Proposed Development: HyNet Carbon Dioxide Pipeline
Planning Inspectorate Reference: EN070007
Applicant: Liverpool Bay CCS Ltd

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Summary

1. The project justification in terms of positive climate impacts and reduction of greenhouse gas (GHG) emission is unproven. I ask the applicant for more information about sources of carbon dioxide to be stored,
2. The application does not follow Cumulative Effects Assessment guidelines;
3. The safety of the pipeline is not possible to assess due to inadequate current understanding and regulation to assess that safety;
4. Flood risk has not taken into account predicted sea level rise due to climate change.

1. Climate impacts
   In their first written questions, 1.5.2 the Examining Authority (ExA) invites comments in relation to Climate Change, saying "Therefore, the cumulative benefits of the DCO Proposed Development combined with the other elements of the Project are argued by the Applicant to lead to a cumulative beneficial effect overall".
   In their Cover Letter, referencing the wider HyNet project, the applicant estimates a projected reduction of 10 million tonnes of CO2 emissions a year by the early 2030s. I question the justification for this claim.

   1.1. Blue Hydrogen
      1.1.1. Much of the Environmental Statement (ES) project description (D.6.2.2) relates to blue hydrogen production from fossil fuel methane. There is growing evidence that blue hydrogen is not a low-carbon fuel, and that investment in it is misplaced.

      1.1.2. Research by the National University of Australia, comparing both emissions and economics of blue hydrogen finds 'Establishing hydrogen supply chains on the basis of fossil fuels, as many national strategies foresee, may be incompatible with decarbonisation objectives and raise the risk of stranded assets.'
      1.1.3. Peer reviewed research from Stanford and Cornell Universities found "the greenhouse gas footprint of blue hydrogen is more than 20% greater than burning natural gas or coal for heat". Although HyNet argue their Johnson-Mathey Steam Reforming process is more efficient than that used in this research, their claim that they will capture 97.7% of emissions refers only to emissions from this process and neither includes 'upstream' fugitive emissions when exploring for, extracting and transporting the methane, nor emissions

from burning methane to power the carbon capture process (the energy penalty).

1.1.4. More recent research has confirmed that upstream emissions of blue hydrogen production are not acknowledged and/ or are underestimated. January 2023 Princeton research concluded that as much as five times more methane is being leaked from oil and gas production than reported and that the UK government systematically and severely underestimates emissions in its mandatory reports to international bodies.

1.1.5. The ES project introduction (D.6.2.1 para 1.1.3) states “CO2 … will be captured from proposed hydrogen production facilities (forming part of the wider Project) and existing industrial sources in the North West of England and North Wales”. Can the applicant explain what proportion of carbon captured will come from sources other than blue hydrogen production, to facilitate an accurate assessment of the validity of carbon reduction claims?

1.2. Unproven nature of Carbon Capture and Storage

1.2.1. Large-scale CCS projects globally have failed to meet projected sequestration targets. Australian government data shows the Gorgon CCS project (capturing CO2 from extraction of reservoir gas) in Australia emitted over 7.7 million tons of CO2 in 2016-17. The project was initially planned to capture and inject underground up to 4 million tonnes (MT) of reservoir CO2 each year but actually sequestered on average less than 1MT per year. Quest, a blue Hydrogen Shell project in Canada, captured 48% of emitted GHG, well below their projected 90%. A Global Witness study found that over a 5 year period, overall project emissions (7.7 MT) significantly exceeded CO2 captured (4.8MT). What experience and expertise does the applicant demonstrate that suggests they are able to substantially improve on these failures?

1.2.2. Also from the ES project introduction: “CO2 … will be securely stored in depleted oil and gas fields in Liverpool Bay”. Although it’s widely assumed that under-sea storage is secure, there is a risk of long-term escape of sequestered gas. A 2010 article published in Nature Geoscience, considering long-term effectiveness and consequences of CO2 sequestration, concluded “Most of the investigated scenarios result in a large, delayed warming in the atmosphere as well as oxygen depletion, acidification and elevated CO2 concentrations in the ocean”.

1.2.3. Recent research by the Institute for Energy, Economic and Financial Analysis (IEEFA) into two of the North Sea fields that are frequently cited as successful models of CO2 storage shows that even with the extensive seismic and geological information at those particular fields, there are uncertainties around security and stability. At Sleipner, three years into the project, CO2 had unexpectedly risen in large quantities to a previously unknown shallow layer. At Snøhvit, a geological structure thought to have 18 years’ worth of CO_2 storage capacity was indicating less than six months of further usage potential. This unexpected turn of events baffled scientists and engineers while at the same time jeopardizing the viability of more than US$7 billion of investment in field development and natural gas liquefaction infrastructure.

1.2.4. What these Norwegian projects demonstrate is that each CCS project has unique geology; that geologic storage performance for each site can change over time; and that a high-quality monitoring and engineering response is a constant, ongoing requirement.
In Eni's written response to 2023 AGM questions, they indicate that they only guarantee to monitor emissions from storage in Liverpool Bay for 20 years after the closure of the storage site. (IEEFA article here)

1.3. CO2 Venting
Ince, Stanlow and Flint AGIs all include "CO2 supply manifold with temporary CO2 vent facilities" In what circumstances will CO2 be vented and what modelling has been done to assess impact on claimed Climate mitigation?

2. **Cumulative Environmental Impact Assessment (EIA):**

2.1. In the applicant's words: *the DCO Proposed Development enables further elements of the HyNet project to be developed which includes the production of low-carbon hydrogen and a hydrogen distribution network. Without the CO2 Pipeline, the wider HyNet project and cluster, cannot take place."*
Despite being asked by the Examining Authority, in their first written questions Q1.1.6, the applicant has not adequately shown that this application does not breach the relevant threshold and significance criteria for Cumulative Effects Assessment under the EIA Regulations. Although the applicant in D.7.16 states 'The applicant can also only take into account information in the public domain and therefore available to it', the applications for the following are underway: the HyNet Hydrogen Pipeline DCO; consent and licence for undersea storage; all Above Ground Installations (AGI) and Block Valve Stations (BVS). All AGIs include a "Connection point for potential future pipeline connections as part of future stages of the Project".
What is in substance and reality a very large set of interrelated projects has been 'salami-sliced' into a series of smaller projects, of which this DCO request is just one, and the cumulative environmental impact of the whole cannot be assessed.

2.2. This approach is problematic not only from the point of view of the EIA Regulations. Liverpool Bay CCS (Parent company ENI) and other HyNet partners are currently negotiating with HM Government for public money to subsidise construction. This means that the risk is not theirs, but the Treasury's (tax payer risk). In addition, if this consent is granted, there could be unfair pressure on decision makers to grant consent for subsequent related projects because of the public money already committed.

3. **The land-based pipeline.**
CO2 is odourless, colourless, heavier than air (so will not disperse quickly, and is an asphyxiant and intoxicant, so transporting carbon dioxide by pipeline poses serious public safety risks.

3.1. **Corrosion risk and the repurposed pipeline**
Historically, CO2 pipelines have transported relatively dry and pure CO2. In this pipeline, different sources of CO2 have the potential for higher water content and more impurities being introduced. Carbon dioxide mixed with water can form carbonic acid which is corrosive to the internal surface of the pipe and exacerbates

risk of brittle fracture.

There are additional risks associated with repurposing pipelines previously used to transport hydrocarbons. The Health and Safety Executive (HSE) states: "UK experience of designing and operating CO_2 pipelines is limited and only some pipeline design codes include it as a relevant fluid within their scope. With regard to the re-use of existing pipelines, any proposal to change the fluid conveyed will require a re-assessment of the original pipeline design to ensure that the pipeline is capable of conveying the fluid safely. Oil and gas companies, particularly in the USA, do have some experience of using high pressure injection of CO_2 in oilfields for enhanced oil recovery. However, the extent of the reliability data available from these activities is limited compared to that from hydrocarbon pipeline operation." https://www.hse.gov.uk/pipelines/co2conveying-full.htm.

There appears to be little information in this application concerning the repurposing of the 24km pipeline between Flint Connection and Point of Ayr, that has previously carried methane in from the Liverpool Bay gas fields.

Can the applicant explain how risk of corrosion and fracture is managed, both in the new and in the repurposed pipeline?

3.2. **Soil stability**

The risk of rupture will be exacerbated by climate-change related increased rainfall and temperatures which may impact soil stability in areas previously considered stable.

In 2020, a CO2 pipeline in Satartia Mississippi ruptured, leading to the evacuation of approx. 200 residents and 46 people treated in local hospitals. The investigation into the incident, undertaken by US regulatory authority Pipeline and Hazardous Materials Safety Administration (PHMSA), implicated a landslide triggered by heavy rains, which created axial strain on the pipeline and resulted in a full circumferential girth weld failure. The PHMSA subsequently issued an advisory note listing 17 significant pipeline incidents in the US related to earth movement and other geological-related incidents in the period 2016-2022.

3.3. **Limited understanding and regulation**

Internationally, regulation and guidance has not kept up with recent interest in CCS systems and new large-scale pipelines associated with them.

The incident in Satartia prompted the PHMSA to initiate new research and development projects related to the safe transportation of carbon dioxide through pipelines (PHMSA, n.d.). These projects will not report for 2 years. They attempt to address knowledge gaps, for example in relation to:

1. fracture toughness and steel pipe quality needed to prevent CO2 leak or ruptures.
2. The effects of corrosion, dents, cracks, or gouges on a wide range of steel grades
3. Odorization strategies (Odorization of CO2 is likely one of the simplest ways to ensure effective leak detection as well as public safety and emergency response).
4. Defining a safe distance or plume dispersion model for developing a potential impact area (PIR). (Without a PIR, it is impossible to establish accurate emergency response safe distances, potentially with deadly consequences).

These projects will not report for 2 years.

Considering the scope of this research, and the directive to look at CO2 as both a gas and a liquid, it is clear that PHMSA is concerned not only with the under-regulation of CO2 pipelines, but also with the current lack of technical knowledge which is needed to create appropriate minimum safety standards (Trust, Pipeline Safety, 2022).

3.4. In the UK the situation is similar. The Health and Safety Executive (HSE) https://www.hse.gov.uk/carboncapture/major-hazard.htm acknowledges limited experience and safety data in relation to CO2 pipeline development. HSE states that "currently the behaviour of CO_2, when released in its dense and supercritical phases, is not yet fully understood", and that "detailed standards and codes of practice written specifically for the design and operation of dense phase or supercritical CO_2 plant and pipelines are still being developed".
A 2009 report concluded that CO2 used for CCS has sufficient toxicity to be regulated as a dangerous fluid under the Pipeline Safety Regulations (PSR) but regulations have not been updated since 1996.
A 2011 report concluded that CO_2 has major accident hazard potential if released at, or above, its critical pressure. Despite these reports, CO_2 is not currently defined as a dangerous substance under the Control of Major Accident Hazards Regulations 1999 (COMAH) or as a dangerous fluid under PSR.
As part of a written response 24th July 2023 to my request for information about regulation of CO2 transport in pipelines, HSE responded: "HSE has initiated a four-year programme of work to develop modelling capability for CO_2 pipelines, to support HSE's role as a statutory consultee to the planning system."

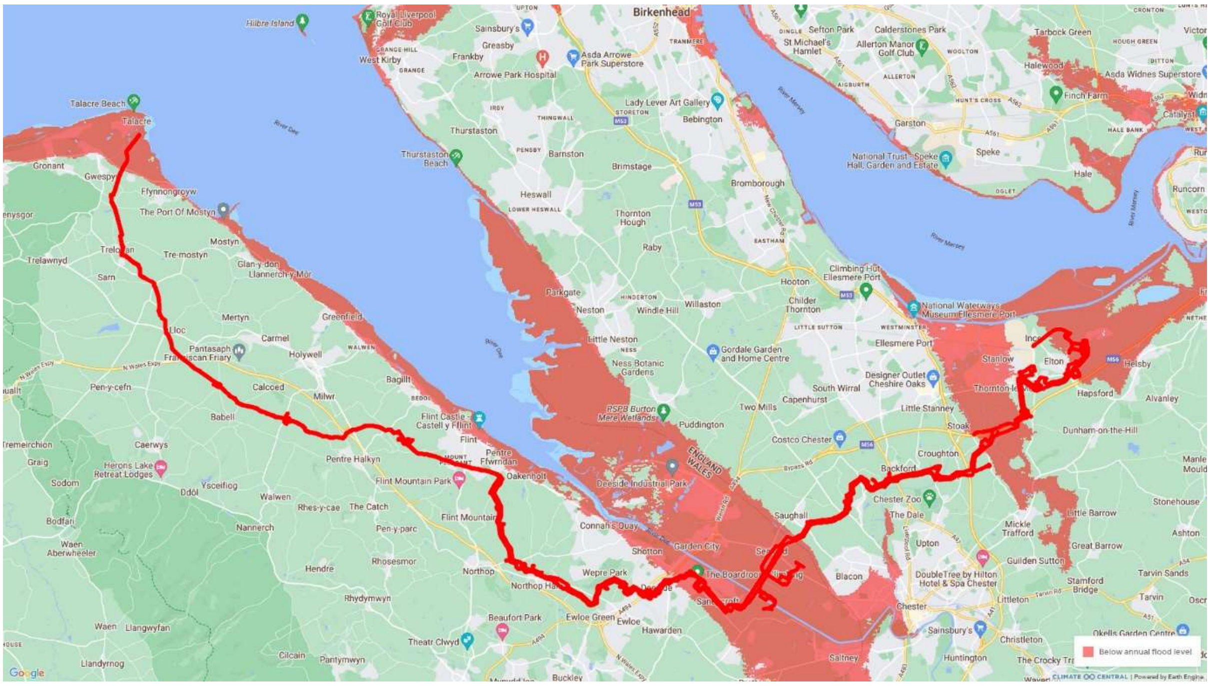
3.5. I note that the HSE has yet to answer the ExA's first written questions at 1.20.3 concerning the designation of CO2 as a dangerous fluid and the pipeline's classification as a Major Accident Hazard Pipeline

3.6. The applicant states in Chapter 13 of the Environmental Statement on Major Accidents and Disasters "CO2 (in gaseous phase) conveyed by the DCO Proposed Development is not currently defined as a dangerous fluid under these Regulations. Despite this being the case, the Applicant has followed the principle of the Regulations to ensure that risks are identified and managed out at the Design and Pre-Construction Stages." (13.2.25)
How can risk be eliminated when international understanding is limited in so many ways and the HSE programme of work on this won't report for 4 years?

4. **Flood risk**

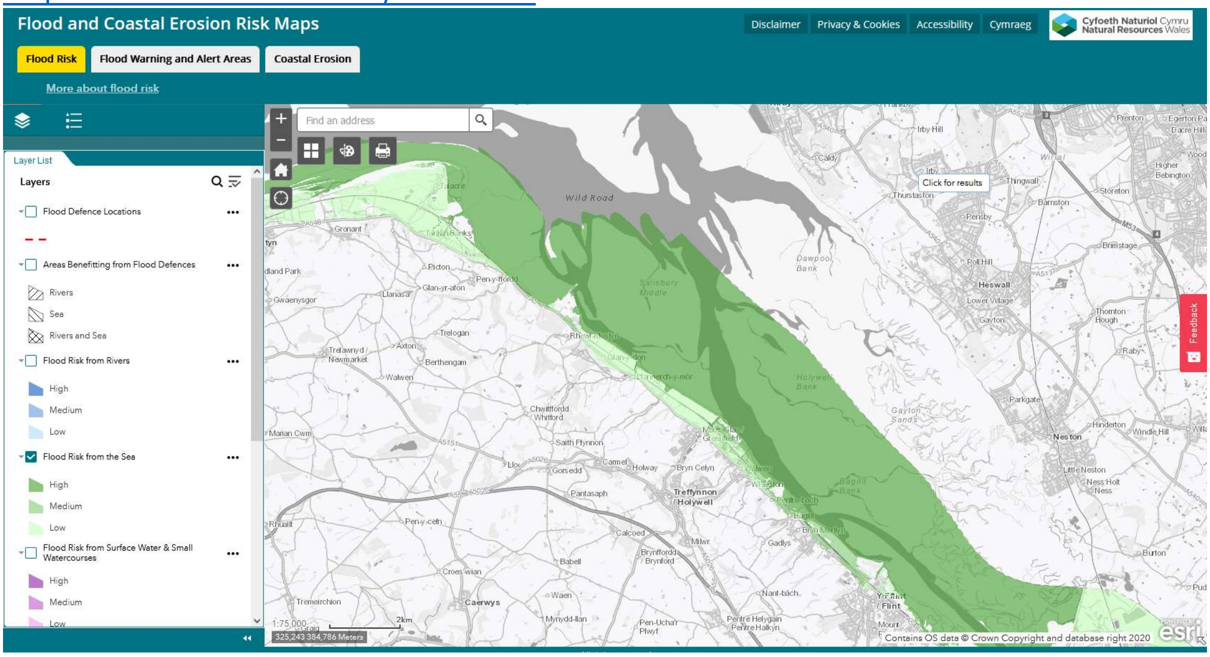
4.1. Government advice on "When and how local planning authorities, developers and their agents should use climate change allowances in flood risk assessments" and in particular "Assessing credible maximum scenarios for nationally significant infrastructure projects" is quoted below. Source: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#credible-maximum-scenarios
"Nationally significant infrastructure projects (NSIPs) are major infrastructure projects such as new harbours, roads, power stations and power lines. If you develop NSIPs you may need to assess the flood risk from a credible maximum climate change scenario. Check the relevant national policy statement."

4.2. This map shows the pipeline route superimposed over Climate Central prediction of land that will be below annual flood level by 2050. The pipeline is due to be in operation till 2065.



(Climate Central predictions are based on IPCC data from 2021. It is known that IPCC data is 12 to 24 months old by the time it is reported, and that new evidence of accelerating sea level rise and ice melting were released in autumn 2022)

This Natural Resource Wales flood risk map https://flood-risk-maps.naturalresources.wales/?locale=en



substantially agrees that at Point of Ayr and along the pipeline route, there is High flood risk from the sea. High means that "each year, this area has a chance of flooding of greater than 1 in 30 (3.3%)"

4.3. The maps show that substantial sections of the pipeline, as well as Aston Hill BVS and the Point of Ayr terminal, will be below annual flood levels by 2050.
Alston Hill BVS (Diagram EN070007-D.2.8-EL-Sheet 3, D.2.8 updated Mar 23), does

not appear to be mentioned in the flood risk assessment with the (D.6.3.18.4). The Point of Ayr terminal has been scoped out of this assessment, but is presumably essential for pipeline operation.
Although the applicant has quoted climate related sea level rises in the Flood Risk Assessment, this does not appear to have been discussed in meetings with the Environment Agency or Natural Resource Wales. The applicant has not indicated impact or mitigation. What arrangements has the applicant made for maintenance and security of the pipeline when under water?