugitive hydrogen below.
- The Applicant does not believe it is necessary to update tables 9-7 to 9-9 of the operational emissions with fugitive hydrogen figures as the relevant information is provided in this submission. The assessment and figures provided in tables 9-7 to 9-9 already provide a robust assessment in line with IEMA guidance against the UK carbon budgets and LCHS and as discussed below, it would not be appropriate to choose one number to be incorporated into those tables. In any event, that information presented would not meaningfully assist for the purposes of the EIA for the reasons set in the first bullet point above.
- There is no further information or updates required for the EIA.

3.1.4 CEPP's suggestion that a 20-year time frame should be used for global warming potential is clearly inappropriate for the reasons explained in the Applicant's written response to CEPP's WR (AS-040). In brief, this is because a 100-year time frame is used for all key emission factor databases from the UK government and the private sector, as well as being used in the UKs net-zero trajectory and the Low Carbon Hydrogen Standard (LCHS) (DESNZ, 2023). As stated in the Applicant's previous response:

"It is neither practicable nor informative to undertake the assessment using GWP_{20}, as there are limited datasets with which to undertake such an assessment, and the outputs could not be compared against national carbon budgets or LCHS to indicate consistency with UK's net zero trajectory and policies.

While CEPP makes a number of claims to advocate for using GWP_{20} in the GHG assessment, the Applicant does not consider this would be reasonable or informative as the key approaches for assessing significance by reference to UK carbon budgets, LCHS and net zero trajectories, in line with the accepted methodology for assessing GHG impacts for EIA (i.e. IEMA) are all derived using GWP_{100}. There is therefore no support for an alternative approach within the context of the IEMA methodology. The use of GWP_{100} is an appropriate and robust basis on which to carry out the assessment and determine the significance of effects."

3.1.5 CEPP's Deadline 3 submission claims that the Applicant has only excluded effects from fugitive hydrogen emissions because they are not a recognised Kyoto protocol gas. This is not the case, and is an unhelpful mischaracterisation of the Applicant's position.

3.1.6 As explained in the ES, fugitive hydrogen emissions were not quantified because they are not currently in scope of the $20gCO_2e/MJ_{LHV}$ emissions intensity threshold set by the Low Carbon Hydrogen Standard (LCHS) (DESNZ, 2023), nor in the UK carbon budgets, which are key to the assessment of significance in the ES, as explained in the Applicant's written response to CEPP's WR (AS-040).

3.1.7 Paragraph 10.3 of the LCHS states that hydrogen production facilities should apply best available techniques set out by the UK Government and its agencies in order to minimise emissions of hydrogen from production, storage and transport. The Applicant is committed to doing this. The Proposed Development is to be designed in line with best practice and a fugitive hydrogen emissions reduction plan will be produced as required by the LCHS. Paragraph 10.3 of the LCHS also notes "work is still ongoing to narrow uncertainties for both the Global Warming Potential (GWP) impact and fugitive emission rates from hydrogen production, but a hydrogen GWP may be included within the GHG Emission Intensity calculation under the Standard in the future". As such, it may be a matter that will be considered later on in project development as and when it becomes a requirement of the LCHS or recognised within the UK carbon budgets, but such information is not available now for policy or project purposes.

3.1.8 In paragraph 16 of CEPP's Deadline 3 submission and Appendix U of CEPP's Deadline 3 submission (REP3-017 and REP3-016) a fugitive hydrogen emission rate of up to 4.2% of production and storage is suggested in hydrogen facilities. The Applicant does not believe this is realistic, as the 4.2% figure is the absolute maximum value found from one method in Figure 9 of the paper cited by CEPP, whereas median fugitive emission rates were all at or below 1%. The site in the study is based on electrolytic hydrogen production and steam-methane reforming rather than auto-thermal reformer production to be used at the Proposed Development.

3.1.9 Furthermore, Appendix U (REP3-016) is simply one contribution to the scientific consideration of this topic. Other research has shown that electrolytic production of hydrogen can potentially have a much higher percentage emission rate than CCS-

enabled hydrogen (Frazer-Nash, 2022). Therefore the 4.2% figure quoted in CEPP's submission is not realistic for the Proposed Development. The Frazer-Nash study, commissioned by BEIS as a research study to inform future policy development for hydrogen, sets out potential fugitive emission rates. This study indicates rates of 0.76% at a 50% confidence and 1.53% at a 99% confidence rate (see Table 2 below) for CCUS-enabled hydrogen, the technology to be used by the Proposed Development. These figures are in line with the confidence ranges given in Appendix U of CEPP's Deadline 3 submission (REP3-016).

3.1.10 The Applicant notes that these fugitive emission rates are likely higher than what will be achieved in practice based on engineering assessments. These figures are therefore appropriately used as a reasonable worst case scenario.

Table 2: Fugitive hydrogen emission rates and selected scenarios for Proposed Development (Frazer-Nash, 2022)

SECTOR	SPECIFIC AREA	PREDICTED 50% CONFIDENCE LEVEL EMISSION RATE	PREDICTED 99% CONFIDENCE LEVEL EMISSION RATE
Production	CCUS-enabled	0.25%	0.50%
Transport and Storage	Distribution Network	0.26%	0.53%
End-uses	Process Industry	0.25%	0.50%
Total		**0.76%**	**1.53%**

3.1.11 Based on these rates, and an hourly hydrogen production rate of 22,175 kg/h in Phase 1 and 44,350 kg/h in Phases 1 and 2 combined, the following indirect global warming contributions have been calculated from hydrogen. For these calculations an emissions factor of 11 $kgCO_2e/kg$ (GWP_{100}) has been used for Hydrogen (DESNZ, 2022).

Table 3: Emissions resulting from Fugitive Hydrogen (H_2 EF = 11 $kgCO_2e/kg$)

EMISSION RATE SOURCE	FUGITIVE HYDROGEN EMISSIONS RATE (% OF OVERALL OUTPUT)	FUGITIVE HYDROGEN QUANTITY IN PHASE 1 (T/YEAR)	FUGITIVE HYDROGEN QUANTITY IN PHASE 1 + 2 (T/YEAR)	FUGITIVE HYDROGEN EMISSIONS (OVER 25 YEAR DESIGN LIFE) (TCO_2E)
50% Confidence Level	0.76 %	1,477	2,954	780,032
99% Confidence Level	1.53 %	2,974	5,948	1,570,328

3.1.12 This approach is in line with UK policy, and fugitive emissions will be managed in line with the requirements and best practice set out in the LCHS. This will include creating and implementing a fugitive emissions risk reduction plan as detailed in section 10 of the LCHS, with methods for minimising, monitoring and reducing fugitive emissions over the operation of the facility. This will also include developing a leak detection and repair (LDAR) programme to manage releases of hydrogen throughout the Proposed Development, in line with emerging techniques guidance for blue hydrogen (Environment Agency, 2023; European Commission, 2006).

3.1.13 As noted in the Applicant's previous submission (AS-040), the Applicant will be required to comply with the LCHS in order to receive government support under the Low Carbon Hydrogen agreement. Failure to complete a Fugitive Hydrogen Emissions Risk Reduction Plan will prevent compliance with the LCHS.

3.1.14 Furthermore, in light of the figures set out above, when considered in the context of the figures in tables 9-7 and 9-9 of the ES, it is clear that these fugitive emissions would not affect the overall conclusion of the assessment. The hydrogen product would still align with the LCHS and it would significantly displace consumption of either natural gas, grey hydrogen, or other fossil-fuel based products through its operation, leading to a direct reduction in overall emissions in line with UK's net-zero goals.

3.1.15 However, whilst it is considered that the Frazer-Nash emissions factors are more relevant for potential use for a project such as the Proposed Development, there is still a degree of uncertainty in the emerging science around both hydrogen's global warming impact as a gas, and its likely fugitive emissions rate from different production pathways.

3.1.16 Fugitive hydrogen emissions are therefore not currently quantified in the carbon budgets or the LCHS which means it is not appropriate for fugitive emissions to be included in the calculations which inform the judgments made in the ES.

4.0 RESPONSES TO APPLICANT'S RESPONSE TO EXQ1

4.1 Q1.5.1

4.1.1 CEPP claims in section 4.1 of its Deadline 3 submission that a delay in construction of Phase 1 or Phase 2 would have an impact on emissions within Carbon Budget Delivery Plan (CBDP) sectoral carbon budget projections given in table 19-11 of the ES (APP-072). This is not the case.

4.1.2 Any delay to the construction schedule will not have a material impact on the assessment against the carbon budgets as presented in Table 19-11 of the ES (APP-072). After the first two years of operation (Phase 1), emissions from the Proposed Development remain consistent throughout the remainder of its design life (subject only to alteration in the carbon intensity of grid electricity). Emissions reported for CB6 are already a maximum (i.e. 5 years of Phase 1 and 2 operation), so any delay in construction could only potentially reduce emissions reported for this period. For all other future budget periods maximum emissions are reported. Further detail on carbon budget reporting is provided in Section 4.7 of this response.

4.2 Q1.5.2

4.2.1 CEPP claims in section 4.2 of its Deadline 3 submission that not all emissions 'have been considered' as stated by the Applicant in response to ExQ1.5.2 (REP2-023). The Applicant maintains that all emissions have been considered, and quantified where reasonable and proportionate. This response has provided additional detail on amines and other chemicals, which were considered but not quantified due to their immaterial nature, which remains the case. This response has also provided additional quantitative assessment of the impact of fugitive hydrogen emissions but for the reasons set out above, contextualisation of these figures against UK carbon budgets or the LCHS threshold is not possible.

4.2.2 Please refer to the Applicant's previous response to CEPP's WR at Deadline 2 (AS-040), and Section 2 and Section 3 of this response for additional quantification of sources of emissions raised by CEPP.

4.3 Q1.5.3 and 1.5.6

4.3.1 CEPP alleges in sections 4.3 and 4.6 of its Deadline 3 submission that 95% capture rate used in the ES (APP-072) is not a realistic or a robust assumption for assessment purposes, and requests details on how the Environment Agency and permit would manage this.

4.3.2 Please refer to Section 5 of the Applicant's Deadline 2 response to the CEPP's WR (AS-040) where the use of a 95% capture rate and the interaction with the permitting regime is discussed in detail. The Applicant will continue to discuss a Statement of Common Ground (SoCG) with the EA, but it is noted that the starting point of permitting will be the requirement for capture rates as discussed in the EA Hydrogen Production with Carbon Capture Emerging Techniques guidance. This means the 95% capture rate is a robust basis for assessment.

4.3.3 Furthermore, monitoring will be captured in the permit, as demonstrated in the permit obtained for Net Zero Teesside (REP2-023).

4.4 Q1.5.4

4.4.1 The Applicant notes that Dr Boswell's challenge to the NZT DCO was rejected by the High Court and an appeal is due to be heard by the Court of Appeal l on March 4th and 5th 2025.

4.5 Q1.5.5

4.5.1 CEPP requests in section 4.5 of its Deadline 3 submission that fugitive hydrogen emissions are quantified and updated in tables 9-7 to 9-9 of the ES (APP-072).

4.5.2 The Applicant has provided additional information on fugitive hydrogen emissions in Section 3 of this document. The Applicant does not consider it is necessary to update the ES for these sources as discussed above.

4.6 Q1.5.7

4.6.1 CEPP claims in section 4.7 of its Deadline 3 submission that amine solvent emissions and fugitive hydrogen emissions should be included in the assessment and that the benefits of hydrogen use in displacing other fossil fuel offtakers should not be considered. The Applicant disagrees with this position.

4.6.2 Please refer to Section 2 of this report for details on the emissions relating to amine solvents and other process chemicals.

4.6.3 Please refer to Section 3 of this document concerning fugitive hydrogen emissions.

4.6.4 Please refer to the Applicant's response to CEPP's WR (AS-040) for the Applicant's position that including the benefit of hydrogen use is in line with IEMA guidance and best practice. As noted in that response, this is consistent with the ruling of the Supreme Court in the case of *Finch* (paragraph 150).

4.7 Q1.5.9

4.7.1 CEPP claims in section 4.8 of its Deadline 3 submission (REP3-017) that the use of "hybrid" numbers is incorrect for comparisons with CB5 and CB6. It claims the hybrid approach could create an overestimate of emissions in CB5 and underestimate in CB6. The Applicant disagrees with this position and considers the notion of hybrid figures to be a misconception.

4.7.2 The emissions presented in Table 19-11 of the ES are the most accurate representation of the timeline of emissions that will likely occur, given the construction schedule. Emissions are presented as two years of Phase 1 emissions (2028-2030), followed by continuous Phase 1 and 2 operation throughout the remainder of CB5, and the duration of CB6. CB5 figures consider a scenario of 2 years of phase 1, and 2 years of phase 1 and 2 which is the most accurate reflection of emissions in that period, representing an accurate reflection of how the Proposed Development will be operating year by year. CB6 figures consider consistent Phase 1 and Phase 2 emissions so are not an underestimate and are the most accurate reflection of emissions in that period.

4.7.3 Please refer to Section 4.1 of the Applicant's previous response (AS-040) for more detail on the planned phasing of the Proposed Development.

5.0 CONCLUSION

5.1.1 The Applicant notes that section 5 of CEPP's Deadline 3 submission summarises the requests set out across the rest of its submission. The Applicant has responded to those requests throughout this submission.

5.1.2 The Applicant also notes that CEPP has made a number of requests of the EA and ExA. Whilst both parties will take their own view on these requests, the Applicant would highlight that whilst concerns are expressed about the success of carbon capture to date:

- it is Government policy that carbon capture supported projects are brought forward, so the question of whether they should be brought forward, in general terms, is not one for the Examination;
- the past performance of a rapidly evolving technology does not mean that predicted carbon capture rates are unlikely to be achieved;
- the permitting regime is a separate process to the DCO process which should be assumed to operate effectively and should not be duplicated through the DCO regime;
- NPS EN-1 makes clear that the Secretary of State should assume that the permitting regime will achieve its role in managing emissions. This includes greenhouse gases; and
- it is robust for an assessment to have been carried out based on relevant guidance which exists at the time of the assessment.

5.1.3 The Applicant has demonstrated why its approach to assessment is robust and based on assumptions developed from current knowledge, best practice, and aligned with the Government's hydrogen policy.

6.0 REFERENCES

Department for Energy Security and Net Zero (DESNZ) (2023). UK Low Carbon Hydrogen Standard.

Department for Energy Security and Net Zero (DESNZ) (2022). Atmospheric implication of increased hydrogen use.

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

European Commission (2006). Reference Document on Best Available Techniques on Emissions from Storage.

Frazer-Nash (2022). Fugitive Hydrogen Emissions in a Future Hydrogen Economy

Greenhouse Gas Protocol (2024). Life cycle databases for GHG inventories.