Author Details	
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DEADLINE D6A 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 I have not used AI to create or alter any part of my documents, information or data, submitted to this Examination to date.

1.2 Deadline 6A submission

2 This submission is my written submission following my oral submissions at the ISH3 of January 14th. It relates only to the ISH3, and related issues, which emerge from that hearing. It is my response to the ExA's action point ISH3-AP10 [EV7-002]. As such it responds to the Environment Agency's "Hearing submission", the Applicant's Deadline 5 submissions, as they relate to the ISH3 agenda items.

3 This submission is not a response to AS-040, REP5-051, REP4-013 and other documents where they do not relate to the ISH3 agenda items. A response to these matters will be submitted separately, and as soon as possible.

2 DOCUMENTS

2.1 Appendices

4 For clarity, I continue the alphabetic sequencing of Appendices from my D2, D3 and D4 submissions (so any appendices for this document start at "Y").

2.2 Draft dDCO

5 Throughout this document, dDCO refers to the latest dDCO at [REP5-006], Document Reference: 4.1: Draft Development Consent Order, Rev 5, December 2024 .

2.3 Documents referred to

6 [AS-044] – email from the Environmental Agency to the ExA as read out by the ExA at the ISH3.

7 [REP5-051] – Applicant's response (at section 7 in document) to CEPP's D4 submission [REP4-038]

8 [REP5-045] – Applicant's response to Response to ExQ2.9 questionms

9 [REP4-016] - Summary of Applicant's Oral Submissions at ISH2

10 [REP4-014] - Applicant's Response to CEPP'S D3 submissions [REP3-017]

3 INTRODUCTION

11 At bullet 7 of REP4-038, I laid out two matters relating to proposed amendments to the dDCO.

12 The first matter was to make a similar provision to that in the Net Zero Teesside and Keadby 3 DCOs on carbon capture so that a minimum capture rate is secured in the DCO itself. The first matter itself had two parts. Part 1: aligning the DCO with the 95% capture rate specified in the project's Environmental Statement, and Part 2: securing the carbon storage itself when the development is in commercial operation.

13 The second matter was to make a further provision to secure, in the DCO, the Applicant's proposed design of the H2 Teesside plant as being compliant with the LCHS standard.

14 These are now each discussed at a high-level first to give parties a clear steer on my response on each issue.

15 An issue which has very clearly emerged from the Environmental Agency's "evidence" to the ISH3 is how reliance is made on the EA environmental permitting regime to "secure" descriptions, and the assumptions underlying them, of the likely significant environmental impacts of the project for the ES. This has implications for how decision making is made on the ES under the 2017 EIA regulations: in other words how the SoS later makes the decision about the DCO. I provide a more detailed analysis of this issue in section 4 below.

3.1 Matter 1, part 1

16 W.r.t. to part 1, at REP5-051/7.1.6, the applicant accepts, rather belatedly, that there is a precedent for this approach in the Keadby 3 and NZT DCOs, and accepts that it would be appropriate to include an "equivalent provision" for H2Teesside.

17 The applicant has provided changes to the wording for Work No. 1A.1 and Work No. 1A.2 in the dDCO, rev 5 [REP5-006] which say each of these works "*is designed to capture a minimum rate of 95% of the carbon dioxide emissions*".

18 Unfortunately, this is not consistent with the applicant's position in its Environmental Statement, nor evidence given at the ISH3. In the ES, the applicant takes a stronger position on the carbon capture rate than the "is designed" to capture position. As described later, the applicant's position is *"... it is assumed that a 95% carbon capture rate will be achieved …*" [APP-072/19.5.71].

19 CEPP therefore does not accept the applicant's DCO changes in [REP5-006] as being aligned with the applicant's ES and DCO application. This is explained further in section 4 below.

3.2 Matter 1, part 2

20 With respect to part 2, the ExA requested a without prejudice basis for Requirement 27 that would prevent operation of either Work No.1A.1 or Work No.1A.2 before connection to a carbon capture and storage facility is available at Q2.9.7. The ExA's reason was it remained "*concerned that there is no control on phasing within the draft DCO*". (See question and applicant's response at [REP5-045]).

21 CEPP consider the issue goes beyond the phasing with the draft DCO. It extends to whether the carbon capture and storage facility is actually operating fully functionally at any time during the continued operation of the H2 Teesside plant. I will cover this in more detail in section 5.

22 I note that the applicant has provided without prejudice amendments for Requirement 27 in response to Q2.9.7 [REP5-045].

3.3 The applicant's inventions around Drax

23 At [REP4-038], bullet 28, I noted that the applicant had falsely claimed that I had made "similar submissions" (ie requesting DCO changes) at the Drax BECCS DCO examination. These statements appear to be an invention of the Applicant. I, quite reasonably, requested the applicant provide evidence or retract the allegations.

24 In responding, the applicant has provided no such evidence. This is not surprising because there is none to support its claim. Instead at REP5-051/7.1.3, the applicant repeats the false statements. The ExA should note that the only reference which I have made in this examination to the Drax DCO is to point out that in [REP4-038], 27-28 that the Drax BECCS DCO does not any have similar provisions, and that the applicant has made false statements about it.

25 It is somewhat bizarre, and also frustrating, that the applicant has continued with this false and invented claim.

26 It would be courteous at this stage for the applicant to simply formally retract all the false statements which it has made about the Drax DCO and correct the record for this examination.

3.4 Matter 2

27 The second matter was not discussed at the ISH3. However, the applicant did respond at sections 7.1.16-7.1.24 of REP5-051. Without prejudice, I do not intend to respond further on this second matter in this submission.

28 However, I would draw the ExA's and SoS's attention to the fact that, based on the development's operational assumptions in the ES, the Applicant calculates that the development has an LCHS emission factor of 16.62 gCO2e/MJ_{LHV} compared to the LCHS threshold of 20 gCO2e/MJ_{LHV} [APP-072, 19.5.69]. This analysis by the applicant demonstrates a theoretical compliance with the LCHS threshold. However, it is based on the theoretical numbers in the ES which I contest as not accurately describing the environmental impacts of the scheme (see my detailed analysis in REP2-046]. And it is *very close* to exceeding the threshold (ie non-compliance). The applicant has provided no sensitivity testing on how the development's LCHS emission factor varies if any of the developer's assumptions are not met in practice.

29 I have made such sensitivity tests, and in each case the LCHS threshold is exceeded, and in some sensitivity tests by huge margins. My sensitivity tests are essentially based upon variations of the Scope 1 uncaptured emissions and Scope 3 upstream, based on recent evidence of likely significant effects of these emissions. Even small changes to the applicant's assumptions on these figures (especially if in combination) will push the LCHS emission factor for the development over the threshold (and into non-compliance).

30 I, therefore, consider that it is highly likely that the plant will operate outside compliance with the LCHS for considerable periods of time, and I may return to the issue of related DCO changes at a later stage if necessary.

31 I will respond to the applicant's AS-040, and the details of the technical arguments (which fall outside the ISH3 session) relating to LCHS compliance in a further submission.

4 MATTER 1, PART 1: IMPLICATIONS FOR, AND OF, THE ENVIRONMENTAL IMPACT ASSESSMENT

32 The issues examined during the ISH2 and the ISH3 around the dDCO and the future reliance on the environmental permit to secure the carbon capture rate raise very serious issues on whether the Secretary of State can make a reasoned decisions about the environmental impacts of the project. This is now explained.

33 These comments relate primarily to Matter 1, part 1.

4.1 The regulations

34 The applicant accepts that the project comes under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ("the 2017 Regulations") and has accordingly prepared an Environmental Statement (ES).

35 Under the 2017 regulations, the Regulation 21 requires that the Secretary of State must examine the environmental information (which includes the ES), reach a reasoned conclusion on the environmental impacts, and integrate the conclusion into decision on whether to grant development consent.

36 Section 4.3 of the EN-1 NPS lays out that how "Environmental Effects/Considerations" should be dealt with, including the Secretary of State decsion making. At the section 4.3.18, EN-1 says the "*Secretary of State should consider the worst-case impacts in its consideration of the application and consent, providing some flexibility in the consent to account for uncertainties in specific project details.*"

4.2 The applicant's ES position and its misalignment with dDCO

37 The applicant says that H2Teesside is designed to operate at 95% carbon capture.

38 However, in the ES, the applicant takes a stronger position on the carbon capture rate of the project beyond that it is just "designed to" to operate at 95% carbon capture. The applicant states *"... it is assumed that a 95% carbon capture rate will be achieved …"* [APP-072/19.5.71]. This "will be achieved" assumption is then central to identify, describing (include enumeration) and assessing the environmental impacts of the project.

39 The applicant has now amended the dDCO (rev 5 [REP5-006]) as described above for Work No. 1A.1 and Work No. 1A.2. However, the DCO amendment(s) only align to the "is designed to capture" position. The amendment does not align with the applicant's actual stronger position that *a 95% carbon capture rate* "will be achieved".

40 Therefore, I do not accept the applicant's DCO changes in [REP5-006] as being aligned with the applicant's ES and DCO application. I suggest further amendments which do align with the applicant's ES and DCO application in Appendix Z.

4.3 The reliance of the applicant's EIA assessment on the EP regime

41 Having stated the key assumption that the 95% carbon capture rate will be achieved, the applicant's ES then predicates this assumption on the Environment Agency Environmental Permit ("EP"). "*The capture rate will be addressed by Environmental Permit*" [APP-072/19.5.71]. (See also APP-072/19.5.58, 8th bullet point in a discussion on uncertainties and assumptions, and APP-072/19.5.43).

42 The proposition is that it is the EP which will deliver the 95% carbon capture rate. Effectively, the applicant is delegating delivery of the 95% capture rate to the EP.

43 At the ISH3, Dr Mallory supported this position, and said[1] on behalf on the applicant:

> *"… the proposed development is assumed to operate at a 95% carbon capture rate. This is to be secured through the environmental permitting regime, …"*

44 It is important to note that the applicant is not just delegating the security of the carbon capture rate to an environmental permit regime. It is delegating the security of the 95% carbon capture rate, and the EIA assumption that "it will be delivered" to:

(A) A permitting scheme for which guidance only exists at "Emerging technique" level (not "Best Available Technique" level)

(B) A permit that does not exist yet

(C) A permit that will not have completed consultation until after the Examination period

45 Critically, the calculations of the likely significant effects of the project in the applicant's ES are predicated on the same key assumption that for the project "*it is assumed that a 95% carbon capture rate will be achieved"* [APP-072/19.5.71].

46 This assumption is at the basis of all the calculations of GHGs in APP-072, and in the EIA assessment made in the ES [APP-072].

[1] EV9-007, page 5

4.4 The Environment Agency's position

47 At Item 7, bullet 2 of the agenda for the ISH3, the ExA asked the EA:

> *"to explain the mechanism by which the EP will ensure the monitored carbon capture rate does not exceed the 95% threshold".*

48 I believe the item is intended to read "*.. the monitored carbon capture rate does exceed the 95% threshold".*

49 In response, the Environment Agency sent a brief email [AS-044] which was read out by the ExA at the ISH3, and contained these three substantive sentences:

> *(A) Carbon capture efficiency is a technical parameter considered in the determination of the Environmental Permit application.*
>
> (B) *The EA will determine whether the Environmental Permit application is to best available techniques (BAT) on this matter, by referring to our non-statutory guidance on emerging techniques relevant to this technology: Hydrogen production with carbon capture: emerging techniques - GOV.UK.*
>
> *(C) If we decide to grant the permit, we will set conditions in line with our guidance and the conclusions of our determination of best available techniques on this matter.*

50 None of this explains how the EA, via the EP, will secure the carbon capture rate which is what the applicant is claiming that it will. Nor does it satisfactorily answer the ExA's question, as below.

51 (A) above is a statement of the obvious but has no bearing otherwise.

52 With respect to (B), the EA does not currently have guidance on Best Available Techniques for hydrogen production with carbon capture. So the reference to BAT in the EA's email is wrong and misleading. In February 2023, a review of emerging techniques for hydrogen production from methane and refinery fuel gas with carbon capture was published. The associated webpage (see Appendix Y) states:

> *"The review provides information about the main environmental issues to address and best practice available on a selection of hydrogen production with carbon dioxide capture options. This is new technology and there is limited evidence or data available for performance of comparable sites.*
>
> *The regulators have also produced a summary of emerging techniques guidance because there is no existing guidance specific to the production of hydrogen when combined with carbon dioxide capture and storage."*

It is clear from that guidance quoted has been developed from a low evidence base and is only "emerging techniques" guidance. This is also clear from the name of the guidance as given in sentence B above. As stated at ISH3, I also previously described how it was incorrect to refer to the referenced document as a Best Available Technology (BAT) guidance document [REP3-017/bullets 39 – 41].

It is surprising, and also disingenuous, that the EA refer in (B) above to deciding "*whether the Environmental Permit application is to best available techniques (BAT)"* when they do not actually have any guidance on the matter at BAT status.

53 The same error is made in sentence (C) where the EA says that it will "*set conditions in line with our guidance and the conclusions of our determination of best available techniques on this matter"* when no such best available techniques yet exist, as identified in the review at Appendix Y. As previously described, the guidance merely states that "*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.*" [REP3-017/bullet 41(ii)]. Essentially, the 95% capture rate is discussed only as a design aspiration, no evidence is given that it can be achieved, and no mechanism is provided to secure it [REP3-017/bullet 42].

54 It is clear that the EA did not satisfactorily explain the mechanism by which "*the EP will ensure the monitored carbon capture rate does exceed the 95% threshold"* at the ISH3 because no such mechanism exists.

4.5 Absurd, illusory and circular logic

55 I wish to highlight to the ExA and the SoS, the absurd, illusory and circular logic in this situation:

a. The applicant is saying that a 95% capture will be achieved, and it will be secured by the Environmental Permit;

b. The EA says in non-statutory guidance "*you should achieve an overall CO_2 capture rate of at least 95%"*. In circular logic, this aspiration is being presented to the Examination as robust evidence that the EA can secure the 95% capture by its permitting regime. (Return to bullet a, and "do not pass go" etc).

56 This fabricated and circular logic cannot be accepted as in any way providing evidence that 95% carbon capture can be achieved by the project.

57 The evidence can only be provided evidentially, and no such evidence has been provided to the examination by the Application.

58 To the contrary, I as an IP, have provided evidence that no commercial CCS project worldwide has been found to operate at greater than 80% carbon capture rate.

4.6 The loophole in the permitting process

59 CEPP said at ISH3 that the EP scheme is a monitoring scheme but it not an enforcement scheme. I stand by that, and that the EP is a non-enforcing regime: the key point being that the EP doesn't actually secure that carbon capture rate.

60 I previously provided evidence at REP4-038, bullets 17-24, as to how it doesn't actually secure the carbon capture rate after the applicant provided the Net Zero Teesside (NZT) EP at [REP2-027], Appendix 1 and claimed that it provided an example of "… *the mechanism for achieving the capture rate is the Environmental Permit*" [AS-040, section 5.2.6].

61 Critically, I highlighted a "get out of jail free" or loophole at REP4-038, bullet 24, and that it was evident that the EP regime is not functionally capable of securing the properties of the development as they are described in the application.

62 The EA was given the opportunity to respond to this at Item 7, bullet 2 of the ISH3, and its brief email [AS-044] singularly failed to do so.

4.7 Regulatory entanglement

63 The applicant has made much of NPS EN-1 (eg: at REP5-051, section 7.1.10) and the requirement to avoid regulatory duplication.

64 However, what is happening with this DCO planning application and the project's proposed environmental permitting regime is something different. In the DCO planning application, far from keeping the regulatory regimes separate, the applicant has actually entangled them. This is because the applicant has placed the validation of assumptions made for its planning application, and in particular its EIA assessment under the 2017 regulations, into the domain of the environmental permitting regime. This placement is not just over regulatory divides but into the future as well: parties to the examination are being expected to accept that the future, and unknown, operation of the EP regime will secure the environmental impacts of the project as they are described in the ES.

65 This entanglement of the regulatory regimes is unhelpful and is not consistent with NPS EN-1. EN-1 does not recommend that the EIA assessment, and decision making on it, for a scheme may be underwritten (somehow, and somehow in the future) by the environmental permitting regime.

66 This also poses a problem for the Secretary of State's decision making on the EIA assessment because the *worst-case impacts* [section 4.3.18, EN-1] cannot be considered without consideration of the EP, and that is not available to the examination.

67 It should be noted that the existence of an EP at the time of the SoS decision on the DCO is not sufficient to overcome this issue. The reason is the two regimes should not be entangled in the first place. And also that the EP regime is clearly not functionally capable of securing the properties of the development as they are described in the application, and so whether an EP exists, or not, is not materially relevant.

68 Before the SoS decision can be made, the two regimes must be disentangled. The applicant can do this as follows:

(A) removing the validation of assumptions made for its planning application, and in particular its EIA assessment under the 2017 regulations, from the domain of the environmental permitting regime;

(B) amend the dDCO further to align with the applicant's position in the EIA;

(C) provide the evidential basis for the assumptions in the EIA assessment in the EIA assessment itself.

69 On point (B) above, in Appendix Z, I provide further draft dDCO amendments which I propose for resolve the issue. Under "Change 1" in Appendix Z, the dDCO is amendment is now drafted to align with the key assumption in the EIA assessment that *"... it is assumed that a 95% carbon capture rate will be achieved* …" [APP-072/19.5.71].

70 With respect to points (A) and (C), it is up to the applicant to resolve the issues.

4.8 Implications for decision making on the scheme

71 The result of the regulatory entanglement issue explained above is that the ExA, SoS and IPs are being expected to accept, via the circular logic presented, that if the applicant says the project is designed to operate at a 95% capture rate, then it will operate at a 95% capture rate.

72 The ExA and SoS are expected to accept this with no further evidence. This is despite CEPP giving evidence that no other CCS system in the world has achieved greater than 80% carbon capture in commercial operation [REP2-046/3.1].

73 The ExA and SoS must be mindful that should the project operate at a lower capture rate, then it adds materially to the environmental impact of the project. For example, if in one year, the average annual capture rate was 80% (ie not 95%), then this will add over 400,000 $tCO2$[2] that year to the projects footprint against that

[2] Table 19-9 [APP-072] gives the annual uncaptured CO2 emissions as 135,960 tCO2e/yr at 95% capture rate. The increment for 80% capture rate is 3 * 135,960 = 407,880 tCO2e/yr.

reported by the applicant. In other words, the Scope 1 emissions from the scheme would be severely underestimated in this scenario.

74 An analogy may help. Consider a developer seeking planning for a 1000 houses development. The planning system seeks to ensure that the developer does what it says it will do, and that only 1000 houses are built. The public would rightly consider that if the developer actually built 2000 houses (with let's say for simplicity's sake twice the environmental impact) that sanctions would be sought against the developer.

75 In the case of H2Teesside, it is quite possible that the environmental impact of Scope 1 uncaptured carbon emissions could be 4 times that presented in the Environmental Statement (ie an actual average operational capture rate of 80% rather than 95%), and even then on the basis of an optimistic reading of the track record of the industry which has never achieved more than 80% capture rate. Yet the applicant is expecting the public to accept that it is reasonable for the Secretary of State to consent the scheme under this prevailing uncertainty of the scheme's environmental impacts with no genuine sanction mechanism being available.

5 MATTER 2, PART 2

76 The ExA requested on a without prejudice basis for an amendment Requirement 27 that would prevent operation of either Work No.1A.1 or Work No.1A.2 before connection to a carbon capture and storage facility is available at Q2.9.7. The ExA's reason was it remained "*concerned that there is no control on phasing within the draft DCO*". (See question and applicant's response at [REP5-045]).

77 CEPP consider the issue of securing that operation of the H2Teesside plant only occurs when it is connected to "an operational carbon dioxide storage site" goes beyond control on phasing within the draft DCO.

78 The requirement must also apply for a situation when the carbon capture storage is not operating fully functionally. This is because carbon capture storage is extremely complex, and there is considerable evidence that things may not go as planned. Therefore it is not just a matter of whether the storage site has a licence and has started operating, but also whether the storage site is fully operational during any time of continued operation of the plant. I note some examples of issues with CO2 storage below: these are not comprehensive but just a couple of examples which highlight that a fully functional carbon storage site is not a simple matter that can be predicted to always work once it has been commissioned.

5.1 CO2 Storage issues

79 The Northern Endurance Partnership (NE) operators have proposed to run the Net Zero Teesside (NZT) gas-CCS plant at full baseload operation for a significant period (eg 4 years) in order to perform "dynamic appraisal" of the operation of the NEP CO2 storage site(s).

80 A "Philosophy" document for the NZT CO2 Endurance storage site (provided at Appendix AA) identifies a period of "Initial Dynamic Appraisal" at section 3.2.1. Put simply, this period is to monitor the operation of the Endurance storage at a near constant level of CO2 injection to determine whether the storage site can operate above 4 MTPAa of CO2 storage, and how – hence the running of NZT at full baseload is required to generate the necessary level of sustained CO2 injection for 3 -5 years. The associated Development Plan for the Endurance Storage (provided at Appendix AB) expands on this at section 4.3. The purpose of the "Initial Dynamic Appraisal" is to determine whether the site may be expanded to higher rates of CO2 injection. It is clear that expanding rate of CO2 injection at the storage site is not guaranteed.

81 The question has to be asked what happens if the storage site cannot be readily expanded and has to operate at lower levels of CO2 injection than planned, and consequentially is not capable of meeting the demand of CO2 being generated. This is particularly the case as more third-party emitters join the Net Zero Teesside cluster pushing the demand for CO2 storage above the initial 4 MTPAa CO2 storage rate.

82 There may be times, therefore, when the CO2 storage site is unable to provide storage services to the full demand from H2 Teesside due to other competing emitters. What happens then?

83 In order to secure the environmental impacts as they are described in the DCO application and ES, then the dDCO must provide security.

84 Further, a recent press report (from DeSmog and provided at Appendix AC) describes how Norway's Equinor (one of the NEP partners) has been forced to withdraw a key claim on Carbon Capture. Equinor has retracted a claim that it stores about a million tonnes of carbon dioxide annually at its flagship Sleipner carbon capture project after DeSmog obtained data showing the real figure was as little as a tenth of that amount. This support the point made that a fully functioning storage site cannot be guaranteed, and the need for security of the DCO application environmental impacts to be made in the dDCO.

5.2 dDCO amendment

85 Based on the applicant's without prejudice drafting of an amendment in [REP5-045], I have provided wording in Appendix Z which makes it clear that H2 Teesside is required to be connected to a fully functional carbon dioxide storage site when it is operating in continual commercial use.

6 SUMMARY

86 In the DCO planning application, far from keeping the regulatory regimes separate, the applicant has actually entangled them. This regulatory entanglement is because the applicant has placed the validation of assumptions made for its planning application, and in particular its EIA assessment under the 2017 regulations, into the domain of the environmental permitting regime.

87 At the heart of the regulatory entanglement issue there is absurd, illusory and circular logic in which the EIA assumes that the project will operate at a 95% carbon capture rate which is secured by the EP regime, whilst the EP regime states such a blue hydrogen project should aspire to 95% carbon capture rate. Neither provides any mechanism, or security, that the project will actually perform this way.

88 Before the SoS decsion can be made, the two regimes must be disentangled. Further work by the applicant is required here. To assist, I propose further dDCO amendments in Appendix Z of this document which align the project's DCO with the description of the environmental impacts in its EIA.

89 I respectfully request that the ExA and SoS are mindful that should the project operate at a lower capture rate, then it adds materially to the environmental impact of the project. For example, in the entirely plausible scenario that the project operates to the best known commercial carbon capture rate for a commercial system (ie 80%), then an additional 400,000 tCO2 will be added each year to the projects footprint.

90 Under the 2017 regulations, the Regulation 21 requires that the Secretary of State must examine the environmental information (which includes the ES), reach a reasoned conclusion on the environmental impacts, and integrate the conclusion into decision on whether to grant development consent.

7 SIGNED

Dr Andrew Boswell,
Climate Emergency Policy and Planning, January 22nd, 2025

8 APPENDIX Y – Review of emerging techniques for hydrogen production from methane and refinery fuel gas with carbon capture

From: https://www.gov.uk/government/publications/review-of-emerging-techniques-for-hydrogen-production-from-methane-and-refinery-fuel-gas-with-carbon-capture

GOV.UK

Research and analysis

Review of emerging techniques for hydrogen production from methane and refinery fuel gas with carbon capture

Evidence review of main environmental issues to address and best practice available on a selection of hydrogen production with carbon dioxide capture options.

From: **Environment Agency (/government/organisations/environment-agency)**

Published 3 February 2023

Documents

Review of emerging techniques for hydrogen production from methane and refinery fuel gas with carbon capture

(https://assets.publishing.service.gov.uk/media/63b447c8d3bf7f36a8b6e5c5/Review_of_emerging_techniques_for_hydrogen_production_from_methane_and_refinery_fuel_gas_with_carbon_capture.pdf)

PDF, 1.14 MB, 93 pages

This file may not be suitable for users of assistive technology.

▶ Request an accessible format.

Details

The following environmental regulators (referred to as 'the regulators') commissioned this review of emerging techniques:

- Environment Agency
- Natural Resources Wales
- Northern Ireland Environment Agency (an executive agency of the Department of Agriculture, Environment and Rural Affairs)
- Scottish Environment Protection Agency

The review provides information about the main environmental issues to address and best practice available on a selection of hydrogen production with carbon dioxide capture options. This is new technology and there is limited evidence or data available for performance of comparable sites.

The regulators have also produced a summary of emerging techniques guidance (https://www.gov.uk/government/publications/emerging-techniques-for-hydrogen-production-with-carbon-capture) because there is no existing guidance specific to the production of hydrogen when combined with carbon dioxide capture and storage.

The regulators envisage that this review of emerging techniques and the emerging techniques guidance will be used by:

- operators when designing their plants and preparing their application for an environmental permit
- their own staff when determining environmental permits
- any other organisation or members of the public who want to understand how the environmental regulations and standards are being applied

Published 3 February 2023

9 APPENDIX Z –DRAFTING OF CEPP PROPOSED CHANGES TO dDCO

91 Change 1

92 This drafting is based on Document Reference: 4.1: Draft Development Consent Order, Rev 5, December 2024 [REP5-006].

93 Under Schedule 1:

(A) replace:

> *" (a) **Work No. 1A.1** – one carbon capture enabled hydrogen unit of 600 MW, which is designed to capture a minimum rate of 95% of the carbon dioxide emissions of this hydrogen unit operating at full load, comprising … "*
>
> with:
>
> "(a) **Work No. 1A.1** – one carbon capture enabled hydrogen unit of 600 MW, which will capture a minimum rate of 95% of the carbon dioxide emissions of this hydrogen unit operating at full load, comprising …"

(B) replace:

> *" (b) **Work No. 1A.2** – a second carbon capture enabled hydrogen unit of 600 MW, which is designed to capture a minimum rate of 95% of the carbon dioxide emissions of this hydrogen unit operating at full load, comprising … "*
>
> with:
>
> " (b) **Work No. 1A.2** – a second carbon capture enabled hydrogen unit of 600 MW, which will capture a minimum rate of 95% of the carbon dioxide emissions of this hydrogen unit operating at full load, comprising … "

94 Change 2

95 This drafting is based on the applicant's response to the Q2.9.7 [REP5-0345]. The applicant's suggested wording is in italics and my additions are in normal font.

(A) Under Requirement 27 add:

> *(2) No part of Work No. 1A.1 may be brought into commercial use,* or continue in commercial use, *following commissioning of Work No. 1A.1 without Work No. 7 also being brought into commercial use following commissioning and Work No. 7 being connected to an operational* and fully functional *carbon dioxide storage site.*

(3) No part of Work No. 1A.2 may be brought into commercial use, or continue in commercial use, *following commissioning of Work No. 1A.2 without Work No. 7 also being brought into commercial use following commissioning and Work No. 7 being connected to an operational* and fully functional *carbon dioxide storage site."*

10 APPENDIX AA – BP, May 2022, "Multi-Store Development Philosophy", NS051-SS-PHI-000-00010

97 From: https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-innovation-nepnzt-key-knowledge-deliverables

Supplied as separate document

11 APPENDIX AB – BP, May 2022, "Endurance Storage Development Plan", NS051-SS-REP-000-00010

98 From: https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-innovation-nepnzt-key-knowledge-deliverables

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12 APPENDIX AC – "Exclusive: Norway's Equinor Forced to Withdraw Key Carbon Capture Claim", DeSmog, Jan 14 2025

From: https://www.desmog.com/2025/01/14/exclusive-norways-equinor-forced-to-withdraw-key-carbon-capture-claim/

Exclusive: Norway's Equinor Forced to Withdraw Key Carbon Capture Claim

Oil company was storing a fraction of advertised amount of CO2 at offshore project, data shows.

By **Edward Donnelly (https://www.desmog.com/user/edward-donnelly/)**
on Jan 14, 2025 @ 06:10 PST
6 min read

Equinor's Sleipner offshore gas field. Philip Stephen/ Nature Picture Library / Alamy Stock Photo.

This story is the tenth part of a DeSmog ***series on carbon capture (https://www.desmog.com/investigating-how-europes-plans-to-capture-carbon-risk-prolonging-the-fossil-fuel-era/)*** *and was developed with the support of* ***Journalismfund Europe (https://journalismfund.eu/)***.

Equinor has retracted a claim that it stores about a million tonnes of carbon dioxide annually at its flagship carbon capture project after DeSmog obtained data showing the real figure was as little as a tenth of that amount.

The Norwegian oil company scrubbed the estimate from its website in November, when presented with official figures showing that it captured 106,000 tonnes of carbon dioxide (CO2) at its Sleipner **carbon capture and storage (https://www.desmog.com/2023/09/25/fossil-fuel-companies-made-bold-promises-to-capture-carbon-heres-what-actually-happened/)** (CCS) facility in 2023.

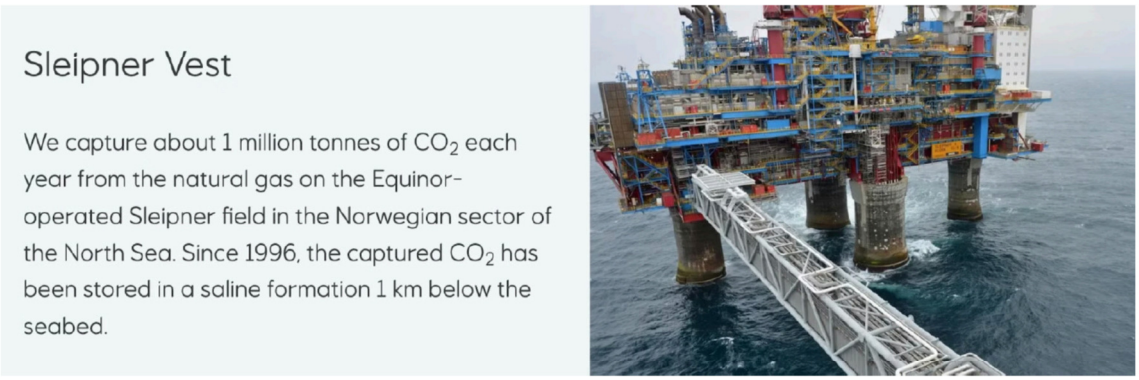
Equinor has not captured 1 million tonnes of CO2 per year at the site since 2001, according to the data, provided by the Norwegian Environment Agency.

The company put the reason for the discrepancy between the official figures and its public-facing claim to be capturing "about 1 million" tonnes of CO2 a year down to a failure to update a "static" webpage.

"We have now removed this error from our website and updated this section with the correct information," Equinor spokesman Gisle Ledel Johannessen said via email.

Equinor has been capturing CO2 from a gas processing plant at the Sleipner gas field in the North Sea since 1996. The field has particularly high concentrations of CO2, which Equinor filters out during the gas purification process and then injects below the seabed.

The project has been **cited (https://www.theguardian.com/environment/2023/apr/03/making-the-case-for-carbon-capture-and-storage)** by carbon capture advocates, and Equinor itself, as evidence that the technology is reliable enough to help meet global climate goals, despite its long **history (https://www.desmog.com/2023/09/25/fossil-fuel-companies-made-bold-promises-to-capture-carbon-heres-what-actually-happened/)** of cost-overruns and failed targets.



A screenshot of Equinor's website, taken on 13 October, 2024 Credit: Edward Donnelly. The claim has since been removed.

Expansion Plans

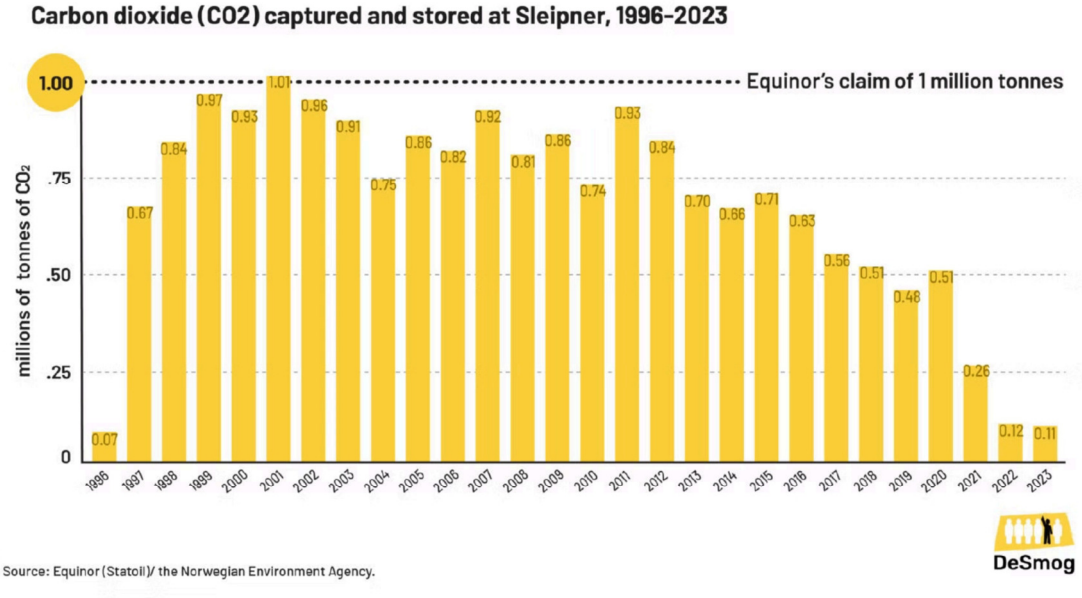
Equinor is positioning itself to play a key role in the European Union's plans to **massively increase (https://www.desmog.com/2024/08/27/big-oil-is-the-winner-from-dutch-carbon-capture-subsidies/)** carbon capture. The bloc has adopted an official target to deploy an annual 50 million tonnes of CO2 storage capacity by 2030 from roughly **three million tonnes (https://www.iea.org/data-and-statistics/data-tools/ccus-projects-explorer)** available across the continent today, though the pace of the existing roll-out is nowhere near on track to achieve that goal.

Norway, not an EU member, is home to almost all of Europe's operational carbon capture capacity, which is comprised of Sleipner and a similar project also operated by Equinor at its Snøhvit gas field in the Barents Sea. The two sites stored a total of 763,000 tonnes of CO2 in 2023, according to the Norwegian Environment Agency figures, less than half of their combined capacity of 1.7 million tonnes of CO2.

Equinor's statement that it was capturing "about 1 million tonnes of CO2 each year" at Sleipner alone appears to have first been published on the company's "carbon capture and storage (CCS)" webpage in 2022, according to **archived (https://web.archive.org/web/20220516063946/https://www.equinor.com/energy/carbon-capture-utilisation-and-storage)** internet data. That year, the Sleipner field captured 260,000 tonnes of CO2, according to the Norwegian Environment Agency, which regulates the oil and gas industry.

DeSmog asked Equinor for its data on carbon capture at Sleipner in October. When the company declined to provide it, DeSmog obtained the figures from the Norwegian Environment Agency, which collates companies' self-reported data.

Equinor spokesman Johannessen said that Sleipner had been capturing less CO2 in recent years because of **declining gas production (https://www.norskpetroleum.no/en/facts/field/sleipner-vest/)** at the site.



Credit: Sabrina Bedford.

Broken Equipment

Equinor had previously acknowledged that faulty monitoring equipment at Sleipner caused it to over-estimate the amount of CO2 it was capturing at the field for several years, as DeSmog **reported (https://www.desmog.com/2024/10/28/norways-equinor-admits-it-over-reported-amount-of-carbon-captured-at-flagship-project-for-years/)** in October. During a more than four-year period from January 2017 through March 2021, the company said that it had captured a cumulative total of about 2.7 million tonnes of CO2 at the site. Equinor later amended the figure to 2.1 million tonnes, about a 28-percent decrease.

The gulf between Equinor's public claims and Sleipner's actual performance underscores **concerns (https://www.desmog.com/2023/09/25/fossil-fuel-companies-made-bold-promises-to-capture-carbon-heres-what-actually-happened/)** among climate advocates that the oil industry is hyping the potential of carbon capture as a climate solution to deflect pressure to cut production of fossil fuels.

At least 480 carbon capture lobbyists **attended (https://www.ciel.org/news/ccs-presence-cop29/)** the latest annual UN climate conference in Azerbaijan in November, according to the nonprofit Center for International Environmental Law. In October, DeSmog revealed that Equinor had been holding more meetings with ministers to **lobby (https://www.desmog.com/2024/10/07/uks-22-billion-carbon-capture-pledge-follows-surge-in-lobbying-by-fossil-fuel-industry-records-show/)** the UK government over CCS than any other company, part of its plans to play a **leading role (https://www.desmog.com/2024/10/31/norwegian-oil-giants-plan-to-capture-uks-carbon-is-fraught-with-risks/)** in the country's carbon capture plans.

Equinor suggested that carbon capture could be the "best-kept secret" for climate action in a 2019 **video (https://www.youtube.com/watch?v=pAAb1S4bqks)**, concluding that renewable energy sources such as wind and solar were "not enough." In **sponsored content (https://equinor.ft.com/infographics/understanding-carbon-capture-storage)** currently viewable on the **Financial Times (https://www.desmog.com/2024/04/23/financial-times-reuters-pull-saudi-aramco-sponsored-climate-content/)** website, Equinor says that CCS "has emerged as one of the key technologies in mitigating global warming" and addresses "misconceptions," such as concerns over high costs and links to **continued oil and gas production (https://www.desmog.com/2023/09/25/how-carbon-capture-and-storage-projects-are-driving-new-oil-and-gas-extraction-globally/)**.

Ketan Joshi, an Oslo-based climate consultant, said that the way Equinor presents its CCS operations as a climate solution is "misleading" because its existing projects only capture a small proportion of emissions, while total fossil fuel emissions in Norway remain high.

"Equinor uses 'ambitious' CCS targets as a way of simulating action without actually performing it," Joshi said. "They report the amount of CO2 they capture each year and it does not increase."

Table 3.37 CO2 from the Sleipner field injected in the Utsira formation.

Year	CO_2 (ktonnes)	Year	CO_2 (ktonnes)	Year	CO_2 (ktonnes)
1996	70	2005	858	2014	658
1997	665	2006	820	2015	707
1998	842	2007	921	2016	632
1999	971	2008	814	2017	557
2000	933	2009	860	2018	509
2001	1 009	2010	743	2019	482
2002	955	2011	929	2020	506
2003	914	2012	842	2021	322
2004	750	2013	702	2022	115

Source: Source: Equinor (Statoil) / the Norwegian Environment Agency

**A screenshot of a table showing the amount of CO2 captured at Sleipner provided to DeSmog by the Norwegian Environment Agency. The agency noted in an email that the 2021 volume should be 260 kilotonnes and not 322 kilotonnes, and that it will correct the figure in the next edition. The 106 kilotonne figure (106,000 tonnes) for 2023 was provided separately by email.*

CO2 Tax

The Sleipner CCS project was devised by Equinor (then Statoil) in the mid-1990s as a way to reduce its exposure to Norway's newly implemented CO2 emissions tax. The company established its CCS project at Snøhvit in 2008 also to reduce its tax burden from CO2 released during gas processing.

"Sleipner and Snøhvit are CCS projects with high quality that rightly enjoy worldwide recognition from academia, industry, governmental bodies and science institutions as proven and safe CO2 storages over decades where Equinor and our partners so far have stored over 25 million tonnes of CO2 since 1996," said Equinor spokesman Johannessen.

He added that over the past five years, the company has "injected 99.7 percent of the CO2 that has been captured on Sleipner into the ground."

The amount of CO2 captured by Equinor's two CCS projects is dwarfed by the emissions released by burning the oil and gas sold by the company. In 2023, Equinor recorded a total of 262 million tonnes of CO2 emissions — including the emissions produced by its operations, and the emissions from burning the oil and gas those operations extracted, according to company sustainability data.

In contrast, the company captured and stored a total of about 0.8 million tonnes of CO2 at Sleipner and Snøhvit, more than 300 times less than the amount emitted into the atmosphere by burning its products.

And even with a functioning carbon capture facility onsite, net CO2 emissions at Sleipner far exceeded the amount of the gas that was stored.

The Sleipner offshore platform provides power to several nearby gas fields by burning gas in turbines — a process that released 658,000 tonnes of CO2 into the atmosphere in 2023, according to the company's **sustainability reporting (https://sustainability.equinor.com/climate-tables)**. That's more than six times the 106,000 tonnes of CO2 that Equinor captured and stored from gas processing at Sleipner that year.

To reduce the offshore platform's CO2 footprint, Equinor **announced (https://www.equinor.com/news/20240404-reducing-emissions-from-sleipner-and-gudrun)** last April that it would introduce an electrification plan for Sleipner, rather than opting to expand CCS operations at the field. The company is also **planning (https://www.equinor.com/energy/snohvit-future)** an electrification project to reduce emissions from the gas export facility at Snøhvit.

Government Subsidies

In September, Equinor and partners Shell and TotalEnergies inaugurated the Northern Lights CO2 transport and storage facility near the Norwegian port of Bergen, which the companies **say (https://www.equinor.com/energy/northern-lights)** will store 1.5 million tonnes of CO2 a year from industrial sources on the Norwegian mainland at full capacity when it starts operations.

The project is mostly **financed (https://www.upstreamonline.com/energy-transition/norway-greenlights-1-2bn-funding-for-northern-lights-carbon-transport-and-storage-scheme/2-1-931379?zephr_sso_ott=zq8FVI)** by $1.2 billion in Norwegian government subsidies, with an additional $141 million **pledged (https://carbonherald.com/green-light-for-northern-lights-eu-approves-e131m-funding/)** by the European Union.

By 2035, Equinor says it aims to store 30 to 50 million tonnes of CO2 a year from new projects announced in Norway, Denmark, the UK, and the United States — an exponential increase from its current capacity.

While Equinor has signalled that it will need substantial subsidies to go forward with its CCS plans, the company continues to direct most of its investments into extracting more fossil fuels. In August, chief executive Anders Opedal **announced (https://www.reuters.com/business/energy/equinor-invest-up-67-bln-per-year-off-norway-towards-2035-2024-08-26/)** up to $6.7 billion a year to fund new Norwegian oil and gas drilling until 2035.

In contrast, Equinor **said (https://www.powermag.com/norways-equinor-cuts-20-of-renewable-energy-staff/)** in November that it will cut its renewable energy division's workforce by 20 percent — about 250 jobs — citing economic headwinds in the sector.

"At the most basic level, Equinor presents CCS in a similar way to many other major oil and gas companies: a 'necessary' part of the climate solutions mix," said Joshi, the climate consultant. "This is presented alongside the company's aggressive expansionist agenda: opening many new oil and gas fields."

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