HyNet North West

ENVIRONMENTAL STATEMENT (VOLUME II)

Chapter 10 Greenhouse Gases (Clean)

HyNet Carbon Dioxide Pipeline DCO

Planning Act 2008

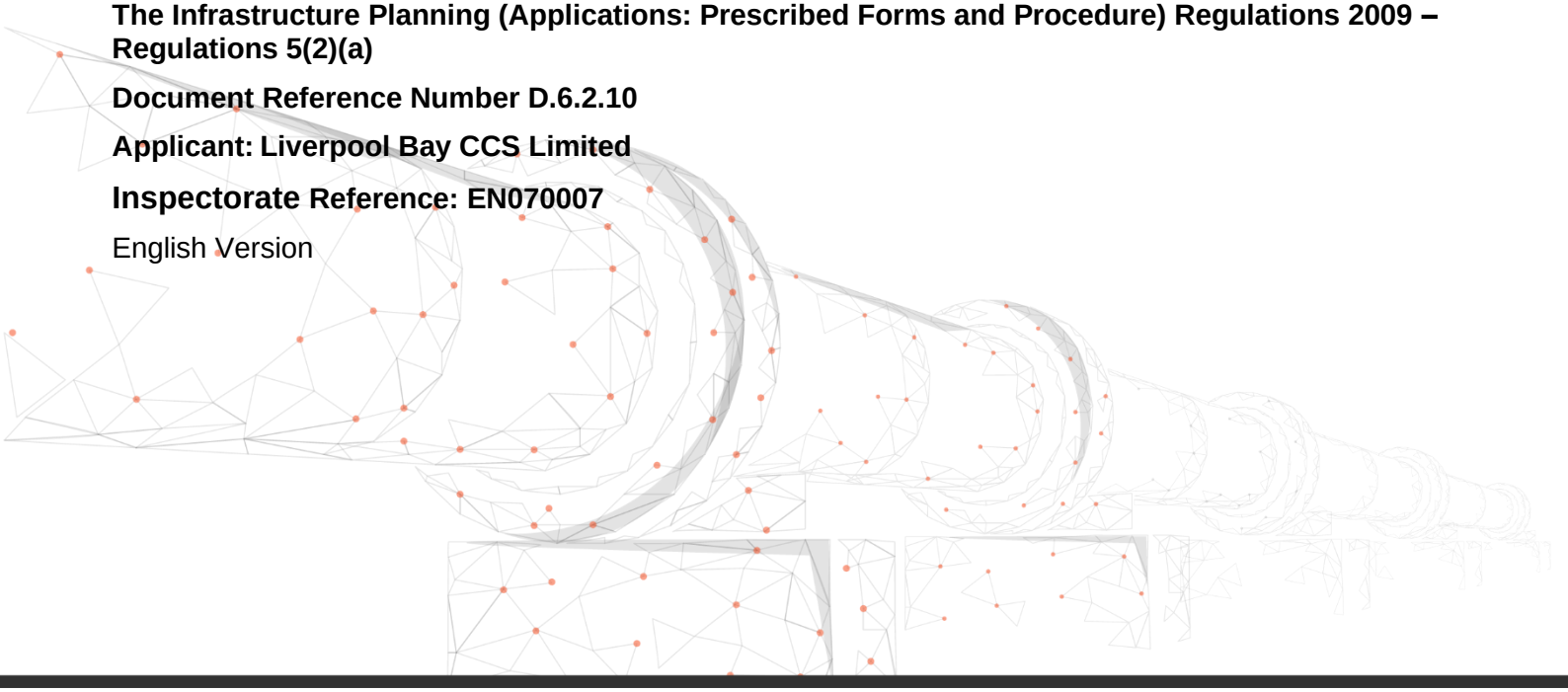
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulations 5(2)(a)

Document Reference Number D.6.2.10

Applicant: Liverpool Bay CCS Limited

Inspectorate Reference: EN070007

English Version



REVISION: B

DATE: June 2023

DOCUMENT OWNER: WSP UK Limited

PUBLIC

QUALITY CONTROL

Document Reference		D.6.2.10		
Document Owner		**WSP**		
Revision	**Date**	**Comments**	**Author**	**Approver**
A	September 2022	Submitted with DCO application	EL	HP
B	June 2023	Updated for design change request 1 and 2	EL	HP

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10. GREENHOUSE GASES

10.1. INTRODUCTION

10.1.1. This Chapter reports the assessment of the likely significant effects of the Development Consent Order (DCO) Proposed Development on greenhouse gases (GHG) and describes:

- Relevant, legislation, policy and guidance;
- Consultation undertaken;
- Scope of the assessment;
- Assessment methodology;
- Baseline conditions;
- Sensitive receptors;
- Design development and embedded mitigation;
- Assessment of likely impacts and effects;
- Mitigation and enhancement measures;
- Residual effects;
- Monitoring; and
- Next steps.

10.1.2. This Chapter is intended to be read as part of the wider ES and has been prepared by competent experts with relevant and appropriate experience, as outlined in **Appendix 5.1 Relevant Expertise and Competency (Volume III).**

10.2. LEGISLATIVE AND POLICY FRAMEWORK

10.2.1. A summary of the international, national, and local legislation, planning policy and guidance relevant to the GHG assessment for the DCO Proposed Development is set out below.

LEGISLATIVE FRAMEWORK

International

- United Nations Framework Convention on Climate Change (**Ref. 10.1**); and
  - The UK is a member of the United Nations Framework Convention on Climate Change (UNFCCC) which drives international action on climate change. The UK has pledged to reduce emissions under the Paris Agreement, as a part of a joint pledge by members of the European Union (EU). This provides an overarching commitment by the UK.
- Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (**Ref. 10.2**).

- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the DCO EIA Regulations) set out the procedures to be followed in relation to environmental impact assessments linked to nationally significant infrastructure projects in England and Wales. The regulations requires EIA to identify, describe and assess the direct and indirect significant effects of a project on the climate. It also stipulates that the information to be included within the EIA report should include the '*impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*'.

National

- Environment Act 2021 (**Ref. 10.3**);
  - The Act was passed into UK law last year, which acts as the UK's new framework of environmental protection. The Act sets out clear statutory targets for the recovery of the natural world in four priority areas and includes the requirement for the production of an Environmental Improvement Plan by the Secretary of State to significantly improve the natural environment.
- Environment (Wales) Act 2016 (**Ref. 10.4**);
  - The Act is an iterative framework that ensures that managing natural resources sustainably is a core consideration in decision-making in Wales. It requires Welsh Ministers to set statutory targets for reducing GHG emissions and to set carbon budgets.
- Climate Change Act 2008 (2050 Target Amendment) Order 2019 (**Ref. 10.5**);
  - The 2019 amendment to the Climate Change Act 2008 established a legal requirement for reaching net zero GHG emissions in the UK economy by 2050, which is reflected in the UK Net Zero Strategy. The 2008 Act also created the Committee on Climate Change, with a responsibility for:
    - Setting five-year carbon budgets;
    - Advising and scrutinising the UK Government's associated climate change adaptation programmes; and
    - Producing a national adaptation plan for the UK Government to implement.

- The Carbon Budget Order 2021 (**Ref.10-6**); and
  - This Order set the sixth carbon budget to limit the net amount of GHG emissions that the UK can release to 965 Mt $MtCO_2e$ during the five-year period from 2033 to 2037. The sixth carbon budget would reduce GHG emissions by 78% by the 2033-37 budgetary period, compared to 1990 levels.
- The Greenhouse Gas Emissions Trading Scheme Order 2020 (**Ref. 10.7**).
  - This Order sets out the framework for the UK Emissions Trading Scheme (UK ETS) to replace the UK's participation in the EU ETS. The UK ETS is a cap and trade system that is designed to limit the overall GHG emissions and incentivise cost-effective decarbonisation.

POLICY

National

- Planning Policy Wales (**Ref. 10.8**) sets out *"the land use planning policies of the Welsh Government"* with the aim to *"ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales*".
- National Planning Policy Framework (**Ref. 10.9**) sets out the core planning principle of supporting "*the transition to a low carbon future in a changing climate*…":
  - **Chapter 14 Meeting the Challenge of Climate Change, Flooding and Coastal Change** – states that "*new development should be planned in ways that can help to reduce GHG emissions, such as through its location, orientation and design*".
- Infrastructure Carbon Review (**Ref. 10.10**).
  - In 2013, the UK government published the Infrastructure Carbon Review, aiming to "*release the value of lower carbon solutions and to make carbon reduction part of the DNA of infrastructure in the UK*." Major infrastructure owners, operators and developers were invited to endorse, become signatories and make commitments under the review.
  - The review provided increased emphasis on 'capital carbon' (GHG emissions associated with raw materials, activities and transport for construction, repairs, replacement, refurbishment and de-construction of infrastructure) while acknowledging that 'operational carbon' (associated with energy consumption for the operation and use of infrastructure) will continue to dominate overall emissions to 2050 and beyond.

- The Infrastructure Carbon Review highlighted the importance of assessing GHG emissions early in the lifecycle of an infrastructure scheme when there is the greatest carbon reduction potential. The assessment presented in this Chapter provides an assessment of the DCO Proposed Development early in its lifecycle.

- Net Zero Strategy: Build Back Greener (**Ref. 10.11**).
  - The UK's Net Zero Strategy sets out the policies to decarbonise all sections to meet the UK's net zero target by 2050. Point 8 of the strategy is a commitment to investing in Carbon Capture, Usage and Storage (CCUS) through a £1 billion CCUS Fund and commitment for two industrial CCUS clusters by mid-2020, and four by 2030, capturing up to 10 $MtCO_2e$ per year.

Local

- Flintshire County Council - Environment and Sustainability Policy (**Ref. 10.12**); and
  - This Policy sets out Flintshire County Council's commitment to "*embedding continuous environmental improvement into its business model and ethos*". As part of this Policy, the Council have committed to developing a Sustainability strategy, reduce the Council's negative impact on climate change through the implementation of various projects including a Carbon Reduction Plan, integrate sustainability consideration into the Councils decisions and reduce the environmental impact of procurement through sustainable procurement processes.
- Cheshire West and Chester Climate Emergency Response Plan (2021) (**Ref. 10.13**).
  - Cheshire West and Chester Council have declared a climate emergency, and this Plan sets the strategic direction for the Council to prioritise climate change and achieve carbon neutrality by 2045. The Plan sets out the actions that the Council will take to respond to the climate emergency and its potential trajectory over the period 2020-2045. These actions, which are primarily mitigation-based but also adaptation-based, include those under the direct control of the Council, as well as those the Council could advocate for the borough, as a whole, and at national and international level.
- Flintshire Local Development Plan (LDP) **(Ref.10.26)**
  - Policy EN13 (renewable and low energy development): outlines the requirements for the permitting of renewable and low carbon energy development;
  - Policy STR14 (climate change and environmental protection): details the Council's strategy to ensure environmental protection, including

encouraging energy efficient development and environmentally acceptable renewable and zero / low carbon energy generation; and

- PC4 (sustainability and resilience of new development): requires developments to be sustainably located and accessible to non – private car means of travel, make efficient use of resources through sustainable construction techniques and materials and incorporate renewable energy technologies and carbon sinks where appropriate.

GUIDANCE

- Institute of Environmental Management and Assessment (IEMA) (2022) Assessing Greenhouse Gas Emissions and Evaluating their Significance 2nd Edition (**Ref. 10.14**);
- Publicly Available Specifications (PAS): 2080 Carbon Management in Buildings and Infrastructure (2023) (hereafter referred to as PAS 2080) **(Ref. 10.15)**; and
- Royal Institute of Chartered Surveyors (RICS) Whole life carbon assessment for the built environment (2017) (**Ref. 10.16**).

10.3. SCOPING OPINION AND CONSULTATION

RESPONSE TO THE SCOPING OPINION

10.3.1. An EIA Scoping Opinion (**Appendix 1.2 EIA Scoping Opinion, Volume III**) was received by the Applicant from the Planning Inspectorate (The Inspectorate) on 14 July 2021, including formal responses from Statutory Consultees. A full list of the responses from The Inspectorate and how these requirements have been addressed by the Applicant are set out in **Appendix 1.3 Scoping Opinion Responses (Volume III)**.

CONSULTATION UNDERTAKEN TO DATE

10.3.2. No consultation has been undertaken to inform the GHG assessment to date. No future engagement is required.

10.4. SCOPE OF THE ASSESSMENT

10.4.1. The scope of this assessment has been established through an ongoing scoping process. Further information can be found in **Chapter 5 EIA Methodology (Volume II)** of this ES.

10.4.2. This section provides an update to the scope of the assessment and re-iterates the evidence base for scoping out elements following further iterative assessment.

ELEMENTS SCOPED OUT OF THE ASSESSMENT

The elements shown in

Table 10.1 are not considered to give rise to likely significant effects as a result of the DCO Proposed Development and have therefore not been considered within this assessment. The DCO Proposed Development in this assessment does not include the existing Flint Connection to PoA Terminal Pipeline.

Table 10.1 - Elements Scoped Out of the Assessment

Element Scoped Out (as per PAS2080 Lifecycle Module (Ref. 10.15))	Justification
Maintenance, repair, refurbishment and replacement (B2-5)	No major maintenance, repair, refurbishment, or replacements are expected throughout the lifespan. Therefore, emissions from replacement are anticipated to be negligible.

ELEMENTS SCOPED INTO THE ASSESSMENT

10.4.3. The following elements are scoped into this assessment, as per PAS2080 lifecycle modules:

Construction Stage

- Product stage (manufacture and transport of raw materials to suppliers (A1-3);
- Transport of materials to site (A4);
- Plant and equipment used during construction (A5);
- Transport of waste (A5);
- Disposal of waste (A5); and
- Construction land use, land use change and forestry (LULUCF) (A5).

Operation Stage

- Operational energy use (B1/B6);
- Fugitive gas emissions (B8);
- Venting gas emissions (B8);
- Operational LULUCF (B8); and
- Avoided emissions (D).

Decommissioning Stage

- Decommissioning process (C1); and
- Transport and disposal of materials (C2-4).

10.5. ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

STUDY AREA

10.5.1. The assessment of GHG is not restricted by geographical area but instead includes any increase or decrease in emissions as a result of the DCO Proposed Development, wherever that may be. This includes:

- Construction emissions from within the Newbuild Infrastructure Boundary but also relating to the transport of materials to and from Site and their manufacture. This may be distant from the location of the DCO Proposed Development, for example, GHG emissions associated with the manufacture of steel in terms of embodied carbon and energy in the production process.
- Operational emissions (increase or reduction) which result from the end-use of the DCO Proposed Development. In this case, GHG emissions include on-site energy use, venting, fugitive gas emissions, land use change and emissions avoided by carbon capture and storage (CCS).
- End of life decommissioning emissions from within the Newbuild Infrastructure Boundary but also relating to the transport of waste from Site and its disposal. This may be distant from the DCO Proposed Development locations, for example, GHG emissions associated with recycling steel.

METHOD OF BASELINE DATA COLLATION

Site Visit and Surveys

10.5.2. For the purpose of this assessment, no site visits or surveys were required as all information could be provided from desk-based sources.

IMPACT ASSESSMENT METHODOLOGY

10.5.3. The assessment approach considers the likely magnitude of GHG emissions (or avoided emissions) in comparison to the baseline scenario without the DCO Proposed Development.

10.5.4. Where data was available, GHG emissions have been quantified using the methodologies described below. Please refer to the assumption and limitations in **paragraph 10.5.21 and 10.5.22** for further information. Where data was unavailable, the impact on GHG emissions was assessed qualitatively using professional judgement and experience on projects of a similar nature and scale.

Calculation of GHG Emissions

10.5.5. The LULUCF assessment compared the carbon storage of habitats that are subject to change between the baseline and DCO Proposed Development scenarios. Carbon storage refers to the amount of carbon that is 'locked up' in biomass, including vegetation and soil. It is referred to as the stock of carbon and measured in tonnes of carbon (tC). Carbon can be locked up for hundreds of years (for example in the case of ancient woodlands).

10.5.6. To quantify the carbon storage of habitats in the baseline, do nothing and do something scenarios, data on the habitat types and area (aligning to the Phase 1 Habitat types as reported in **Chapter 9 Biodiversity, Volume II**) within the Newbuild Infrastructure Boundary was sourced from the Applicant's design team. A habitat carbon calculator was then used to estimate the carbon storage of each habitat using the most appropriate carbon storage values sourced from Natural England (**Ref. 10.17**) and the Woodland Carbon Code (**Ref. 10.18**).

10.5.7. To quantify emissions from the reduction in the sequestration potential of peat, data on the area and type of peat to be impacted was sourced from the Applicant's design team. An appropriate emission factor from the Peatland Code Emissions Calculator was then applied to these areas to estimate the reduction in sequestration potential (**Ref. 10.19)**.

10.5.8. The Construction Stage emissions from LULUCF are reported as the loss of carbon stored from habitats removed between the DCO Proposed Development scenario and the baseline scenario. The Operational Stage emissions from LULUCF are reported as the difference between the DCO Proposed Development scenario and the do nothing scenario.

10.5.9. To quantify the embodied emissions of construction materials, estimated bulk materials data (for example the type and quantity of materials) was sourced from the Applicant's design team. The quantity of materials was multiplied by emissions factor data, sourced from ICE v3.0 (**Ref. 10.20**).

10.5.10. To estimate the emissions associated with transporting materials and waste during construction and end of life decommissioning, the expected mass of materials and waste were multiplied by transport distance assumptions provided by RICS (**Ref. 10.16**), resulting in tonne kilometres. The tonne kilometres were then multiplied by an appropriate BEIS (**Ref. 10.21**) emission factor.

10.5.11. To quantify the emissions associated with the disposal of waste during construction and end of life decommissioning, the expected mass of waste to be disposed of was multiplied by an appropriate BEIS emission factor (**Ref. 10.21**).

10.5.12. To quantify the emissions associated with plant and equipment during construction and end of life decommissioning, indicative plant data (for example the type and quantity of fuel to be used) was sourced from the Applicant's design team. The estimated quantities of fuel used during the construction and end of life decommissioning periods were multiplied by an appropriate BEIS emission factor (**Ref. 10.21**).

10.5.13. To estimate the emissions associated with operational fuel use of the DCO Proposed Development, the expected fuel consumption was multiplied by an appropriate BEIS emission factor (**Ref. 10.21**). To estimate the emissions associated with operational electricity use of the DCO Proposed Development, the expected electricity consumption was multiplied by the BEIS greenbook grid decarbonisation forecasts (**Ref. 10.22**).

10.5.14. To quantify the GHG emissions associated with venting of the DCO Proposed Development, the estimated volume of CO_2 to be vented from each source was sourced from the Applicant's design team.

10.5.15. To quantify fugitive gas emissions associated with the operation of the DCO Proposed Development, the estimated number of flanged connections and valves at the Above Ground Installations (AGIs) and Block Valve Stations (BVSs) and hours of operation was multiplied by an appropriate emission factor published by the American Petroleum Institute (API) (**Ref. 10.23**).

10.5.16. To quantify the avoided emissions associated with the operation of the DCO Proposed Development, the estimated annual flow per year was sourced from the Applicant's design team.

10.5.17. The construction, operational and end of life Decommissioning Stage emissions were compared with the UK (**Ref. 10.24**) and Wales (**Ref. 10.25**) carbon budgets.

SIGNIFICANCE CRITERIA

10.5.18. There are currently no agreed thresholds for what level of GHG emissions is considered significant for EIA. The significance of GHG emissions is assigned with reference to the magnitude of emissions, their context on the UK's trajectory towards net zero, guidance from IEMA (**Ref. 10.14**), and the use of professional judgement.

10.5.19. As climate change impacts are global in nature, it is not possible to link a specific project with a specific environmental impact. Recently published guidance from IEMA (**Ref. 10.14**) sets out five distinct levels of significance based on the GHG emissions relative contribution towards achieving a science-based 1.5ºC aligned transition towards net zero by 2050. As such, significance of GHG emissions have been put into context through comparison with the respective UK (**Table 10.2Error! Reference source not found.**) and Wales carbon budgets (**Table 10.3**) to assess their compatibility with the UK's net zero trajectory.

Table 10.2 - UK Carbon Budgets ($MtCO_2e$)

Carbon Budget Period	UK Carbon Budget
Third: 2018-2022	2,544 $MtCO_2e$
Fourth: 2023-2027	1,950 $MtCO_2e$
Fifth: 2028-2032	1,725 $MtCO_2e$
Sixth: 2033-2037	965 $MtCO_2e$

Table 10.3 - Wales' Carbon Budgets ($MtCO_2e$) (Ref 10.22)

Carbon Budget Period	Wales Carbon Budget
2021-2025	43.12 $MtCO_2e$*
2026-2030	35.28 $MtCO_2e$*

*Note that these figures have been estimated by utilising high-level figures for the 1990 baseline and the percentage reduction targets for each budget from Net Zero Wales Carbon Budget 2 **(Ref. 10.25)**.

Effect Significance

10.5.24. The following terms have been used to define the significance of the effects identified as set out in IEMA guidance (**Ref. 10.14**):

- **Major adverse (significant)**: the GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy and do not make a meaningful contribution to the UK's trajectory towards net zero;
- **Moderate adverse (significant)**: the GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy

requirements but would not fully contribute to decarbonisation in line with local and national policy goals, falling short of fully contributing to the UK's trajectory towards net zero;

- **Minor adverse (not significant)**: the GHG impacts are fully consistent with applicable existing and emerging policy requirements and good practice design standards, fully in line with measures necessary to achieve the UK's trajectory towards net zero;
- **Negligible (not significant)**: the GHG impacts are reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050; and
- **Beneficial (significant)**: the net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline, substantially exceeding net zero requirements with a positive climate impact.

ASSUMPTIONS AND LIMITATIONS

10.5.25. To ensure transparency, the following Preliminary Design limitations and assumptions have been identified:

- It is assumed that the operational life span of the DCO Proposed Development is 25 years; and
- For the end of life Decommissioning Stage, it is assumed that the Newbuild Carbon Dioxide Pipeline and Flint Connection to PoA Terminal Pipeline will be left in situ, with the AGIs and BVSs dismantled.

10.5.26. To ensure transparency, the following methodology limitations and assumptions have been identified:

- For the current LULUCF baseline and construction LULUCF scenarios, woodland habitats are assumed to be 50 years old;
- A worst-case approach has been used to quantify the reduction in the sequestration potential of peat, whereby it was assumed that all peat would be lost and in the do-minimum scenario, none of the peat would be degraded;
- A worst-case scenario has been used to estimate the emissions from the disposal of biomass (A5);
- Fugitive gas emissions have in part been assessed qualitatively due to data being unavailable;
- Where specific material data was not available an appropriate emissions factor has been selected based on professional judgement;

- Embodied and construction waste emissions and emissions arising during the end of life Decommissioning Stage have been calculated based on estimated bill of quantities data sourced from the Applicant's design team;
- The transportation of materials and waste to and from Site (for example, the source of materials and destination of waste) has been taken from RICS assumptions for transportation scenarios (**Ref. 10.16**);
- Professional judgement and guidance from IEMA have been used to assess significance;
- GHG emissions from construction plant have been calculated based on indicative data sourced from the Applicant's design team covering the main types of plant to be used;
- In the absence of information, it has been assumed that the same plant used during construction will be required during the end of life Decommissioning Stage;
- It has been assumed that waste will be recycled where possible during the end of life decommissioning stage;
- A worst-case scenario has been assumed for the fuel type used for construction and end of life decommissioning plant;
- A worst-case scenario has been assumed for the embodied carbon of the copper cables;
- A worst-case scenario has been assumed for steel;
- Material specification of 70% polyethylene and 30% glass fibre has been assumed for the fibre optic cables;
- The conversion of Nm^2 to kg for CO_2 used is at 0ºC and 1 atmospheric pressure;
- Vented gas and fugitive gas emissions are assumed to be 100% CO_2;
- A worst-case scenario has been assumed for the frequency of pigging to clean and maintain the pipeline;
- A worst-case scenario has been assumed for the frequency of manifold venting;
- It is assumed that the quantity of CO_2 captured each year will remain constant at the maximum operational capacity of the Stanlow AGI to Flint AGI Pipeline, which is 4.5 $MtCO_2$/yr, from 2027 onwards over the lifespan of the DCO Proposed Development; and
- The estimated annual flow used to calculate avoided emissions from the Project includes all emissions captured from the plants that feed into the Carbon Dioxide Pipeline system as part of the Project. This is because the DCO Proposed Development cannot function in isolation from the other Project components. The avoided emissions will therefore be double

counted between Planning Applications for the other components that form part of the Carbon Capture and Storage (CCS) infrastructure. Please refer to **Chapter 2 The Project (Volume II)** for further information.

10.6. BASELINE CONDITIONS

10.6.1. In the baseline (Do Minimum) scenario, GHG emissions occur constantly and widely as a result of natural and human activity, including land use and land use change, transport, energy consumption (e.g., fossil fuels for purchased energy from the grid and/or other sources) and industrial processes.

10.6.2. The GHG assessment has only considered instances in which the DCO Proposed Development results in additional or avoided emissions in comparison to the baseline scenario and the DCO Proposed Development's assumed evolution. The baseline conditions therefore focus on those sources of emissions subject to change between the baseline scenario and the scenarios that include the DCO Proposed Development.

EXISTING BASELINE

10.6.3. The baseline scenario involves no construction or end of life decommissioning activities within the Newbuild Infrastructure Boundary and therefore the construction and end of life decommissioning baselines are zero emissions.

10.6.4. The existing operational baseline includes the current carbon storage of habitats within the Newbuild Infrastructure Boundary which has been quantified as outlined in the **Section 10.5**. The total GHG emissions arising from operational LULUCF are estimated to be approximately -60,333 tC.

FUTURE BASELINE

10.6.5. The future baseline scenario involves no construction or end of life decommissioning activities within the Newbuild Infrastructure Boundary and therefore the construction and end of life decommissioning baselines are zero emissions.

10.6.6. The future operational baseline ('Do Nothing') includes the future carbon storage of habitats within the Newbuild Infrastructure Boundary which has been quantified as outlined in the **Section 10.5**. The total GHG emissions arising from future operational LULUCF are estimated to be approximately -61,247 tC.

10.7. SENSITIVE RECEPTORS

10.7.1. As climate change impacts are global in nature, no local sensitive receptors have been identified in relation to GHG emissions. The assessment considers increases in or avoided GHG emissions in relation to the global atmosphere, which is the only identified sensitive receptor.

10.8. DESIGN DEVELOPMENT, IMPACT AVOIDANCE, AND EMBEDDED MITIGATION

10.8.1. The following embedded mitigation has been agreed to increase energy efficiency during the operation of the DCO Proposed Development, reducing GHG emissions associated with operational energy use:

- The Detailed Design of the AGIs / BVSs will ensure that high energy efficiency transformers/motors will be selected (**DCO-GG-013** of the **Register of Environmental Actions and Commitments (REAC), Document Reference: D.6.5.1**);
- Light-emitting diode (LED) based illumination systems will be installed instead of traditional lights for both outdoor and indoor areas of all AGIs / BVSs (**DCO-GG-014** of the **REAC, Document Reference: D.6.5.1**);
- Low-voltage electrical installations will comply with IEC60364, Part 8-1: Energy Efficiency (**DCO-GG-015** of the **REAC, Document Reference: D.6.5.1**); and
- The energy monitoring system will incorporate the new features of the Proposed Development, to comply with ISO 50001 certification (**DCO-GG-016** of the **REAC, Document Reference: D.6.5.1**).

10.8.2. The DCO Proposed Development will use welded-in block valves instead of flanged block valves to reduce the number of fugitive emission sources.

10.9. ASSESSMENT OF LIKELY IMPACTS AND EFFECTS

10.9.1. This section details the preliminary assessment of predicted impacts and effects for the DCO Proposed Development during both the Construction and Operational Stage, pre-mitigation.

Construction Stage

10.9.2. The total estimated GHG emissions arising from embodied carbon (manufacture and transport of raw materials to suppliers), transport of materials to Site, transport of waste from Site, disposal of waste, construction plant use and LULUCF have been quantified as outlined in the **Section 10.5** and are presented in

10.9.3. **Table** 10.4, **Key:** * with Alltami Brook Embedded Pipe Bridge

10.9.4. Table 10.5, **Key:** * with Alltami Brook Embedded Pipe Bridge

10.9.5. Table 10.6, **Table 10.7,**

10.9.7. Table 10.8 and **Table 10.9** respectively. Please note that these may contain rounding discrepancies.

10.9.8. The total GHG emissions arising from embodied carbon, transportation of materials to Site, transport of waste from Site, disposal of waste, plant use and LULUCF for the construction of the DCO Proposed Development are estimated to be approximately 81,328 tCO_2e.

Table 10.4 - Estimated Embodied Emissions (A1-3)

Material	Embodied Carbon (tCO_2e)
Steel	51,925 or 51,928*
Concrete	1,926 or 2,027*
Sand	1,302 or 1,305*
Earthworks	674
Aggregate	384 or 385*
Copper	142
Polyethylene	78
Glass	19
Total	**56,450** or **56,558***

Key: * with Alltami Brook Embedded Pipe Bridge

Table 10.5 - Estimated Emissions for the Transport of Materials to Site (A4)

Material	Transport to Site (tCO_2e)
Steel	1,071
Sand	834 or 839*
Aggregate	534 or 536*
Earthworks	292

Material	Transport to Site (tCO_2e)
Concrete	145 or 153*
Polyethylene	2
Copper	2
Glass	1
Total	**2,881** or **2,896***

Key: * with Alltami Brook Embedded Pipe Bridge

Table 10.6 - Estimated Emissions for the Transport of Waste from Site (A5)

Material	Transport from Site (tCO_2e)
Aggregate	407
Concrete	113
Steel	1
Copper	1
Plastic	1
Timber	1
Hazardous waste	<1
Copper	<0.1
Total	**524**

Table 10.7 - Estimated Emissions for the Disposal of Waste (A5)

Material	Transport to Site (tCO_2e)
Recycling	52
Landfill	1
Incineration	<1
Total	**53**

Table 10.8 - Estimated Plant Use Emissions During Construction (A5)

Stage	Plant Type	Total (tCO_2e)
Newbuild Carbon Dioxide Pipeline	Bulldozers	1,033
	Articulated haul trucks	2,260
	Excavators	1,705
	Vibratory Soil Compactor	465
	Rough Terrain Concrete Trucks	581
	Concrete pump trucks	170
	Motor Graders	581
	Side Boom Pipelayers	1,162
	Directional Drill	148
	Boring Machine	443
	Trenching machine	369
	All-Terrain cranes	664
	Other equipment	1,131
AGIs and BVSs	Mini Excavator	69
	Tandem Vibratory Roller	12
	Telehandler	14
	Site Dumper	15
	Motor Graders	17
	Other equipment	29
	Total	**10,868**

Table 10.9 - Estimated Emissions from Construction LULUCF (A5)

Biomass Type	Emissions (tC)
Removed vegetation	11,542
Total	**11,542**

10.9.12. Based on the results presented in

10.9.13. **Table** 10.4**, Key:** * with Alltami Brook Embedded Pipe Bridge

10.9.14. Table 10.5**, Key:** * with Alltami Brook Embedded Pipe Bridge

10.9.15. Table 10.6**, Table** 10.7**,**

10.9.17. Table 10.8 **and Table 10.9**, guidance from IEMA and professional judgement, the magnitude of embodied emissions and GHG emissions from the transport of materials and waste to/from Site, disposal of waste, plant use and LULUCF for the DCO Proposed Development is predicted to have a *Minor Adverse* effect during construction.

Operational Stage

10.9.1. The total estimated GHG emissions arising from operation energy use, LULUCF, venting, fugitive gas emissions and avoided emissions have been quantified as outlined in the **Section 10.5** and are presented in **Table 10.10**, **Table 10.11, Table 10.12**,

10.9.3. Table 10.13 and **Table 10.14** respectively. Please note that these may contain rounding discrepancies.

10.9.4. The total GHG emissions arising from operation energy use, LULUCF, venting and fugitive gas emissions during the operation of the DCO Proposed Development are estimated to be approximately 12,379 tCO_2e.

10.9.5. As noted in **paragraph 10.5.17,** the avoided emissions include all emissions associated with the Project. This is because the DCO Proposed Development cannot function in isolation from the other Project components. The significance of the GHG emissions arising during the Operational Stage has considered the total including the avoided emissions as the reduction in GHG emissions cannot occur without the DCO Proposed Development.

10.9.6. The total GHG emissions arising from the operation of the DCO Proposed Development including avoided emissions associated with the Project are estimated to be approximately -106,937,621 tCO_2e. The total GHG emissions arising from operation energy use, LULUCF, venting and fugitive gas emissions account for 0.01% of the avoided emissions across the lifespan of the DCO Proposed Development.

10.9.7. Complete data on fugitive gas emissions was not available due to their unintentional nature, making them difficult to estimate. Fugitive emissions from valves and flanged connections at the AGIs and BVSs have been assessed quantitatively. There is also the potential for fugitive gas emissions to arise from other valves, flanges, seals and equipment within the Newbuild Infrastructure Boundary. However, GHG emissions from these sources are expected to be minimal and are not expected to materially affect the outcome of this assessment.

Table 10.10 - Estimated Emissions from Operational Energy Use (B2/6)

Energy Source	Energy Use (tCO_2e)
Electricity	4,183
Diesel	338
Total	**4,521**

Table 10.11 - Estimated Emissions from Operational LULUCF (B8)

Carbon Sequestration Scenario	Emissions (tC)
Do Nothing (future baseline)	-61,247
Do Something habitats retained	-48,917

Carbon Sequestration Scenario	Emissions (tC)
Do Something habitats created	-5,901
Peat	86
Overall change in sequestration	**6,428**

Table 10.12 - Estimated Emissions from Venting of the Flint, Stanlow and Ince AGIs (B8)

Venting type	Vented Emissions (tCO_2e)
Pigging	182
Manifold	76
Total	**259**

Table 10.13 - Estimated Fugitive Gas Emissions from the AGIs and BVSs (B8)

Source	Fugitive Gas Emissions (tCO_2e)
Valves	938
Flanged connections	147
Total	**1,085**

Table 10.14 - Estimated Avoided Emissions (D) of the Project

Item	Total (tCO_2e)
Avoided emissions	-106,950,000

10.9.13. Based on the results presented in Table 10.10, Table 10.11, Table 10.12 and

10.9.15. Table 10.13, guidance from IEMA and professional judgement, the magnitude of GHG emissions from operation energy use, LULUCF, venting and fugitive gas emissions as a result of the operation of the DCO Proposed Development is predicted to have a *Minor Adverse (not significant)* effect.

10.9.16. Based on the results presented in **Table 10.10**, **Table 10.11, Table 10.12**,

10.9.18. Table 10.13 and **Table 10.14**, guidance from IEMA and professional judgement, the magnitude of GHG emissions from operation energy use, LULUCF, venting, fugitive gas emissions as a result of the operation of the DCO Proposed Development and avoided emissions associated with the Project is predicted to have a ***Beneficial (Significant)*** effect.

Decommissioning Stage

10.9.19. The total estimated GHG emissions arising from decommissioning plant use, transport of waste from Site and disposal of waste have been quantified as outlined in **Section 10.5** and are presented in **Table 10.15**, **Table 10.16** and **Table 10.17** respectively. Please note that these may contain rounding discrepancies.

10.9.20. The total GHG emissions arising from plant use, transport of waste from Site and disposal of waste during end of life decommissioning of the DCO Proposed Development are estimated to be approximately 11,765 tCO_2e.

10.9.21. The processes to dismantle the DCO Proposed Development are uncertain, and this assessment reflects emissions arising from the Construction Stage. However, by the end of the DCO Proposed Development's design life, decommissioning plant and the transport of waste are expected to be net zero along with the rest of the UK, as outline in the Climate Change Act 2008 (2050 Target Amendment) Order 2019 (**Ref. 10.5**). This assessment is therefore based on a worst-case scenario.

Table 10.15 - Estimated Plant Use Emissions During Decommissioning (C1)

Plant Type	**Total (tCO_2e)**
Demolition and hauling equipment	10,868
Total	**10,868**

Table 10.16 - Estimated Emissions for the Transport of Waste from Site (C2)

Material	**Transport to Site (tCO_2e)**
Sand	834
Earthworks	292
Aggregate	126
Concrete	32

Material	Transport to Site (tCO_2e)
Steel	10
Polyethylene	<1
Copper	<1
Glass	<1
Total	**1,295**

Table 10.17 - Estimated GHG Emissions from the Disposal of Waste (C3-4)

Disposal Method	Emissions (tCO_2e)
Landfill	494
Recycling	96
Total	**591**

10.9.24. Based on the results presented in Table 10.15, **Table 10.16** and Table 10.17, guidance from IEMA and professional judgement, the magnitude of GHG emissions from plant use, the transport of waste from Site and the disposal of waste for the DCO Proposed Development is predicted to have a *Minor Adverse* effect.

10.10. MITIGATION AND ENHANCEMENT MEASURES

10.10.1. This section sets out the preliminary avoidance, mitigation and compensation measures which are likely to be required to address the minor adverse effects as assessed in **Section 10.9.**

10.10.2. The magnitude of GHG emissions associated with the Construction and Operational Stage of the DCO Proposed Development can be reduced by, amongst others:

- The Detailed Design of the DCO Proposed Development will reflect the carbon hierarchy and include feasible measures to reduced embodied carbon as part of the Detailed Design, as outlined in PAS 2080 (**Ref. 10.15**). This will include potential for re-using or refurbishing assets; and use of low carbon solutions (technologies, materials and produces) to minimise resource consumption as far as practicable.

- The Detailed Design of the Proposed Development will ensure the design is optimised, to avoid unnecessary permanent design aspects, and minimising material consumption and waste generation, as far as reasonably practicable (**D-GG-001** of the **REAC, Document reference: D.6.5.1**).
- The Detailed Design of the DCO Proposed Development will substitute-in and use alternative raw materials and resources (for example, procuring steel with a higher than average recycled content (UK steel is typically 50-60% recycled content)), where practicable (**D-GG-002** of the **REAC, Document reference: D.6.5.1**).
- The Detailed Design of the DCO Proposed Development will use efficient construction processes, such as embracing design for manufacture and assembly, where practicable (**D-GG-003** of the **REAC, Document reference: D.6.5.1**).
- Maximising the opportunity to use more sustainable materials by specifying in tender documentation that materials and products with reduced embodied carbon emissions and materials/resources featuring recycled content (where safe and of sufficient integrity for engineering), eventually supported with eco- and carbon labels or verified Environmental Product Declarations (EPD), are preferred (**D-GG-004** of the **REAC, Document reference: D.6.5.1**).
- Construction materials will be sourced from local suppliers and local waste disposal facilities will be used in the Flintshire and Cheshire regions where practicable (**D-GG-005** of the **REAC, Document reference: D.6.5.1**).
- Construction waste will be recycled or reused where practicable to avoid disposal to landfill (**D-GG-006** of the **REAC, Document reference: D.6.5.1**).
- Using more modern and efficient low emission construction plant and delivery vehicles, and/or those powered by electricity from alternative/lower carbon fuels. Construction Contractors will ensure high performance of plant and equipment through correct and efficient operation, maintenance, and servicing of vehicle fleet to avoid polluting emissions (**D-GG-007** of the **REAC, Document reference: D.6.5.1**).
- Training policies will be in place during site induction to avoid idling of engines, spills of fuels (for example, when refuelling) and safe/environmentally sensitive driving techniques to maximise fuel saving (**D-GG-008** of the **REAC, Document reference: D.6.5.1**).
- The sustainability credentials of suppliers and companies in the supply chain will be considered as part of the procurement process (**D-GG-009** of the **REAC, Document reference: D.6.5.1**).
- Where practicable, innovative construction methods (for example, optimising gradients of haul and access roads/points) will be incorporated to reduce construction energy consumption, such as plant use and minimise the need

for sharp acceleration and braking in order to save fuel (**D-GG-010** of the **REAC, Document reference: D.6.5.1**).

10.10.3. The magnitude of GHG emissions associated with the eventual operation of the DCO Proposed Development can be reduced by, amongst others:

- The design and construction of the DCO Proposed Development will be undertaken with a view to maximising the operational lifespan and minimising the need for maintenance and refurbishment (and thus reducing the frequency of releasing associated GHG emissions) (**D-GG-011** of the **REAC, Document reference: D.6.5.1**).
- Specifying efficient mechanical and electrical equipment such as lighting and telecommunications that is long-lasting and based on its durability, repairability and energy efficiency credentials (**D-GG-012** of the **REAC, Document reference: D.6.5.1**).
- Operating, maintaining, and refurbishing the DCO Proposed Development using best-practices in energy efficiency, and using low/no-carbon approaches, plant, and equipment, such as sourcing clean energy for the operation of the DCO Proposed Development (**D-GG-017** of the **REAC, Document reference: D.6.5.1**).
- Explore opportunities to source the energy required for operation from 100% clean energy suppliers (**D-GG-018** of the **REAC, Document reference: D.6.5.1**).
- A leak detection and maintenance programme will be implemented as part of the operational management and monitoring regime (**D-GG-019** of the **REAC, Document reference: D.6.5.1**).

10.10.4. The magnitude of GHG emissions associated with the end of life Decommissioning Stage of the DCO Proposed Development can be reduced by, amongst others:

- Where practicable, designing, specifying, and dismantling the DCO Proposed Development with a view to maximising the potential for the reuse/repurposing, recycling and/or recovery of materials and components of the DCO Proposed Development at its end-of-life stage (**D-GG-020** of the **REAC, Document reference: D.6.5.1**).
- Using local waste disposal facilities where available and practicable to minimise the distance that waste is transported from Site to disposal (**D-GG-021** of the **REAC, Document reference: D.6.5.1**).
- Decommissioning the DCO Proposed Development using best-practices in energy efficiency, and using low/no-carbon approaches, plant, and equipment (**D-GG-022** of the **REAC, Document reference: D.6.5.1**).

10.10.5. These measures are included in the **Register of Environmental Actions and Commitments (REAC) (Document reference: D.6.5.1)** submitted with this ES.

10.11. RESIDUAL EFFECTS

10.11.1. Table 10.18 below summarises the residual effects associated with the DCO Proposed Development during construction, operation and end of life decommissioning.

Table 10.18 - Summary of Residual Effects

Description of the effect	Pre-mitigation significance of effects	Mitigation measure	Residual effect
Construction			
Construction Stage GHG emissions	*Minor adverse*	Construction emissions could be minimised though design optimisation to reflect the carbon reduction hierarchy as well as other measures detailed in **Section 10.10**.	*Minor adverse (not significant)*
Operation			
Operational Stage GHG emissions	*Minor adverse* for the operation of the DCO Proposed Development alone. ***Beneficial (Significant)*** including the avoided emissions captured from the plants that feed into the Carbon Dioxide Pipeline system as part of the Project.	Operational emissions could be minimised by specifying high efficiency mechanical and electrical equipment and operating, maintaining, and refurbishing the DCO Proposed Development using best practices in energy efficiency and low carbon energy sources as well as other measures detailed in **Section 10.10**.	*Minor adverse (not significant)* for the operation of the DCO Proposed Development alone. ***Beneficial (Significant)*** including the avoided emissions captured from the plants that feed into the Carbon Dioxide Pipeline system as part of the Project.

Description of the effect	Pre-mitigation significance of effects	Mitigation measure	Residual effect
Decommissioning			
End of life decommissioning Stage GHG emissions	*Minor adverse*	Decommissioning emissions could be minimised by maximising the potential for the reuse/repurposing, recycling and/or recovery of materials and components of the DCO Proposed Development at its end-of-life stage, avoiding disposal of materials into landfill, as well as other measures detailed in Section 10.9.	*Minor adverse (not significant)*

10.12. MONITORING

10.12.1. No operational monitoring is proposed in relation to the GHG assessment.

10.13. REFERENCES

Ref. 10.1 – United Nations (1992) United Nations Framework Convention on Climate Change

Ref. 10.2 – Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

Ref. 10.3 – Environment Act (2021)

Ref. 10.4 – Environment (Wales) Act 2016

Ref. 10.5 – Climate Change Act 2008 (2050 Target Amendment) Order 2019

Ref. 10.6 – The Carbon Budget Order 2021

Ref. 10.7 – The Greenhouse Gas Emissions Trading Scheme Order 2020

Ref. 10.8 – Planning Policy Wales (2018)

Ref. 10.9 – National Planning Policy Framework (2021)

Ref. 10.10 – Infrastructure Carbon Review (2013)

Ref. 10.11 – Net Zero Strategy: Build Back Greener (2021)

Ref. 10.12 – Flintshire County Council - Environment and Sustainability Policy [online] Available at: https://www.flintshire.gov.uk/en/PDFFiles/Countryside--Coast/Biodiversity/Flintshire-County-Council-Sustainability-Policy.pdf

Ref. 10.13 – Cheshire West and Chester Council (2021) Cheshire West and Chester Climate Emergency Response Plan [online] Available at: https://www.cheshirewestandchester.gov.uk/your-council/councillors-and-committees/the-climate-emergency/documents/climate-emergency-response-plan.pdf

Ref. 10.14 – IEMA (2022) Assessing Greenhouse Gas Emissions and Evaluating their Significance 2nd Edition

Ref. 10.15 – BSI (2023) PAS 2080 Carbon Management in Infrastructure.

URef. 10.16 – RICS (2017) Whole life carbon assessment for the built environment

Ref. 10-17 – Natural England (2021) Carbon Storage and Sequestration by Habitat (2nd)

Ref. 10.18 – Woodland Carbon Code (2021) Woodland Carbon Code Calculator V4

Ref. 10.19 – IUCN UK (2017) Peatland Code Emissions Calculator

Ref. 10.20 – ICE Database (2019) v3.0

Ref. 10.21 – BEIS (2021) Greenhouse Gas Reporting: Conversion Factors 2021

Ref. 10.22 BEIS (2021) Green Book Supplementary Guidance: Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal

Ref. 10.23 American Petroleum Institute (2021) Compendium of Greenhouse Gas Emissions Methodologies for the Natural Gas and Oil Industry

Ref. 10.24 – Committee on Climate Change, UK Carbon Budgets, Available at: [redacted]

Ref. 10.25 – Net Zero Wales Carbon Budget 2 (2021 to 2025) (2021), Available at: https://gov.wales/net-zero-wales-carbon-budget-2-2021-2025

Ref. 10.26 - Flintshire County Council. (2023). Flintshire Local Development Plan 215 - 2030. Retrieved from https://www.flintshire.gov.uk/en/PDFFiles/Planning/Examination-Library-Documents/FINAL-LDP-Written-Statement-