Intermodal Logistics Park North Ltd

INTERMODAL LOGISTICS PARK NORTH (ILPN)

Intermodal Logistics Park North (ILPN) Strategic Rail Freight Interchange (SRFI)

Project reference TR510001

Preliminary Environmental Information Report (PEIR)

Appendix 17.1 GHG Emissions and Carbon Budgets

October 2025

Planning Act 2008

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

This document forms a part of a Preliminary Environmental Information Report (PEIR) for the Intermodal Logistics Park North (ILPN) project.

A PEIR presents environmental information to assist consultees to form an informed view of the likely significant environmental effects of a proposed development and provide feedback.

This PEIR has been prepared by the project promoter, Intermodal Logistics Park North Ltd. The Proposed Development is described in Chapter 3 of the PEIR and is the subject of a public consultation.

Details of how to respond to the public consultation are provided at the end of Chapter 1 of the PEIR and on the project website:

https://www.tritaxbigbox.co.uk/our-spaces/intermodal-logistics-park-north/

This feedback will be taken into account by Intermodal Logistics Park North Ltd in the preparation of its application for a Development Consent Order for the project.

Appendix 17.1 ◆ GHG Emissions and Carbon Budgets

INTRODUCTION

1 This appendix to Chapter 17: Climate Change of the Preliminary Environmental Information Report (PEIR) details the calculation of construction- and operational-stage greenhouse gas (GHG) emissions from the Proposed Development. It also provides information on Local Authority baseline emissions and carbon budgets, which are used within Chapter 17 to reach a conclusion on the significance of effects on climate change. This appendix should therefore be read in conjunction with Chapter 17 of the PEIR, which sets the magnitude of GHG emissions in a policy context to judge the significance of effects on climate change.

2 In overview, GHG emissions have been estimated by applying published emissions factors and/or benchmark data to activities required for the Proposed Development. The emissions factors relate to a given level of activity, a physical or chemical process, or amount of fuel, energy or materials used to the mass of GHGs released as a consequence.

EMISSION SOURCES

3 Construction of the Proposed Development will cause direct and indirect GHG emissions from the fuel and energy used by construction plant and in the ‘embodied carbon’ of materials used. The embodied carbon refers to the indirect emissions in the supply chain for those materials: extracting and transporting the raw materials, manufacturing them into products, and delivery of those products to the DCO Site.

4 Together with the assembly work on-site, this comprises modules A1 to A5 in the terminology used to describe life-cycle carbon assessment. A1-3 refers to the materials manufacturing supply chain; A4 is delivery to the DCO Site; and A5 is assembly on the DCO Site.

5 The sources of GHG emissions considered within this assessment, or the future assessment to be contained within the Environmental Statement (ES) where sufficient information is not available at this stage, is shown in Table 1.

Table 1 Sources of GHG emissions for the construction and operational phases

Project stage	Source of GHG emissions	Overview of methodology
Construction	The embodied carbon of materials used in construction of the Proposed Development, including the warehouse units	Embodied carbon has been calculated by Ridge and Partners LLP based on prior Whole Life Carbon Assessments (WLCA) of similar units (taken from WLCA modelling of similar

Project stage	Source of GHG emissions	Overview of methodology
	and ancillary buildings, wider site infrastructure (i.e. onsite highways, access works, drainage, landscaping works, etc.) and rail infrastructure (i.e. rail connected buildings, main line rail works, rail freight terminal works, etc.). The embodied carbon also accounts for use of construction plant on the DCO Site for the warehouse units and ancillary buildings.	schemes of the Applicant). Full details of methodology are provided in Appendix 17.4: Embodied Carbon Assessment.
	Transport of materials to the DCO Site and traffic flows associated with worker commuting.	Not included in PEIR as insufficient information is available at this stage. The emissions from construction and worker transport will be explored further within the ES, informed by expected construction traffic flows and application of GHG conversion factors from DESNZ.
	Land use change	GHG emissions from habitat loss were calculated using the Woodland Carbon Code (WCC) Carbon Calculation Spreadsheet (version 3.0 August 2025) and by applying average biomass carbon stocks reported in Natural England’s Carbon Storage and Sequestration by Habitat report (2021).
Operation	Operational energy consumption	Operational energy demand has been calculated by MBA Consulting Engineers Ltd. Published emission factors have then been applied to the operational energy demand to calculate GHG emissions.
	Operational rail transport	Rail emissions were calculated by applying published emission factors for freight diesel to the total distance travelled by freight trains for the Proposed Development and tonnes of cargo carried by these freight trains, informed by the ILPN SRFI rail expert,

Project stage	Source of GHG emissions	Overview of methodology
		Baker Rose Consultants.
	Operational road transport	Not included in PEIR as insufficient information is available at this stage. The emissions from operational transport will be explored further within the ES, informed by expected operational traffic flows and application of GHG conversion factors from DESNZ.
	Land use change	GHG emissions from habitat gain were calculated using the Woodland Carbon Code (WCC) Carbon Calculation Spreadsheet (version 3.0 August 2025) and by applying average biomass carbon stocks reported in Natural England's Carbon Storage and Sequestration by Habitat report (2021).

6 Key sources relied upon for the assessment, or future assessments, are as follows:

- UK Government GHG Conversion Factors for Company Reporting (DESNZ, 2025)[1]
- OneClick LCA Embodied Carbon Benchmarks for European Buildings (2021)[2]
- RIBA 2030: Climate Challenge (2021)[3]
- LETI Climate Emergency Design Guide[4]
- Forestry Commission, Woodland Carbon Code (WCC) carbon calculation method version 3.0 August 2025[5]

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[1] DESNZ (2025): Greenhouse gas reporting: conversion factors 2025: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2025

[2] OneClick LCA Ltd (2021): Embodied Carbon Benchmarks for European Buildings: https://www.oneclicklca.com/eu-embodied-carbon-benchmarks/

[3] RIBA (2021): RIBA 2030 Climate Challenge: https://www.architecture.com/about/policy/climate-action/2030-climate-challenge?srsltid=AfmBOorFG1rb0JqOWw_pFtU11u5AE50DD3W-zmYM8-bsSUY5vRrh5zJi

[4] LETI (n.d.): LETI Climate Emergency Design Guide: https://www.leti.uk/_files/ugd/252d09_3b0f2acf2bb24c019f5ed9173fc5d9f4.pdf

[5] Forestry Commission, Woodland Carbon Code (2025): Carbon calculation spreadsheet version 3.0 August 2025: https://www.woodlandcarboncode.org.uk/template-documents-and-tools

- Natural England Carbon Storage and Sequestration by habitat (2021)[6]
- UK Net Zero Carbon Buildings Standard (NZCBS) (pilot)[7]
- RICS Whole Life Carbon Assessment for the Built Environment, 2nd Edition (2023)[8]

WHOLE LIFE CARBON ASSESSMENT MAPPING

7 The National Networks National Policy Statement (NNNPS) requires in paragraphs 5.31 *et seq* that a whole-life carbon assessment (WLCA) is carried out by the applicant at relevant project stages, one of which being submission of the DCO application. The WLCA should be carried out in accordance with the DfT's Transport Assessment Guidance module A3[9] which, in turn, at paragraph 4.2.10, suggests that where feasible and proportionate, WLCAs should be carried out in line with the principles of PAS2080:2023 and the RICS Guide to Whole Life Carbon Assessment for the Built Environment, 2nd edition[10].

8 The DfT's guidance specifies that the whole life carbon impacts of a scheme should *"include capital carbon (emissions associated with scheme construction), operational carbon (emissions associated with scheme operation and maintenance), and user carbon (emissions associated with scheme users, such as changes in emissions due to mode shift)"* (paragraph 4.2.11).

9 At this stage of the project, with design being in an early and outline form, WLC impacts have been reported through several DCO application documents. Part of the approach to carbon management over the project lifecycle (set out in the Carbon Management Plan) and indeed the mitigation recommended by Chapter 17 is for WLCA to be carried out at further detailed design, construction and as-built stages, at which point this information would be brought together into a single WLCA report.

10 Figure 1, reproduced from the RICS guidance, illustrates the recommended WLCA system boundary and emission 'modules' for different stages of a project.

11 Table 2 then maps where this WLCA information is contained in DCO application documents, where it is considered likely to be material to the assessment of significance and proportionate to include at this stage. The remainder of this appendix summarises the GHG

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[6] Natural England (2021): Carbon storage and sequestration by habitat: a review of the evidence (second edition): https://publications.naturalengland.org.uk/publication/5419124441481216

[7] BBP, BRE, CIBSE, Carbon Trust, IStructE, LETI, RIBA, RICS and UKGBC (2025): UK Net Zero Carbon Buildings Standard Pilot Version Rev 2: https://www.nzcbuildings.co.uk/_files/ugd/6ea7ba_1ef36b6835de46668f2ad8b589ff1b93.pdf, accessed October 2025

[8] RICS (2023): Whole life carbon assessment for the built environment, 2nd edition, https://www.rics.org/content/dam/ricsglobal/documents/standards/Whole_life_carbon_assessment_PS_Sept23.pdf

[9] DfT (2025): TAG Unit A3. Environmental Impact Appraisal: https://assets.publishing.service.gov.uk/media/681b6bd143d6699b3c1d29ba/tag-unit-a3-environmental-impact-appraisal.pdf, accessed 28/07/25

[10] RICS (2023): Whole life carbon assessment for the built environment. 2nd edition: https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/whole-life-carbon-assessment, accessed 28/07/25

emission totals that have been used in Chapter 17 to determine significance of effects and recommend further mitigation.

Figure 1 RICS WLCA modules and system boundary

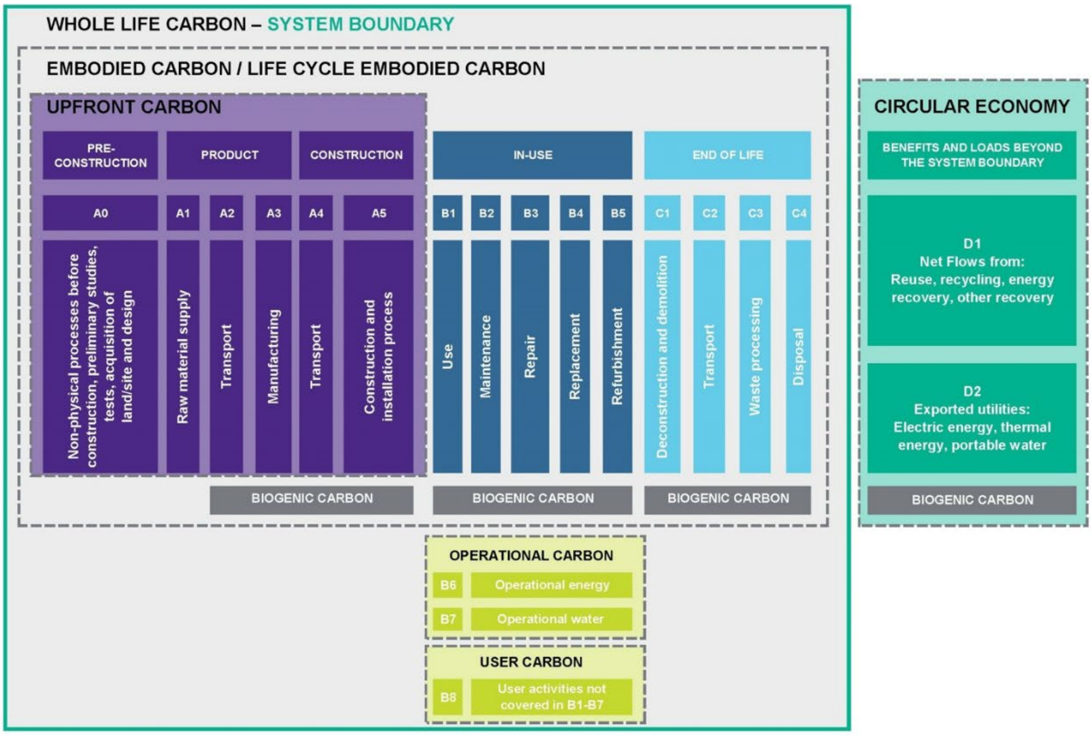

Table 2 Sources of GHG emissions for the construction and operational phases

Module or scope	Where provided in the PEIR documents
DfT TAG A3 overarching requirements	
Capital carbon (emissions associated with scheme construction)	Appendix 17.4: Embodied Carbon
Operational carbon (emissions associated with scheme operation and maintenance)	Energy: Appendix 17.5: Energy Strategy On-site fuel use for tugs: this appendix
User carbon (emissions associated with scheme users, such as changes in emissions due to mode shift)	Off-site transport: this appendix (for rail and associated HGV freight) Off-site transport: this appendix when updated at ES stage (for worker commuting and HGV movements associate with the

Module or scope		Where provided in the PEIR documents
		buildings and not associated with rail terminal)
WLCA modules based on definitions in RICS guidance		
A0 – pre-construction (surveys, design, etc)	Upfront carbon	De minimis and not proportionate to include in assessment at this stage
A1 – raw material supply		Appendix 17.4: Embodied Carbon* Biogenic carbon stock loss from landuse change is reported in this appendix
A2 – material transport		
A3 – manufacturing		
A4 – delivery		
A5 – on-site works		
B1 – direct use	In use	In the RICS definition this is use-stage emissions arising directly from physical products and plant that were installed at the construction stage, not other emissions from user/occupier activities Refrigerant gas leakage from MEP (e.g. conditioned warehouses) to be assessed at subsequent WLCA stages Biogenic carbon sequestration from landscape planting is reported in this appendix
B2 – maintenance		Estimated uplift to the up-front carbon is reported in this appendix for B2 and B3. Replacement and refurbishment (B4 and B5) are assessed qualitatively.
B3 – repair		

Module or scope		Where provided in the PEIR documents
B4 – replacement		
B5 – refurbishment		
B6 – energy use		Appendix 17.5: Energy Strategy
B7 – water use		De minimis and not proportionate to include in assessment at this stage
B8 – other use not covered		Fuel use by tugs assessed in this appendix Operational energy use captured in B6 Other significant direct emissions from occupiers not expected based on likely types of tenants.
C1 – deconstruction	End of life	Scoped out of EIA. To be assessed at subsequent WLCA stages.
C2 – waste transport		
C3 – waste processing		
C4 – waste disposal		
D1 – net flows from recycling and recovery	Outside system boundary	No other significant emission sources identified at this stage
D2 – exported utilities		Implicitly included in the PV calculations (all PV power assumed to be used and displace grid power, whether on-site use or by export)

** in the RICS definition this would be 'upfront carbon', with 'embodied carbon' also including the B- and C-modules relating to materials impacts*

CONSTRUCTION PHASE METHODOLOGY AND RESULTS

Embodied carbon

12 Embodied carbon has been calculated by Ridge and Partners LLP. The full methodology for the embodied carbon assessment is provided in Appendix 17.4. In summary, the upfront embodied carbon of the warehouse units has been modelled based on prior Whole Life Carbon Assessments (WLCA) of similar units in other projects proposed or developed by the Applicant), with a 15% uplift to account for this early design uncertainty, in line with the RICS guidance. The embodied carbon includes lifecycle modules A1-A5, with module A5 considering delivery of materials to the DCO Site and typical use of construction plant site.

13 The upfront embodied carbon of the other DCO Site infrastructure has been modelled based on a cost plan and applying whole-life carbon impacts from relevant Environmental Product Declarations (EPDs) to the materials quantities expected to be required. It also applies typical values for delivery of materials to the site and for construction waste management from the RICS guidance, but excludes use of construction plant site because this is considered to be too variable for the infrastructure works to predict at this stage.

14 The warehouse and ancillary buildings' embodied carbon as set out in Appendix 17.4 is 291,729 tCO_2e; the embodied carbon of rail infrastructure is 44,806 tCO_2e and that for other site infrastructure is 10,765 tCO_2e.

15 The Proposed Development will include solar photovoltaic (PV) panels on building roofs. The quantum of PV to be installed will depend on tenants' actual operational energy needs, but the Energy Strategy estimates at this stage that the proposed PV arrays will have a total installed capacity of up to 77.5 MWp as a maximum (Table 1.3 in Appendix 17.5). The embodied carbon assessment in Appendix 17.4 includes approximately 11.2 MWp of rooftop PV capacity within the embodied carbon impact for the typical warehouse buildings as reported above. A further assessment of the embodied carbon of the potential additional balance of 66.3 MWp that could be installed has therefore been made to ensure this is not under-counted.

16 The embodied carbon of manufacturing and delivering PV panels and system components to the UK depends on the type of panel, manufacturing process and country of origin. Most global production is of single- or multi-crystalline silicon[11]; while there are emerging technologies with potentially lower embodied carbon, these are less common, and robust lifecycle carbon data is not readily available. This assessment has therefore assumed established c-Si panel technology to be conservative.

17 Data from a large NREL review of PV system lifecycle assessment (LCA) studies[12] combined with data on typical UK solar yields indicates a median embodied carbon intensity of 1.87 tCO_2e/kWp; and a further more recent study[13] suggests a similar figure of

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[11] IEA (2020): Life Cycle Inventories and Life Cycle Assessments of Photovoltaic Systems. [Online] Available at: https://iea-pvps.org/wp-content/uploads/2020/12/IEA-PVPS-LCI-report-2020.pdf, accessed: 28/03/2022

[12] NREL (Hsu, D.D., O'Donoughue, P., Fthenakis, V., Heath, G.A., Kim, H.C., Sawyer, P., Choi, J.K. and Turney, D.E) (2012): Life cycle greenhouse gas emissions of crystalline silicon photovoltaic electricity generation: systematic review and harmonization. Journal of Industrial Ecology, 16, pp.S122-S135.

[13] Milousi, M., Souliotis, M., Arampatzis, G. and Papaefthimiou, S. (2019): Evaluating the Environmental Performance of Solar Energy Systems Through a Combined Life Cycle Assessment and Cost Analysis. Sustainability, 11(9), p.2539.

1.89 tCO_2e/kWp. A review published by NREL in 2024[14] suggests lower values of around 0.62–1.20 tCO_2e/kWp (for DC capacity) for systems imported to the US; whereas a review a briefing by Circular Ecology[15] reviewing studies of mono-crystalline PV suggests a higher value of 2.56 tCO_2e/kWp, though cautions that this evidence is dated and requires updated studies. An average of the earlier NREL review and Milousi *et al* reviews, i.e. 1.88 tCO_2e/kWp, has been used in this assessment. For up to 66.3 MWp of additional installed capacity, the additional embodied carbon of the additional PV system capacity could therefore be up to 124,550 tCO_2e.

18 The Proposed Development may include battery energy storage to help match PV generation to demand, but the need and scale of this is yet to be confirmed (see Appendix 17.5). At this stage, in order to be able to indicatively consider the potential magnitude and significance of embodied carbon from a battery storage system, an assumption has been made that it might have capacity in the order of two hours' storage of peak site energy demand (which is estimated to be 32 MW: see Table 1.4 in Appendix 17.5), so 64 MWh. This has then been uplifted to an assumed 94 MWh installed capacity to account for the depth of discharge (assumed 80%) and degradation in capacity over time (assumed 15%).

19 Construction-stage GHG emissions would be caused directly and indirectly in the supply chain of producing the battery modules and other materials used in the proposed development, transport to the site, and from use of construction plant on site. Of these, the 'embodied carbon' of manufacturing the batteries would be the most substantial emission source because of the high energy intensity of the process. Published lifecycle assessment studies (LCAs) have been used to determine a potential range of emissions from battery production.

20 The embodied carbon of manufacturing and delivering battery storage infrastructure to the UK depends on the type of battery installed, manufacturing process and country of origin. At present, lithium-ion batteries are the most common technology being installed in the UK[16], and the two main types of lithium-ion batteries used in this context are lithium-iron-phosphate (LFP) and lithium-nickel-manganese-cobalt-oxide (NMC). A 2023 report by the Faraday Institution[17], the UK's independent institute for electrochemical energy storage research, stated that lithium-ion batteries accounted for over 90% of grid-scale installations in the UK from 2020 to 2024. The same report estimates that approximately 60% of lithium-ion battery systems in the UK market in 2022 comprised LFP batteries due to their lower cost and higher efficiency.

21 The Energy Strategy does not indicate which type of battery might be installed at the Proposed Development. Taking into account the above, for the purposes of this assessment, it is assumed that $LiFePO_4$ (lithium-iron-phosphate, LFP) batteries will be installed.

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[14] NREL (Smith, B., Sekar, A., Mirletz, H., Heath, G. andMargolis, R.) (2024): An Updated Life Cycle Assessment of Utility-Scale Solar Photovoltaic Systems Installed in the United States. Technical Report NREL/TP-7A40-87372. https://docs.nrel.gov/docs/fy24osti/87372.pdf

[15] Circular Ecology (not dated): https://circularecology.com/solar-pv-embodied-carbon.html

[16] Hutton G. et al.(2025): Research Briefing: Battery energy storage systems. House of Commons Library. [Online]. Available at: https://researchbriefings.files.parliament.uk/documents/CBP-7621/CBP-7621.pdf, accessed 10/07/2025

[17] The Faraday Institution and Rho Motion (2023): Market and Technology Assessment of Grid-Scale Energy Storage required to Deliver Net Zero and the Implications for Battery Research in the UK. [Online]. Available at: https://www.faraday.ac.uk/wp-content/uploads/2023/09/20230908_Rho_Motion_Faraday_Institution_UK_BESS_Report_Final.pdf, accessed 10/07/2025

22 A number of published LCAs for LFP battery systems have been reviewed. Gutsch and Leker (2022)[18] provided a systematic review of ten previous LCAs specific to LFP batteries, commenting on data quality and normalising these to a standard functional unit of kgCO_2e/kW of installed capacity. The EPRI in 2019[19] published a prospective LCA of a number of proposed utility-scale battery projects in California, albeit with a range of lithium-based battery chemistries, not just LFP. Lin et al. in 2024[20] published an LCA of utility-scale LFP battery storage systems in China, a major manufacturing location for batteries. Other studies were reviewed but not used as they related to different battery chemistries, or because establishing the impact for a functional unit of kW of installed capacity was not possible from the data. Gutsch and Leker and the EPRI both commented on the quality of available lifecycle inventory data and the fact that many published studies relate back to a relatively limited, and dated, set of primary inventory data about LFP production. This is acknowledged as an area of uncertainty.

23 The embodied carbon results range from 30 kgCO_2e/kWh to 316 kgCO_2e/kWh, indicative of the wide variance in assumptions about the carbon intensity of the production process and the uncertainties in primary data. However, the majority of the results lie in the 100–200 kgCO_2e/kWh range. Taking the mean of all study results yielded 150 kgCO_2e/kWh of installed storage capacity, and this figure has been used in the assessment.

24 Table 3 summarises the construction-phase impacts as predicted by the study in Appendix 17.4 plus the additional PV and BESS impacts calculated here.

Table 3 Embodied carbon impacts of the Proposed Development

Aspect	Embodied carbon emissions (tCO_2e)
Warehouse units and ancillary buildings	291,729
Site infrastructure	10,765
Rail infrastructure	51,527
Additional solar PV*	124,550
Battery storage*	14,108

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[18] Gutsch, M. and Leker, J. (2022): *Global warming potential of lithium-ion battery energy storage systems: A review*. Journal of Energy Storage 52. https://doi.org/10.1016/j.est.2022, accessed 14/04/25

[19] Shaw, S. *et al* for EPRI (2019): *Program on Technology Innovation: Life Cycle Assessment of Lithium-ion Batteries in Stationary Energy Storage Systems*. https://www.epri.com/research/products/000000003002017000, accessed 14/04/25

[20] Lin, X. et al (2024): Environmental impact analysis of lithium iron phosphate batteries for energy storage in China. Frontiers in Energy Research. https://www.frontiersin.org/journals/energy-research/articles/10.3389/fenrg.2024.1361720/full, accessed 14/04/25

Aspect	Embodied carbon emissions (tCO_2e)
Total	**492,679**

** with indicative assumptions about potential maximum installed capacity, above that included in the base assumptions for the warehouse units;: see discussion above*

25 Off-site works are considered separately in Appendix 7.2 Highway Mitigation Options Report.

Land use change

26 The quantities of habitats to be lost and habitats to be created have been provided by the ecological consultants for the Proposed Development. Habitats can be categorised into five main groups: cropland, grassland, woodland, heathland/shrub and hedges.

27 To calculate the carbon stock within woodland habitats, the Woodland Carbon Code (WCC) Carbon Calculation Spreadsheet (version 3.0, August 2025) has been used. This has been applied retrospectively, i.e. estimate the stored carbon value of existing mature woodland habitat on the DCO Site, and prospectively to estimate the potential cumulative carbon sequestration that new planting could attain once it reaches full maturity and equilibrium of stored biomass and soil carbon.

28 For woodland, grassland and heathland/shrub, the area of habitat lost and habitat gained have been provided in hectares (ha). However, the area of hedges to be lost and gained was provided only in length (km). An assumed width of 0.5 m was therefore used to calculate the total area of habitat lost and created.

29 For the existing trees and woodland habitat that will be lost, the total vegetation and soil carbon estimated to be lost is 6,999 tCO_2e. Conservatively, it is assumed that all vegetation carbon and 10% of soil carbon (consistent with a 'very high disturbance' factor in the WCC calculator) would be released into the atmosphere during the construction phase, although in practice this would depend on the use or decay of wood products and how extensively soil carbon is disturbed.

30 For all other habitats, vegetation and soil carbon values have been calculated using average biomass carbon stocks reported in Natural England's Carbon Storage and Sequestration by Habitat report (2021). A summary of the average carbon stock values used is presented in Table 3 below.

Table 4 Non-woodland habitat carbon stocks

Habitat type	Vegetation carbon stock (tCO_2/ha)	Soil carbon stock (tCO_2/ha)
Cultivated land – average UK	0	257
Improved grassland	0	477
Heathland/shrub	22	345
Hedge	168	362

31 The Natural England publication indicates that agricultural grassland has little to no above-ground vegetation carbon stock. Heathland, the category used to represent shrub and scrub areas, has a small amount but this is noted to have higher uncertainty as the evidence is from habitats outside the UK which differ in their composition. In both cases, any soil carbon losses are likely to be the more important factor. To calculate the potential soil carbon stock losses within the grassland, hedgerow and shrub/scrub areas, the WCC assumption of 10% loss from very high disturbance has again been applied.

32 The total vegetation and soil carbon estimated to be lost for the non-woodland habitats is 6,515 tCO_2e.

CONSTRUCTION EMBODIED CARBON BENCHMARKS

33 As explained in Chapter 17 of the PEIR, one of the ways in which GHG impact magnitude could be contextualised to aid in determining the significance of effect is by comparison to benchmarked emissions intensity. Available benchmarks for the warehouse units are shown in Table 4. Where a benchmark for warehousing specifically does not exist, a benchmark for the nearest alternative is instead shown.

Table 5 Construction activity and embodied carbon benchmarks for warehouse units

Description and Source	Intensity ($kgCO_2e/m^2$)	Scope	Notes
OneClick database: western Europe commercial developments (median)	504	A1–A3	Including estimated 20% uplift for fit-out, services and external works
RIBA non-domestic (new build office) metric: BAU	1,400	A1–A5, B1–B5, C1–C4	Also includes in-life maintenance and construction waste (B and C modules)
RIBA non-domestic (new build office) metric: 2025 target	<970		
RIBA non-domestic (new build office) metric: 2030 target	<750		
LETI commercial office metric: BAU	1,000	A1–A5	-
LETI commercial office: 2020 target	600		
LETI commercial office: 2030 target	350		
UKNZCBS: 2030 target for storage and distribution	475	A1–A5	Upfront carbon limits for new works if conforming with standard
UKNZCBS: 2039 target for storage and distribution	220		
UKNZCBS: average of construction period target (2030-2039)	337.5		

OPERATIONAL PHASE METHODOLOGY AND RESULTS

Operational energy consumption

34 The Energy Strategy at Appendix 17.5 provides estimates of the operational energy demand of the Proposed Development after taking into account the passive and active energy efficiency measures that form part of the committed design. Three estimates have been made: for occupancy and heating/cooling of the buildings; for this plus electric vehicle charging in the car park; and finally also including an estimate of possible future electric goods vehicle charging. These are summarised in Table 5; refer to Appendix 17.5 for details.

Table 6 Estimated Operational Energy Consumption

Element	Expected annual demand (MWh)
Occupancy only	27,140
Occupancy and heating	36,110
Occupancy, heating and EV (electric vehicle) charging	48,890
Occupancy, heating, EV and EGV (electric goods vehicle) charging	176,610

35 The Energy Strategy has also calculated how much solar photovoltaic (PV) capacity would be needed to supply the equivalent of this amount of electricity consumption, based on typical figures for PV yield in MWh/annum per m^2 of installed panels. It is important to note that this is equivalent capacity: the time profiles of variable PV generation and variable on-site demand will not necessarily match, so either battery storage or importing and exporting from the national electricity grid (or a combination of these) can be used to balance supply and demand, as set out in the strategy.

36 The Energy Strategy shows that the available warehouse roof space is more than sufficient to accommodate PV panels to meet 100% of the equivalent annual average electricity demand for building occupancy and heating/cooling; and indeed that it would also be possible to fully meet the equivalent annual average electricity demand for estimated EV charging too. The principle of the Energy Strategy and Carbon Management Plan is for the actual installed PV capacity to meet the annual average equivalent demand, when tenant needs and actual energy demand are better established.

37 Indirect GHG emissions from electricity use have been calculated initially by applying a present-day emissions factor for grid-average consumption published by DESNZ for company reporting[1]. Including scope 3 supply chain emissions and transmission and distribution (T&D) losses, this is 0.2454 $kgCO_2e$/kWh. However, the carbon intensity of electricity generation in

the UK is expected to decrease, so a future-year projection has also been used. BEIS publishes forward-looking projections of carbon intensity used in government policy appraisal[21], which indicate a projected carbon intensity of 0.067 kgCO2e/kWh in 2038, the full completion year of the Proposed Development. However, the BEIS factors exclude upstream scope 3 emissions (other than T&D losses) and may be somewhat optimistic relative to actual electricity sector decarbonisation to date. Both figures have been used in this assessment to provide a range.

38 Annual average factors are used rather than half-hourly marginal values because the demand profile and generation profile are not determined in detail at this stage. When considering the effect of PV, this means the PV is assumed to effectively be fully utilised and to displace alternative generation at the grid-average intensity over the course of a year, whether directly or through being stored or exported.

Rail and road freight movements

39 The Proposed Development will serve up to 16 trains per day. At this stage, the trains are estimated to originate from, and deliver to, Flexistowe, London Gateway, Liverpool Port, Cardiff, Teesport, Southampton and Glasgow. The distance to these locations, in both road and rail miles, has been calculated by Baker Rose Consultants, along with the estimated split of trains travelling to/from the location.

40 In total, the Proposed Development would result in 1.27 million miles travelled by freight trains each year to and from the SRFI. Without the Proposed Development, there would be 110.9 million miles travelled by road. This includes additional road miles required to access railports and a proportion of ‘backtracking’ from the Proposed Development to end destinations for those customers not having warehousing on site. It has been assumed that 66% of offsite containers continue the direction of the route, whilst 34% of containers backtrack towards the origin, therefore increasing overall journey miles for the latter.

41 To calculate the resulting GHG emissions from road and rail transport, the total distance travelled by each mode has been multiplied by an appropriate emissions factor. For rail, the emissions factor has been taken from the DESNZ conversion factors 2025 for rail freighting goods (0.2779 kgCO_2e/tonne/km), based on a total of 561 tonnes moved per train. For road, the emissions factor for a Euro VI compliant HGV has been assumed (0.7835 kgCO_2e/km), given the UK’s trajectory to decarbonising road transport. These emissions factors account for direct scope 1 fuel combustion emissions, but do not take into account scope 3 supply chain emissions. Therefore, to ensure scope 3 emissions are considered within the assessment of road and rail emissions, a percentage uplift of 24% was added to the total tCO_2e calculated for both road and rail emissions. This percentage uplift was calculated from the emissions factor for scope 3 diesel fuel production as a percentage of the scope 1 diesel fuel production emissions factor.

42 The resulting scope 1 and scope 3 GHG emissions for rail and road transport are 39,418 tCO_2e/annum and 173,058 tCO_2e/annum, respectively. The Proposed Development would therefore result in a net saving of 133,641 tCO_2e/annum when comparing avoided road

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[21] BEIS (2023): Valuation of Energy Use and Greenhouse Gas: Supplementary guidance to the HM Treasury Green Book. [Online] Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal, accessed 27/02/2024

emissions to the proposed rail emissions.

43 Railport operation also requires short-distance HGV movements or specialised tugs to move containers between cranes and storage/warehouse areas. As a conservative assumption, these have been assumed to be diesel-fuelled, 50% laden rigid HGVs. Again, emissions factors have been sourced from DESNZ. An average round-trip haul distance of 2 km has been assumed.

Other operational traffic

44 Other operational traffic, i.e. worker commuting and any further HGV journeys not already included above, will be assessed at ES stage when traffic modelling data is available.

Maintenance and refurbishment

45 There may be GHG emissions from maintenance (lifecycle module B2) and refurbishment (lifecycle module B3) work during the building's lifetimes. In the absence of data on these emissions, guidance from RICS (2023)[22] has been used to estimate GHG emissions associated with these modules. As reported within the guidance, for module B2 impacts in the UK, a total figure of 10 $kgCO_2e/m^2$ gross internal area (GIA) may be used to cover all building element categories, or 1% of modules A1-A5, whichever is greater. The total A1-A5 embodied carbon emissions, with a 15% uplift to account for the early design phase, is 290,252 tCO_2e, 1% of which would be 2,903 tCO_2e. When applying a figure of 10 $kgCO_2e/m^2$ GIA to each warehouse unit GIA, and uplifting this by 15% to account for early design contingency, the total B2 emissions are 6,905 tCO_2e. The latter is therefore used in reporting the Proposed Development's GHG emissions from building maintenance.

46 With respect to B3 emissions, the guidance states that the UK repair impacts should be assumed as equivalent to 25% of B2 maintenance impacts for the relevant items, expect for MEP, where 10% of A1-A3 impacts should be assumed. As such, GHG emissions from B3 refurbishment are 1,726 tCO_2e.

47 The generating capacity of solar PV systems degrades over time in use through a variety of physical and environmental factors affecting both the PV modules and the balance of equipment in the system (connections, inverters etc). These are summarised in a helpful review published by DNV[23]. As this sets out, a range of warrantied lifetimes are specified by manufacturers but to a degree the useful lifetime of PV panels with different technologies is still being determined (large-scale deployment of such systems being relatively recent) and also depends on how much degradation of generating capacity is acceptable before replacement.

48 PV panel is likely to continue to improve, which may lead to different technologies/suppliers for replacement in future, and the carbon intensity of manufacturing is likely to be reduced in future. Qualitatively, it can be estimated that the embodied carbon impact of one or more

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[22] RICS (2023): Whole life carbon assessment for the built environment, 2nd edition, https://www.rics.org/content/dam/ricsglobal/documents/standards/Whole_life_carbon_assessment_PS_Sept23.pdf

[23] Hieslmair, H. for DNV (2024): Whitepaper: DNV's Views on Long-Term Degradation of PV Systems, https://www.dnv.com/publications/dnv-views-on-long-term-degradation-of-pv-systems/, accessed October 2025

PV system replacements over the Proposed Development's operating life may amount to a combined further impact that is of a similar magnitude to the initial installation impact.

49 Battery systems are capable of a limited number of charge and discharge cycles before their storage capacity becomes unacceptably degraded. It is likely, therefore, that a battery storage system would need to be replaced at least once during the Proposed Development's operating life.

50 Confidential data from three LFP battery manufacturers provided to the author for a battery storage development project suggests that with a typical charge and discharge cycle, around 15 years of usable life (degrading to around 70% of the as-new storage capacity) can be guaranteed. The Gutsch and Leker study cited above suggests a typical 5,000 cycles before an LFP battery is replaced: at one to two cycles per day, this would mean approximately a seven to 14 year replacement interval. Clearly the actual replacement interval will depend on the charge-discharge cycle frequency of the batteries in use, rate of degradation, and a commercial decision on when to refresh the capacity.

51 Battery technology is likely to continue to improve, which may lead to different technologies/suppliers for replacement in future, and the carbon intensity of manufacturing is likely to be reduced in future. Qualitatively, it can be estimated that the embodied carbon impact of one or more battery replacements over the Proposed Development's operating life may amount to a combined further impact that is of a similar magnitude to the initial installation impact.

52 Lifecycle modules C1-4 concern end-of-life impacts, i.e. emissions from disposal or recycling activity. Some of the published LCAs reviewed do include estimates of this and indicate the potential for an embodied carbon credit from recovering and recycling materials. However, the data is limited and based on existing recycling and manufacturing processes. Qualitatively, recycling materials from the PV panels and batteries at end of life may make a minor reduction to the overall lifecycle embodied carbon impact.

53 The degradation in the generating capacity of solar PV over time has not been additionally assessed. Because PV system capacity, generation and use in the Energy Strategy are general estimates at this design stage, introducing additional assumptions about degradation and whether the initial installed capacity would be over-specified to allow for degradation are matters of detail beyond the available information. The embodied carbon of the initial PV installation has been assessed on the 77.5 MWp value from the Energy Strategy, which represents an annualised yield higher than the annualised building demand, so on this basis already effectively has headroom for degradation.

54 Degradation in the storage capacity of a battery system over time has been notionally accounted for by assuming an initial over-specification of capacity, as explained in the construction section.

Land use change

55 For the new woodland habitat that would be created, the net total vegetation and soil carbon sequestered could amount to 12,844 tCO_2e in total by year 100 taking into account initial set-

up and disturbance effects. This is an estimate of potential long-term benefit: it assumes no thinning as part of the management regime, and of course depends on the created woodland being successful and being retained in perpetuity.

56 Non-woodland habitat would sequester 281 tCO_2e. As a conservative measure, soil carbon sequestration has not been included within the non-woodland habitats on the basis that the baseline position is not necessarily a heavily depleted or zero-carbon soil.

OPERATIONAL CARBON BENCHMARKS

57 Table 6 shows the available energy use intensity benchmarks for operation of the warehouse units provided as part of the Proposed Development. Again, where a benchmark for warehousing specifically does not exist, a benchmark for the nearest alternative is instead shown.

Table 7 Energy use intensity benchmarks and targets

Description and Source	Intensity (kWh/m²/annum)
RIBA new-build office metric: BAU	130
RIBA new-build office metric: 2025 target	75
RIBA new-build office metric: 2030 target	55
LETI 2030 target for offices	55
UKNZCBS: 2030 target for storage and distribution (unconditioned storage)	30
UKNZCBS: 2039 target for storage and distribution (unconditioned storage)	21
UKNZCBS: average of the target for storage and distribution over the 2030-2039 period	25.5

CARBON BUDGETS

58 National- and local-scale carbon budgets, and carbon reduction trajectories or intensity

targets, are used as part of the context for judging the significance of effect resulting from the impact of GHG emissions. This is discussed further in Chapter 17; the data referenced is presented here.

59 Table 7 shows the UK national carbon budgets and rate of reduction relative to the baseline of the budget for the 2018-22 period. The tCO_2e/annum and the percentage reductions have been calculated as a simple average across each five year budget period, not declining year on year within the period, and are shown as originally published (prior to EU ETS credit or any carbon border mechanism adjustment).

Table 8 National carbon budgets

Period	tCO_2e	tCO_2e/annum (simple average)	Reduction against 2018–22 baseline
2018-2022	2,544,000,000	508,800,000	n/a
2023-2027	1,950,000,000	390,000,000	-23%
2028-2032	1,725,000,000	345,000,000	-32%
2033-2037	965,000,000	193,000,000	-62%
2033-2037*	535,000,000	107,000,000	-79%
2035 single year budget	193,000,000	-	-

* *At the time of writing, the seventh carbon budget has not been adopted by the UK Government and remains a recommendation by the Climate Change Committee.*

60 Baseline GHG emissions data is available, disaggregated into local authority areas and for certain economic sectors, of which ‘transport’ is most relevant to this assessment. Tables 8-10 show the 2023 data (latest available) for St Helens, Wigan and Warrington respectively. The ‘total under local authority influence’ excludes emissions from large industrial sites, railways, motorways, land-use, livestock and soils.

Table 9 St Helens baseline GHG emissions (2023)

Period	tCO_2e/annum
Transport	282,341
Total	1,065,676
Total under local authority influence*	985,640

* *Only available as CO_2 (excluding other GHGs)*

Table 10 Wigan baseline GHG emissions (2023)

Period	tCO_2e/annum
Transport	418,842
Total	1,176,685
Total under local authority influence*	1,058,137

* *Only available as CO_2 (excluding other GHGs)*

Table 11 Warrington baseline GHG emissions (2023)

Period	tCO_2e/annum
Transport	577,873
Total	1,245,978
Total under local authority influence*	1,140,729

* *Only available as CO_2 (excluding other GHGs)*

61 The UK's national carbon budgets are broken down into devolved administration targets but not further to a regional or local authority level. However, the Tyndall Centre for Climate Change Research has recommended local authority-specific carbon budgets up to 2100 that, in its research, are considered to be an equitable distribution and compatible with a 1.5°C-aligned trajectory for the UK. The Tyndall Centre carbon budgets sum to being more stringent than the UK national budgets: the recommended budgets for St Helens and Warrington would result in achieving near zero carbon no later than 2041, and for Wigan no later than 2042.

62 This is shown in Table 12 to Table 14. Again the annual figures are a simple average across each five-yearly budget period; the budget figure for the 2030-39 period (Proposed Development construction phase) is 4,600,000 tCO_2e using three years of the 2028-32 period, five of the 2033-2037 period and two from the 2038-2042 period for each of the local authorities.

Table 12 St Helens carbon budgets

Period	tCO_2	tCO_2/annum (simple average)
2023-2027	2,400,000	480,000
2028-2032	1,200,000	240,000
2033-2037	600,000	120,000
2038-2042	300,000	60,000

Table 13 Wigan carbon budgets

Period	tCO_2	tCO_2/annum (simple average)
2023-2027	2,800,000	560,000
2028-2032	1,400,000	280,000
2033-2037	700,000	140,000
2038-2042	300,000	60,000

Table 14 Warrington carbon budgets

Period	tCO_2	tCO_2/annum (simple average)
2023-2027	2,800,000	560,000
2028-2032	1,300,000	260,000
2033-2037	600,000	120,000
2038-2042	300,000	60,000