



## **Great North Road Solar and Biodiversity Park**

Environmental Statement

Volume 4 – Technical Appendices

Technical Appendix A15.1 – Lifecycle Greenhouse Gas Evaluation

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### A15.1.1 SUMMARY

- 1 A note on precision: For ease of interpretation and to minimise risk of providing greater precision than accuracy, numbers in this document have been rounded to three significant figures or the decimal point, whichever gives the greater precision, with the exception of the emissions factor. Rounding errors are therefore of the order of 0.1% or less, which would not affect the conclusions of the assessment.

**Table A15.1.1 – Summary of Emissions Produced (Worst-Case Scenario)**

Development Phase	Total Emissions (teCO <sub>2e</sub> )
Production Emissions – Material	1,957,095
Production Emissions - Transport	377,812
Construction Emissions - Waste	1,492
Construction Emissions - Other	3,619
Operational Emissions	1,183
Operational Emissions – Waste Transport	391
Sheep – Methane	43,421
Sheep – Water	51
Equipment Replacement	800,253
Decommissioning – Waste	952
Decommissioning – Waste Transport	4,376
Decommissioning – Other	3,619
<b>Total</b>	<b>3,194,264</b>

**Table A15.1.2 – Summary of Emissions Savings (with 2024 grid carbon intensity baseline for solar PV)**

Development Phase	Total Emissions (teCO <sub>2e</sub> )
Land Use Change	44,218
Solar PV Generation	6,503,763
BESS	3,246,690
<b>Total</b>	<b>9,794,671</b>

**Table A15.1.3 – Summary of Emissions Savings (Worst-Case Scenario)**

Development Phase	Total Emissions (teCO <sub>2e</sub> )
Land Use Change	44,218
Solar PV Generation	692,648
BESS	3,246,690
<b>Total</b>	<b>3,983,556</b>

**Table A15.1.4 - Summary of Net Emissions (with 2024 grid carbon intensity baseline for solar PV)**

Total Emissions	Total Emissions (teCO <sub>2e</sub> )
Total Emissions Produced	3,194,264
Total Emissions Saved	(-) 9,794,671
<b>Net Emissions</b>	<b>(-) 6,600,408</b>

**Table A15.1.5 – Summary of Net Emissions (Worst-Case Scenario)**

Total Emissions	Total Emissions (teCO <sub>2e</sub> )
Total Emissions Produced	3,194,264
Total Emissions Saved	(-) 3,983,556
<b>Net Emissions</b>	<b>(-) 789,292</b>

## A15.1.2 ASSESSMENT

**Table A15.1.6 – Production Emissions**

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Battery storage (BESS) Cells	880,000	kWh (Storage capacity)	89	Forbes (2020). Estimating the carbon footprint of utility scale battery storage. <sup>1</sup>	313,280	Based on a 440 MW/2-hour BESS. It is possible that the BESS will have a higher MWh storage capacity, however, this is considered the worst-case outcome for climate change due to the beneficial carbon avoidance associated with the BESS, see table A15.1.21.  Augmentation of an overall 50% of capacity will take place over the lifetime of the project (30 years). System expected to weigh around 2 tonnes per MWh (pure battery cells).

<sup>1</sup> Rapier (2020). Estimating The Carbon Footprint of Utility Scale Battery Storage. [Online]. Available at: <https://www.forbes.com/sites/rrapier/2020/02/16/estimating-the-carbon-footprint-of-utility-scale-battery-storage/>. (Accessed 05/03/2025).

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
PV Panels	1,120,000	kWp installed capacity	701	Louwen, van Sark, Faaij & Schropp (2016). Re-assessment of net energy production and greenhouse gas emissions avoidance after 40 years of photovoltaics development. <sup>2</sup>	785,120	Take 0.020 kg CO <sub>2</sub> /kWh (data from 2018, downward trend so likely over-estimate). Assume conservative 10% capacity factor for 40-year operational life
PV Inverters	800,000	kW	65.31	Rajput & Singh (2017). Reduction in CO <sub>2</sub> emission through photovoltaic system: a case study. <sup>3</sup>	52,248	Based on 800 MW(AC) capacity.
PV Framework (steel) (Chinese blast furnace steel)	44,800	Tonnes of steel (stainless )	4,180	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	187,264	Approx 40 tonnes steel per MWp-dc PV capacity, various data sources. Assumes 100% stainless steel.

<sup>2</sup> Louwen, van Sark, Faaij & Schropp (2016). Re-assessment of net energy production and greenhouse gas emissions avoidance after 40 years of photovoltaics development. Nature Communications. [Online]. Available at: <https://core.ac.uk/download/pdf/161700754.pdf>. (Accessed 05/03/2025).

<sup>3</sup> Rajput & Singh (2017). Reduction in CO<sub>2</sub> Emission through Photovoltaic System: A Case Study. [Online]. Available at: [https://www.researchgate.net/publication/327832806\\_Reduction\\_in\\_CO2\\_Emission\\_through\\_Photovoltaic\\_System\\_A\\_Case\\_Study](https://www.researchgate.net/publication/327832806_Reduction_in_CO2_Emission_through_Photovoltaic_System_A_Case_Study). (Accessed 05/03/2025).

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
PV framework (aluminium)	23,520	Tonnes of aluminium	14,600	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	343,392	Approx 21 tonnes Aluminium per MWp-dc PV capacity, various data sources. Sourced from China.
BESS Inverters	440,000	kW	65.31	Rajput & Singh (2017). Reduction in CO <sub>2</sub> emission through photovoltaic system: a case study. <sup>3</sup>	28,736	Based on 440 MW maximum capacity.
Transformers - steel	510	Tonnes of Steel	2,570	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	1,311	Assumes emissions from manufacturing transformers are negligible (less than 1%). This is unlikely to be true for an individual transformer, but very likely for the whole Development (1% of total emissions would be c. 14,000 tCO <sub>2</sub> ). Assumes steel will be 'finished cold-rolled coil steel', as the best estimate

<sup>4</sup> Circular Ecology (2024). Embodied Carbon - The ICE Database v4, 2024. Available at: <https://circularecology.com/embodied-carbon-footprint-database.html>. (Accessed 05/03/2025).

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
						of kg CO <sub>2</sub> e from the ICE database.
Transformers - oil (mineral)	255	Tonnes of Oil	1,401	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024. <sup>5</sup>	357	The tonnes of mineral oil have been estimated by client's construction team.
Security fence (substations)	48.82	Tonnes of Steel (galvanised)	2,710	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	132	6 km of fencing. 3 m each. 2000 units total. 25.04 kg each - 50,080 kg total or 50.08 tonnes. <sup>6</sup>
Paint (security fence)	561.75	kg of paint	3,760	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	2,112	Approximate total area of fence <sup>6</sup> calculated at 1.07 m <sup>2</sup> . 2000 units, 2,142.29 m <sup>2</sup> . Assumes 1 L covers 5 m <sup>2</sup> (2,142.29/5). Assumes 1.5 kg/l. Emissions factor is based on ICE solvent-based paint.

<sup>5</sup> Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024. Available at: [Greenhouse gas reporting: conversion factors 2024 - GOV.UK](https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024). (Accessed 05/03/2025).

<sup>6</sup> First Fence (2025). 1.8m High Stripe Mesh Security Fencing Kit. [Online]. Available at: <https://firstfence.co.uk/1-8m-high-stripe-mesh-security-fencing?srltid=AfmBOoo3rRhcw-P6Ag8q-VqucxQkdDvWCm7J4XGVPI2Lhl5nslI38yUd>. (Accessed 28/05/2025).



Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Storage Containers (steel)	1,659	Tonnes of Steel	2,570	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	4,263	Assumes the worst case of 754 containers, weighing 2.2 tonnes each <sup>7</sup> . Assumes steel with be 'finished cold-rolled coil steel' as the best estimate of kg CO <sub>2</sub> e from the ICE database.
Concrete pad and foundations	540	Tonnes of concrete	103	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	56	Weight assuming minimal use (plinths) at BESS and foundations under substation infrastructure and transformers. Thickness of foundation assumed at 300mm based on weight supporting requirements, meaning 720 kg per m <sup>2</sup> . Approximately 750 m <sup>2</sup> assumed across the site. Assumed to be general concrete produced by the British Ready-Mixed Concrete Associated (BRMCA). Mixture is 200 kg CEM I, 95 kg ground

<sup>7</sup> ASLG (2025) 20ft, 40ft, and 40HC Container Size, Capacity and Payload. [Online]. Available at: <https://www.airsupplycn.com/20ft-40ft-container/>. (Accessed on 01/06/2025).

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
						granulated blast furnace slag (ggbs), 15 kg fly ash, 1,915 kg aggregate, 139 kg water and 1.55 kg admixture.
Steel containers	80	Tonnes of steel	2,570	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	206	For communications, staff and general structures. Approximate figure assuming 40 20ft containers used around the site, weighing 2 tonnes each. Assumes steel will be 'finished cold-rolled coil steel', as the best estimate of kg CO <sub>2</sub> e from the ICE database.
Substation (steel)	2,800	Tonnes of steel	2,570	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	7,196	Based on 400 tonnes per 33/132kV substation and 1200 tonnes for the 132/400kv substation. The tonnage of steel in the substations has been estimated by client's construction team. Assumes steel will be 'finished cold-rolled coil

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
						steel', as the best estimate of kg CO <sub>2</sub> e from the ICE database
Deer fence	152.6	Tonnes of Steel (galvanised)	2,710	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	414	110 kg/100 m for steel deer fence. Based on a maximum 150 km of fencing required. 100 m/roll, 1,500 rolls. 163,500 kg. <sup>8</sup>
Deer fence poles	116.67	Tonnes of wood	493	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	58	A maximum of 150 km of fencing. One pole every 3 m. 50,000 poles. 2.1 m pole, 2.5 kg per pole. 125,000 kg <sup>9</sup>

<sup>8</sup> Ultimate One (2025). FX13/190/15 Deer Fencing Mesh - High Tensile ~ 190cm x 100m – British. [Online]. Available at: <https://www.ultimate-one.co.uk/fx1319015-deer-fencing-mesh-high-tensile-190cm-100m-british-p-1640>. (Accessed 28/05/2025).

<sup>9</sup> Sure Green (2025). Green Treated Machine-Round Fence Post. [Online]. Available at: <https://www.sure-green.com/catalog/product/view/id/353/s/wooden-fencing-posts/category/840/>. (Accessed 28/05/2025).

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Access tracks (Grit)	58,050,000	kg	0.00747	Inventory of Carbon and Energy (ICE) Version 3 <sup>10</sup>	434	43 km of tracks, 4.5 m wide, 15 cm deep. 28,350 m <sup>3</sup> @ 2,000 kg/m <sup>3</sup> .  The emissions factor from ICE v3 has been used as a best estimate, as it was not included within ICE v4.
Access Tracks Tarmac	4,320,000	kg	52.2	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	225,504	2 km at 4.5m width and 20 cm depth = 1,800 m <sup>3</sup> and 2.4 t/m <sup>3</sup> weight. CO <sub>2</sub> e figure Assuming asphalt 4% binder content.
Concrete	100,000	kg	0.103	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	10	Assumed to be general concrete produced by the British Ready-Mixed Concrete Associated (BRMCA). Mixture is 200 kg CEM I, 95 kg ggbs, 15 kg fly ash, 1,915 kg aggregate, 139 kg water and 1.55 kg admixture. Approximate amount, (100 tonnes)

<sup>10</sup> Circular Ecology (2019). Embodied Carbon - The ICE Database v3, 2019. Available at: <https://circularecology.com/embodied-carbon-footprint-database.html>. (Accessed 01/10/2024). No longer available.

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
						excluding concrete in pad and foundations covered in a separate row of this table.
Aggregate	36,000,000	kg	0.00747	Inventory of Carbon and Energy (ICE) Version 3 <sup>10</sup>	269	Based on an estimate of market average aggregate. Unbound stone for construction compounds. 32 (based on access tracks) construction compounds, 50 m by 75 m each, 15 cm depth) (2 tonnes per m <sup>3</sup> of aggregate). The emissions factor from ICE v3 has been used as a best estimate, as it was not included within ICE v4.
Cabling - Copper	736,165	kg	2.71	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	1,995	Estimated by the Applicant's construction team.

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Cabling - Tin	12,145	kg	14.47	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	176	Estimated by the Applicant's construction team.
Cabling - Polyethylene	351,235	kg	2.9	Benavides, Lee, & Zarè-Mehrjerdi (2020). Life cycle greenhouse gas emissions and energy use of polylactic acid, bio-derived polyethylene, and fossil-derived polyethylene. <sup>11</sup>	1,019	Estimated by the Applicant's construction team. General Polyethylene.
Cabling - Polypropylene	114,955	kg	4.77	CarbonCloud (2024). Plastic, PP resin, fossil based. <sup>12</sup>	548	Estimated by the Applicant's construction team. Polypropylene.

<sup>11</sup> Benavides, Lee, & Zarè-Mehrjerdi (2020). Life cycle greenhouse gas emissions and energy use of polylactic acid, bio-derived polyethylene, and fossil-derived polyethylene. Journal of Cleaner Production. Vol 277. Available at: Life cycle greenhouse gas emissions and energy use of polylactic acid, bio-derived polyethylene, and fossil-derived polyethylene - ScienceDirect.

<sup>12</sup> CarbonCloud (2024). Plastic, PP resin, fossil based. [Online]. Available at: <https://apps.carboncloud.com/climatehub/product-reports/id/128828874513#:~:text=%E2%80%9DPlastic%2C%20PP%20resin%2C%20fossil,of%204.77%20kg%20CO%E2%82%82e%2Fkg>. (Accessed 05/03/2025).

Embodied Carbon - Component/Material	Activity Data	Units	Emission factor, kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Cabling - thermal sand	133,325	Tonnes of sand	7.47	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	996	Estimated by the Applicant's construction team.
<b>Total</b>					<b>1,957,095</b>	

**Table A15.1.7 – Materials Transport Emissions**

<b>Transport - Component or material and mode of transport</b>	<b>Mass in tonnes</b>	<b>Distance in km</b>	<b>Emissions factor, kg CO<sub>2</sub>e per tonne.km</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
Battery storage (BESS) Cells; HGV (within China)	7,644	30	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	55	Guandong to Yantian International Container Terminal (Shenzhen)
Battery storage (BESS) Cells; sea	7,644	19600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	19,476	Approximately 8.686 tonnes per MWh based on spec sheet provided by BYD.
Battery storage (BESS) Cells; HGV	7,644	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	440	Estimated by the Applicant's construction team.
PV Panels; HGV (within China)	58,585	500	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	7,030	Approximately 500 km from Xinjiang province to Shanghai by train.



Transport - Component or material and mode of transport	Mass in tonnes	Distance in km	Emissions factor, kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
PV Panels; train (within China)	58,585	4,000	0.02779	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	6,512	Approximately 4,000 km from Xinjiang province to Shanghai by train.
PV Panels; sea	58,585	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	149,274	Assuming 34 kg per 650-watt panel (average between Trina, Sunway & Canadian Solar Panels).
PV Panels; HGV	58,585	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	3,374	Estimated by the Applicant's construction team.
PV Inverters; HGV (within China)	444	449	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	48	Distance from Anhui (world's largest cluster of inverter manufacturers) to Shanghai Port by road.

Transport - Component or material and mode of transport	Mass in tonnes	Distance in km	Emissions factor, kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
PV Inverters; sea	444	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,130	Based on Sungros SG250HX 250 kW string inverter, 99kg rated at 250 kW (0.396 kg/kW).
PV Inverters; HGV	444	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	26	Estimated by the Applicant's construction team.
PV framework; HGV (within China)	44,800	13	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	140	Xiamen Torch Hi-tech zone to Port of Xiamen.
PV framework (steel); sea	44,800	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	114,150	Approx 40 tonnes steel per MWp-dc PV capacity, various data sources.

<b>Transport - Component or material and mode of transport</b>	<b>Mass in tonnes</b>	<b>Distance in km</b>	<b>Emissions factor, kg CO<sub>2</sub>e per tonne.km</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
PV framework (steel); HGV	44,800	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	2,580	Estimated by the Applicant's construction team.
PV framework (aluminium); HGV (within China)	23,520	214	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,208	Distance from Linqu Country, Weifang City (aluminium capital of china) to Port of Qingdao.
PV framework (aluminium); sea	23,520	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	59,929	Estimated by the Applicant's construction team.
PV framework (aluminium); HGV	23,520	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,355	Approx 21 tonnes Aluminium per MWp-dc PV capacity, various data sources.

<b>Transport - Component or material and mode of transport</b>	<b>Mass in tonnes</b>	<b>Distance in km</b>	<b>Emissions factor, kg CO<sub>2</sub>e per tonne.km</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
BESS Inverter; HGV (within China)	2,640	449	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	284	Hefei, Anhui Province to Port of Shanghai.
BESS Inverters; sea	2,640	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	6,727	Estimated by the Applicant's construction team.
BESS Inverters; HGV	2,640	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	152	PCS + MV Skid (including inverters) shown in tech sheet at 30 tonnes per 5MW unit - so 6 kg/kw).
Transformers Steel; HGV (within China)	510	273	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	33	Distance from Zhejiang province to Ningbo Port.

<b>Transport - Component or material and mode of transport</b>	<b>Mass in tonnes</b>	<b>Distance in km</b>	<b>Emissions factor, kg CO<sub>2</sub>e per tonne.km</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
Transformers Steel; Shipping	510	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,299	Estimated by the Applicant's construction team.
Transformers Steel; HGV	510	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	29	Estimated by the Applicant's construction team.
Transformers Mineral Oil; HGV (within China)	255	281	0.02779	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	2	Distance from Zhejiang province to Ningbo Port.
Transformers Mineral Oil; Shipping	255	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	650	Estimated by the Applicant's construction team.

<b>Transport - Component or material and mode of transport</b>	<b>Mass in tonnes</b>	<b>Distance in km</b>	<b>Emissions factor, kg CO<sub>2</sub>e per tonne.km</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
Transformers Mineral Oil; HGV	255	19,600	0.13	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	650	Estimated by the Applicant's construction team.
Storage containers	440	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	96	Estimated by the Applicant's construction team.
Substation	2,800	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	161	Estimated by the Applicant's construction team.
Fencing and gates	339	240	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	20	Estimated by the Applicant's construction team Deer fencing, deer fence poles, and security fencing.
Concrete; HGV	100	150	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas	4	Estimated by the Applicant's construction team.

Transport - Component or material and mode of transport	Mass in tonnes	Distance in km	Emissions factor, kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
				Reporting: Conversion Factors, 2024 <sup>5</sup>		
Aggregate; HGV	36,000	100	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	864	Assume 100 km for aggregate transport - likely much less than this.
Cabling; HGV	1,348	350	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	113	Estimated by the Applicant's construction team.
<b>Total</b>					<b>377,812</b>	

**Table A15.1.8 – Construction Waste and Transport Emissions**

<b>Construction Waste - Component and Method</b>	<b>Activity data</b>	<b>Units</b>	<b>Emissions factor kg CO<sub>2</sub>e per unit</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
Concrete; landfill	0	Tonnes	1.23393	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.
Concrete; recycled	0	Tonnes	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.
Aggregate; landfill	0	Tonnes	1.23393	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.
Aggregate; recycled	94,050	Tonnes	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	92.6	All construction compounds and temporary access tracks are removed following construction. Tarmac track will remain.



Construction Waste - Component and Method	Activity data	Units	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Steel; recycled	0	Tonnes	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.
Aluminium; recycled	0	Tonnes	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.
Plastic; landfill	1	Tonnes	8.88386	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0.00888	Minimal or no waste is anticipated.
Plastic; recycled	0	Tonnes	6.41061	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.

Construction Waste - Component and Method	Activity data	Units	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Paperboard; recycling	0	Tonnes	6.41061	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Closed loop. Minimal or no waste is anticipated.
Wood; landfill	0	Tonnes	925.24423	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Minimal or no waste is anticipated.
Wood; recycling	5	Tonnes	6.41061	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0.0321	Based on an emissions factor for the closed loop recycling of wood, where the product is recycled back into the same product.
Worker waste	100	Tonnes	497.04416	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	49.7	Assumes 0.5 kg of waste per day per worker. 400 workers for 500 days. Assumes an emissions factor of household waste.

Construction Waste - Component and Method	Activity data	Units	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Total water consumption	18,000	m3	0.18574	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	3	90 L of water per worker per day. 400 workers for 500 days.
Waste transport	5,607,800	Tonne.km	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,346	Sum of tonnes, multiplied by 50 km multiplied by emissions factor.
<b>Total</b>					<b>1,492</b>	

**Table A15.1.9 – Construction Other**

Construction Other	Activity data	Units	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Worker commuting (total car journeys)	8,000,000	km	0.16691	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,335	Assuming 400 workers, average of 1.5 workers per car, average of 60 km round trip distance per day and 500 total days of construction.
Total fuel consumption – Plant	520,000	Litres	2.75541	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,433	Plant and machinery are assumed to consume 5,000 L of diesel per week across full construction period of 2 years.
Total fuel consumption - generators	308,880	Litres	2.75541	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	851	Generators are assumed to consume 16.5 litres per hour, 6 hours a day, 26 days a month. An average of 5 generators assumed to be running throughout the 2-year construction period.
<b>Total</b>					<b>3,619</b>	

**Table A15.1.10 – Land Use Change: Baseline Habitat**

Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2e</sub> )	Reference
Cereal and non-cereal crops	1,482	Arable / cultivated land	120	No vegetation stocks are given - as management (grazing and cutting) removes biomass annually	177,816	652,051	Natural England (2014) <sup>13</sup>
Arable Field margins tussocky, temporary grass and clover leys, other neutral grassland	32.4	Neutral grassland (soil depth 15 cm)	60	No data	1,944	7,129	Natural England (2014) <sup>13</sup>
Mixed scrub, bramble, blackthorn, hawthorn scrubs	5.6	Scrubs	72	60	739	2,711	Natural England (2014) <sup>13</sup>
Modified Grassland	187	Improved Grassland	130	No vegetation stocks are given - as management (grazing	24,245	88,806	Natural England (2014) <sup>13</sup>

<sup>13</sup> Natural England (2021). Carbon Storage and Sequestration by Habitat 2021 (NERR094). Available at: [Carbon Storage and Sequestration by Habitat 2021 - NERR094](#)

Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2e</sub> )	Reference
				and cutting) removes biomass annually			
Wet Woodland, Lowland mixed deciduous, other broadleaved woodland	28.3	30-year mixed broadleaved native wood	55	114	4,783	17,538	Natural England (2014) <sup>13</sup>
Other	31.4		98.7	21.4	3,771	13,829	Natural England (2014) <sup>13</sup>
<b>Total</b>	<b>1,766</b>				<b>Total</b>	<b>782,164</b>	

**Table A15.1.11 – Land Use Change: Habitat Lost in Development**

Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2</sub> e)	Reference
Cereal and non-cereal crops	1,338	Arable / cultivated land	120	No vegetation stocks are given - as management (grazing and cutting) removes biomass annually	160,704	589,248	Natural England (2014) <sup>13</sup>
Arable Field margins tussocky, temporary grass and clover leys, other neutral grassland	32.4	Neutral grassland (soil depth 15 cm)	60	No data	1,944	7,129	Natural England (2014) <sup>13</sup>
Mixed scrub, bramble, blackthorn, hawthorn scrubs	0	Scrubs	72	60	0	0	Natural England (2014) <sup>13</sup>
Modified Grassland	0	Improved Grassland	130	No vegetation stocks are given - as management (grazing and cutting) removes biomass annually	0	0	Natural England (2014) <sup>13</sup>

Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2e</sub> )	Reference
Wet Woodland, Lowland mixed deciduous, other broadleaved woodland	0	30-year mixed broadleaved native wood	55	114	0	0	Natural England (2014) <sup>13</sup>
Other	0		98.7	21.4	0	0	Natural England (2014) <sup>13</sup>
TOTAL	1,370				Total	595,876	
Notes: The Carbon stock has been converted to CO <sub>2e</sub> using the standard converter 1 tC = 3.667 tCO <sub>2e</sub> .							

**Table A15.1.12– Land Use Change: Habitat Created Post Development**

Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2e</sub> )	Reference
Cereal and non-cereal crops	0	Arable / cultivated land	120	No vegetation stocks are given - as management (grazing and cutting) removes biomass annually	0	0	Natural England (2014) <sup>13</sup>



Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2e</sub> )	Reference
Arable Field margins tussocky, temporary grass and clover leys, other neutral grassland	0	Neutral grassland (soil depth 15 cm)	60	No data	0	0	Natural England (2014) <sup>13</sup>
Mixed scrub, bramble, blackthorn, hawthorn scrubs	17.8	Scrubs	72	60	2,351	8,621	Natural England (2014) <sup>13</sup>
Modified Grassland	1,271	Improved Grassland	130	No vegetation stocks are given - as management (grazing and cutting) removes biomass annually	165,247	605,960	Natural England (2014) <sup>13</sup>
Wet Woodland, Lowland mixed deciduous, other broadleaved woodland	13.8	30-year mixed broadleaved native wood	55	114	2,339	8,579	Natural England (2014) <sup>13</sup>

Habitat type	Hectares	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Equivalent CO <sub>2</sub> if released (tCO <sub>2</sub> e)	Reference
Other	38.5		98.7	21.4	4,618	16,934	Natural England (2014) <sup>13</sup>
<b>TOTAL</b>	<b>1,341</b>				<b>Total</b>	<b>640,094</b>	

**Table A15.1.13 – Land Use Change Summary: Net CO<sub>2</sub>e released.**

Habitat loss in CO <sub>2</sub> e if released (tCO <sub>2</sub> e)	595,876
Habitat gained in CO <sub>2</sub> e if released (tCO <sub>2</sub> e)	640,094
<b>Net change in CO<sub>2</sub>e if released (tCO<sub>2</sub>e)</b>	<b>44,218*</b>

\* Positive number means a net store of carbon.

**Table A15.1.14 – Operational Emissions**

- 2 Operational emissions from the maintenance of the Development are estimated below, based on a single on-site warehouse estimated to have a continuous electricity draw of 10 kW, supplied by the national grid, amounting to 87,600 kWh per year. It is estimated that there will be 60 members of staff, but only 30 will attend the Development each day for 300 days of the year, with two people commuting per car for an average of 60 km, totalling 270,000 km across the year. Each employee is estimated to use 90 L of water a day and produce 0.5 kg of waste.

#	Year	Commercial/Public Section Consumption-Based Grid Average Carbon Intensity (kg CO <sub>2</sub> e/kWh)	On Site Warehouse Power Draw (10 kW continuous) (kWh)	Energy Consumption Based Emissions (tonnes CO <sub>2</sub> e)	30 Employees commuting an average of 60 km daily in 15 vehicles (300 days of year) @ average of 100 gCO <sub>2</sub> e/km* (tonnes CO <sub>2</sub> e)	Water use and treatment of 90L each for 30 workers for 300 days (tonnes CO <sub>2</sub> e)	Food and drink waste of 0.5 kg each for 30 workers for 300 days (tonnes CO <sub>2</sub> e)	Total Embodied Carbon Emissions (tonnes CO <sub>2</sub> e)
1	2028	0.0964	87600	0.00844	27	0.34	2.24	29.6
2	2029	0.0718	87600	0.00629	27	0.34	2.24	29.6
3	2030	0.0623	87600	0.00545	27	0.34	2.24	29.6
4	2031	0.0526	87600	0.00461	27	0.34	2.24	29.6
5	2032	0.0485	87600	0.00425	27	0.34	2.24	29.6
6	2033	0.0408	87600	0.00357	27	0.34	2.24	29.6
7	2034	0.0321	87600	0.00281	27	0.34	2.24	29.6
8	2035	0.0255	87600	0.00223	27	0.34	2.24	29.6
9	2036	0.0205	87600	0.00180	27	0.34	2.24	29.6
10	2037	0.0198	87600	0.00173	27	0.34	2.24	29.6
11	2038	0.0193	87600	0.00169	27	0.34	2.24	29.6

#	Year	Commercial/Public Section Consumption-Based Grid Average Carbon Intensity (kg CO <sub>2</sub> e/kWh)	On Site Warehouse Power Draw (10 kW continuous) (kWh)	Energy Consumption Based Emissions (tonnes CO <sub>2</sub> e)	30 Employees commuting an average of 60 km daily in 15 vehicles (300 days of year) @ average of 100 gCO <sub>2</sub> e/km* (tonnes CO <sub>2</sub> e)	Water use and treatment of 90L each for 30 workers for 300 days (tonnes CO <sub>2</sub> e)	Food and drink waste of 0.5 kg each for 30 workers for 300 days (tonnes CO <sub>2</sub> e)	Total Embodied Carbon Emissions (tonnes CO <sub>2</sub> e)
12	2039	0.0180	87600	0.00158	27	0.34	2.24	29.6
13	2040	0.0176	87600	0.00154	27	0.34	2.24	29.6
14	2041	0.0165	87600	0.00145	27	0.34	2.24	29.6
15	2042	0.0157	87600	0.00138	27	0.34	2.24	29.6
16	2043	0.0150	87600	0.00131	27	0.34	2.24	29.6
17	2044	0.0142	87600	0.00125	27	0.34	2.24	29.6
18	2045	0.00896	87600	0.000785	27	0.34	2.24	29.6
19	2046	0.00833	87600	0.000730	27	0.34	2.24	29.6
20	2047	0.00774	87600	0.000678	27	0.34	2.24	29.6
21	2048	0.00757	87600	0.000663	27	0.34	2.24	29.6
22	2049	0.00523	87600	0.000458	27	0.34	2.24	29.6
23	2050	0.00509	87600	0.000446	27	0.34	2.24	29.6
24	2051	0.00323	87600	0.000283	27	0.34	2.24	29.6
25	2052	0.00246	87600	0.000215	27	0.34	2.24	29.6
26	2053	0.00246	87600	0.000215	27	0.34	2.24	29.6
27	2054	0.00246	87600	0.000215	27	0.34	2.24	29.6

#	Year	Commercial/Public Section Consumption-Based Grid Average Carbon Intensity (kg CO <sub>2</sub> e/kWh)	On Site Warehouse Power Draw (10 kW continuous) (kWh)	Energy Consumption Based Emissions (tonnes CO <sub>2</sub> e)	30 Employees commuting an average of 60 km daily in 15 vehicles (300 days of year) @ average of 100 gCO <sub>2</sub> e/km* (tonnes CO <sub>2</sub> e)	Water use and treatment of 90L each for 30 workers for 300 days (tonnes CO <sub>2</sub> e)	Food and drink waste of 0.5 kg each for 30 workers for 300 days (tonnes CO <sub>2</sub> e)	Total Embodied Carbon Emissions (tonnes CO <sub>2</sub> e)
28	2055	0.00246	87600	0.000215	27	0.34	2.24	29.6
29	2056	0.00246	87600	0.000215	27	0.34	2.24	29.6
30	2057	0.00246	87600	0.000215	27	0.34	2.24	29.6
31	2058	0.00246	87600	0.000215	27	0.34	2.24	29.6
32	2059	0.00246	87600	0.000215	27	0.34	2.24	29.6
33	2060	0.00246	87600	0.000215	27	0.34	2.24	29.6
34	2061	0.00246	87600	0.000215	27	0.34	2.24	29.6
35	2062	0.00246	87600	0.000215	27	0.34	2.24	29.6
36	2063	0.00246	87600	0.000215	27	0.34	2.24	29.6
37	2064	0.00246	87600	0.000215	27	0.34	2.24	29.6
38	2065	0.00246	87600	0.000215	27	0.34	2.24	29.6
39	2066	0.00246	87600	0.000215	27	0.34	2.24	29.6
40	2067	0.00246	87600	0.000215	27	0.34	2.24	29.6
<b>Total</b>								<b>1,183</b>

**Table A15.1.15 – Operational Waste, Transport**

Operational Waste - Transport	Activity data	Units	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Waste transport	1,629,000	Tonne.km	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	391	Assumes 30 workers per day for 300 days a year. Includes 32,400 tonnes of water and 180 tonnes of waste. Sum of tonnes, multiplied by 50 km multiplied by emissions factor.
<b>Total</b>					<b>391</b>	

**Table A15.1.16 – Methane Emissions from Sheep**

Sheep type	Number of sheep	Number of days on Site	Data source	Methane per day (in kg/CO <sub>2</sub> e)	Total Methane over 40 years (tCO <sub>2</sub> e)	Assumptions
Ewe	4,000	365	Scottish Government (2021) Greenhouse gas inventory: estimated sheep emissions and their mitigation <sup>14</sup>	0.55890411	32640	Assumes 204 kg CO <sub>2</sub> e per year per sheep Assumes 4,000 ewes on Site all year.
Lamb	5,600	183	Scottish Government (2021) Greenhouse gas inventory: estimated sheep emissions and their mitigation <sup>14</sup>	0.263013699	10781	Assumes 96 kg CO <sub>2</sub> e per year per lamb Assumes 5,600 lambs on site between April and September.
<b>Total</b>					<b>43,421</b>	

<sup>14</sup> Scottish Government (2021) Greenhouse gas inventory: estimated sheep emissions and their mitigation. [Online]. Available at: <https://www.gov.scot/publications/estimated-sheep-emissions-mitigation-smart-inventory/>. (Accessed 28/05/2025).

**Table A15.1.17 – Emissions from Sheep Care, Water**

Sheep type	Number of sheep	Number of days on Site (per year)	Water consumption (per day in litres)	Total water usage (m <sup>3</sup> ) (40 years)	Carbon per m <sup>3</sup> (in kg/CO <sub>2</sub> e)	Data source	Total Emissions (tCO <sub>2</sub> e)	Assumptions
Ewe	4,000	365	2.75	160,600	0.18574	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	30	Assumes 4,000 ewes on Site all year. Assumed 2.75 litres per day <sup>15</sup> .
Lamb	5,600	183	2.75	112,728	0.18574	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	21	Assumes 5,600 lambs on site between April and September. Assumed 2.75 litres per day <sup>15</sup> .
<b>Total</b>							<b>51</b>	

<sup>15</sup> AHDB (2025) Effective Use of Water on Dairy Farms, The Dairy Farm DIY Full Water Audit Pack. [Online]. Available at: <https://projectblue.blob.core.windows.net/media/Default/Tools/Tool%20Download/thedairyfarmdiyfullwaterauditpack.pdf>. (Accessed on 28/05/2025).



**Table A15.1.18 – Component Replacement**

Item	Design life replacement rate	Original embodied emissions (tCO <sub>2</sub> e)	Original transport emissions (tCO <sub>2</sub> e)	Replacement embodied and transport emissions (tCO <sub>2</sub> e)
Transformers	5%	1,668	2,664	217
PV Panels	10%	785,120	166,190	95,131
Panel Supports	10%	530,656	179,362	71,002
PV Inverter	150%	52,248	1,203	80,177
BESS Inverter	150%	28,736	7,163	53,850
BESS cells	150%	313,280	19,971	499,877
<b>Total</b>				<b>800,253</b>

**Table A15.1.19 – Solar PV Carbon Savings**

#	Year	Generation-based long-run marginal Carbon Intensity (kgCO <sub>2</sub> e/kWh)	Annual Energy Production (MWh)	Estimate charged to BESS (MWh)	Solar Energy to Grid (MWh)	Carbon Avoidance (tonnes CO <sub>2</sub> e)
1	2026	0.174	560,549	264,829	295,719	51,485
2	2027	0.154	837,460	256,885	580,575	89,525
3	2028	0.133	1,112,147	249,178	862,969	114,602
4	2029	0.110	1,107,698	241,703	865,996	95,000
5	2030	0.085	1,103,267	234,452	868,816	73,849
6	2031	0.0652	1,098,854	227,418	871,436	56,818
7	2032	0.0501	1,094,459	220,595	873,863	43,781
8	2033	0.0384	1,090,081	213,978	876,103	33,642
9	2034	0.0295	1,085,721	207,558	878,162	25,906
10	2035	0.0226	1,081,378	264,829	816,548	18,454
11	2036	0.0174	1,077,052	256,885	820,168	14,271
12	2037	0.0133	1,072,744	249,178	823,566	10,953
13	2038	0.0102	1,068,453	241,703	826,751	8,433
14	2039	0.0079	1,064,179	234,452	829,728	6,555
15	2040	0.006	1,059,923	227,418	832,505	4,995
16	2041	0.0057	1,055,683	220,595	835,087	4,760
17	2042	0.0036	1,051,460	213,978	837,483	3,015
18	2043	0.0028	1,047,254	207,558	839,696	2,351

#	Year	Generation-based long-run marginal Carbon Intensity (kgCO <sub>2</sub> e/kWh)	Annual Energy Production (MWh)	Estimate charged to BESS (MWh)	Solar Energy to Grid (MWh)	Carbon Avoidance (tonnes CO <sub>2</sub> e)
19	2044	0.002	1,043,065	201,332	841,734	1,683
20	2045	0.0013	1,038,893	264,829	774,064	1,006
21	2046	0.0013	1,034,738	256,885	777,853	1,011
22	2047	0.0013	1,030,599	249,178	781,421	1,016
23	2048	0.0014	1,026,476	241,703	784,774	1,099
24	2049	0.0014	1,022,370	234,452	787,919	1,103
25	2050	0.0013	1,018,281	227,418	790,863	1,028
26	2051	0.0023	1,014,208	220,595	793,612	1,825
27	2052	0.0023	1,010,151	213,978	796,173	1,831
28	2053	0.0023	1,006,110	207,558	798,552	1,837
29	2054	0.0023	1,002,086	201,332	800,754	1,842
30	2055	0.0023	998,077	264,829	733,248	1,686
31	2056	0.0023	994,085	256,885	737,201	1,696
32	2057	0.0023	990,109	249,178	740,931	1,704
33	2058	0.0023	986,148	241,703	744,446	1,712
34	2059	0.0023	982,204	234,452	747,752	1,720
35	2060	0.0023	978,275	227,418	750,857	1,727
36	2061	0.0023	974,362	220,595	753,766	1,734
37	2062	0.0023	970,464	213,978	756,487	1,740

#	Year	Generation-based long-run marginal Carbon Intensity (kgCO <sub>2</sub> e/kWh)	Annual Energy Production (MWh)	Estimate charged to BESS (MWh)	Solar Energy to Grid (MWh)	Carbon Avoidance (tonnes CO <sub>2</sub> e)
38	2063	0.0023	966,583	207,558	759,024	1,746
39	2064	0.0023	962,716	201,332	761,385	1,751
40	2065	0.0023	958,865	195,292	763,574	1,756
<b>Total</b>						<b>692,648</b>
<p><b>Notes:</b> The annual energy production is calculated by multiplying the phase capacity by the yield and by the annual degradation.  e.g. for year 4, this includes the following: Phase 3 capacity (1120 MWp-dc) x yield (1005 kWh/kWp/annum) x annual degradation (1-0.4% x year).  <b>1120 x 1005 x ((1-0.4)*4) = 1,107,698 MWh.</b></p>						

**Table A15.1.20 – Solar PV Carbon Savings with 2024 Baseline for Generation-based Marginal Carbon Intensity**

#	Year	Generation-based marginal Carbon Intensity, 2024 baseline (kgCO <sub>2</sub> e/kWh)	Annual Energy Production (MWh)	Estimate charged to BESS (MWh)	Solar Energy to Grid (MWh)	Carbon Avoidance (tonnes)
1	2026	0.20705	560,549	264,829	295,719	61,229
2	2027	0.20705	837,460	256,885	580,575	120,208
3	2028	0.20705	1,112,147	249,178	862,969	178,678
4	2029	0.20705	1,107,698	241,703	865,996	179,304
5	2030	0.20705	1,103,267	234,452	868,816	179,888
6	2031	0.20705	1,098,854	227,418	871,436	180,431
7	2032	0.20705	1,094,459	220,595	873,863	180,933
8	2033	0.20705	1,090,081	213,978	876,103	181,397
9	2034	0.20705	1,085,721	207,558	878,162	181,824
10	2035	0.20705	1,081,378	264,829	816,548	169,066
11	2036	0.20705	1,077,052	256,885	820,168	169,816
12	2037	0.20705	1,072,744	249,178	823,566	170,519
13	2038	0.20705	1,068,453	241,703	826,751	171,179
14	2039	0.20705	1,064,179	234,452	829,728	171,795
15	2040	0.20705	1,059,923	227,418	832,505	172,370
16	2041	0.20705	1,055,683	220,595	835,087	172,905

#	Year	Generation-based marginal Carbon Intensity, 2024 baseline (kgCO <sub>2</sub> e/kWh)	Annual Energy Production (MWh)	Estimate charged to BESS (MWh)	Solar Energy to Grid (MWh)	Carbon Avoidance (tonnes)
17	2042	0.20705	1,051,460	213,978	837,483	173,401
18	2043	0.20705	1,047,254	207,558	839,696	173,859
19	2044	0.20705	1,043,065	201,332	841,734	174,281
20	2045	0.20705	1,038,893	264,829	774,064	160,270
21	2046	0.20705	1,034,738	256,885	777,853	161,054
22	2047	0.20705	1,030,599	249,178	781,421	161,793
23	2048	0.20705	1,026,476	241,703	784,774	162,487
24	2049	0.20705	1,022,370	234,452	787,919	163,139
25	2050	0.20705	1,018,281	227,418	790,863	163,748
26	2051	0.20705	1,014,208	220,595	793,612	164,317
27	2052	0.20705	1,010,151	213,978	796,173	164,848
28	2053	0.20705	1,006,110	207,558	798,552	165,340
29	2054	0.20705	1,002,086	201,332	800,754	165,796
30	2055	0.20705	998,077	264,829	733,248	151,819
31	2056	0.20705	994,085	256,885	737,201	152,637
32	2057	0.20705	990,109	249,178	740,931	153,410
33	2058	0.20705	986,148	241,703	744,446	154,137

#	Year	Generation-based marginal Carbon Intensity, 2024 baseline (kgCO <sub>2</sub> e/kWh)	Annual Energy Production (MWh)	Estimate charged to BESS (MWh)	Solar Energy to Grid (MWh)	Carbon Avoidance (tonnes)
34	2059	0.20705	982,204	234,452	747,752	154,822
35	2060	0.20705	978,275	227,418	750,857	155,465
36	2061	0.20705	974,362	220,595	753,766	156,067
37	2062	0.20705	970,464	213,978	756,487	156,631
38	2063	0.20705	966,583	207,558	759,024	157,156
39	2064	0.20705	962,716	201,332	761,385	157,645
40	2065	0.20705	958,865	195,292	763,574	158,098
<b>Total</b>						<b>6,503,763</b>
<p><b>Notes:</b> The annual energy production is calculated by multiplying the phase capacity by the yield and by the annual degradation.  e.g. for year 4, this includes the following: Phase 3 capacity (1120 MWp-dc) x yield (1005 kWh/kWp/annum) x annual degradation (1-0.4% x year).  <b>1120 x 1005 x ((1-0.4)*4) = 1,107,698 MWh.</b></p>						

**Table A15.1.21 – Battery Energy Storage System (BESS) Carbon Savings**

#	Year	Evening Peak Carbon Intensity (Gas Peaker) (kg CO <sub>2e</sub> /kWh)	Energy Charged from PV (MWh)	Energy Discharged to Grid (MWh)	Carbon Avoidance (tonnes)
1	2026	0.365	264,829	254,236	92,796
2	2027	0.365	256,885	246,609	90,012
3	2028	0.365	249,178	239,211	87,312
4	2029	0.365	241,703	232,035	84,693
5	2030	0.365	234,452	225,074	82,152
6	2031	0.365	227,418	218,321	79,687
7	2032	0.365	220,595	211,772	77,297
8	2033	0.365	213,978	205,419	74,978
9	2034	0.365	207,558	199,256	72,728
10	2035	0.365	264,829	254,236	92,796
11	2036	0.365	256,885	246,609	90,012
12	2037	0.365	249,178	239,211	87,312
13	2038	0.365	241,703	232,035	84,693
14	2039	0.365	234,452	225,074	82,152
15	2040	0.365	227,418	218,321	79,687
16	2041	0.365	220,595	211,772	77,297
17	2042	0.365	213,978	205,419	74,978
18	2043	0.365	207,558	199,256	72,728



#	Year	Evening Peak Carbon Intensity (Gas Peaker) (kg CO <sub>2</sub> e/kWh)	Energy Charged from PV (MWh)	Energy Discharged to Grid (MWh)	Carbon Avoidance (tonnes)
19	2044	0.365	201,332	193,278	70,547
20	2045	0.365	264,829	254,236	92,796
21	2046	0.365	256,885	246,609	90,012
22	2047	0.365	249,178	239,211	87,312
23	2048	0.365	241,703	232,035	84,693
24	2049	0.365	234,452	225,074	82,152
25	2050	0.365	227,418	218,321	79,687
26	2051	0.365	220,595	211,772	77,297
27	2052	0.365	213,978	205,419	74,978
28	2053	0.365	207,558	199,256	72,728
29	2054	0.365	201,332	193,278	70,547
30	2055	0.365	264,829	254,236	92,796
31	2056	0.365	256,885	246,609	90,012
32	2057	0.365	249,178	239,211	87,312
33	2058	0.365	241,703	232,035	84,693
34	2059	0.365	234,452	225,074	82,152
35	2060	0.365	227,418	218,321	79,687
36	2061	0.365	220,595	211,772	77,297
37	2062	0.365	213,978	205,419	74,978

#	Year	Evening Peak Carbon Intensity (Gas Peaker) (kg CO <sub>2</sub> e/kWh)	Energy Charged from PV (MWh)	Energy Discharged to Grid (MWh)	Carbon Avoidance (tonnes)
38	2063	0.365	207,558	199,256	72,728
39	2064	0.365	201,332	193,278	70,547
40	2065	0.365	195,292	187,480	68,430
<b>Total</b>					<b>3,246,690</b>

**Table A15.1.22 – Decommissioning Waste**

Category	Mass in tonnes	Waste type	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Concrete; recycled	640	Construction–concrete	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0.630	Estimated by the Applicant's construction team.
Aggregate; recycled	0	Construction - aggregate	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Estimated by the Applicant's construction team.

Category	Mass in tonnes	Waste type	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Asphalt; recycled	4,321	Construction - aggregate	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	4.26	Estimated by the Applicant's construction team. Tarmac road removal.
Steel, recycled	45,390	Construction – metals	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	44.7	Estimated by the Applicant's construction team.
Aluminium; recycled	23,520	Construction – metals	0.98485	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	23.2	Estimated by the Applicant's construction team.
Plastic; recycled	466	Plastic	6.41061	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	2.99	Estimated by the Applicant's construction team.

Category	Mass in tonnes	Waste type	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Batteries (cells only), recycled	19,109	Electrical items – batteries	21.294	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	407	Assuming 2 tonnes per MWh of battery system, from a combination of technical specifications.
Miscellaneous other (WEEE), recycled	0	Electrical items – WEEE mixed	21.294	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	N/A.
Transformers - oil (mineral)	255	Tonnes of Oil	6.41	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	2	6.41 kgCO <sub>2</sub> e/tonne.
Cabling - Copper	736	tonnes	0.98	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	1	Estimated by the Applicant's construction team.
Wood (deer fence poles)	125	tonnes	6.41	Inventory of Carbon and Energy (ICE) Version 4 <sup>4</sup>	1	150 km of fencing. One pole every 3 m. 50,000 poles. 2.1 m pole, 2.5 kg per pole. 125,000 kg. <sup>9</sup>

Category	Mass in tonnes	Waste type	Emissions factor kg CO <sub>2</sub> e per unit	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Worker waste	100	Tonnes	497.04416	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	49.7	Assumes 0.5 kg of waste per day per worker. 400 works, 500 days. Assumes a household waste emissions factor.
Total water consumption	18,000	m3	0.18574	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	3	90 L of water per worker per day. 400 workers for 500 days.
PV Modules	64,443	Tonnes	6.41	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	413	Figure as in production emissions + 10% to account for module replacement over lifetime in line with replacement rate expectations. Assumes all panels will be recycled.
<b>Total</b>					<b>952</b>	

**Table A15.1.23 – Decommissioning Waste Transport**

Category	Mass in tonnes	Distance (km)	Emissions factor kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Concrete	640	50	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	7.68	Estimated by the Applicant's construction team.
Aggregate	0	50	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Estimated by the Applicant's construction team.
Asphalt (Tarmac Track)	4,321	50	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	51.9	Estimated by the Applicant's construction team.

Category	Mass in tonnes	Distance (km)	Emissions factor kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Steel	45,390	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	2,179	Estimated by the Applicant's construction team.
Aluminium	23,520	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,129	Estimated by the Applicant's construction team.
Plastic	466	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	22.4	Estimated by the Applicant's construction team.

Category	Mass in tonnes	Distance (km)	Emissions factor kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Batteries	19,109	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	917	Estimated by the Applicant's construction team.
Miscellaneous other (WEEE)	0	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0	Estimated by the Applicant's construction team.
Transformers - oil (mineral)	255	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024	12.2	Estimated by the Applicant's construction team.



Category	Mass in tonnes	Distance (km)	Emissions factor kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Cabling - Copper	736	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024	35.3	Estimated by the Applicant's construction team.
Wood (deer fence poles)	125	50	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1.5	Estimated by the Applicant's construction team.
Worker Waste	100	50	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	0.024	Sum of tonnes, multiplied by 50 km multiplied by emissions factor.

Category	Mass in tonnes	Distance (km)	Emissions factor kg CO <sub>2</sub> e per tonne.km	Emissions factor data source	Emissions (tCO <sub>2</sub> e)	Assumptions
Water Consumption	18,000	50	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	4.32	Sum of tonnes, multiplied by 50 km multiplied by emissions factor.
PV Modules	64,443	200	0.24	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	15.5	Figure as in production emissions + 10% to account for module replacements over lifetime in line with replacement rate expectations.
<b>Total</b>					<b>4,376</b>	

**Table A15.1.24 – Decommissioning: Other**

<b>Decommissioning Other</b>	<b>Activity data</b>	<b>Units</b>	<b>Emissions factor kg CO<sub>2</sub>e per unit</b>	<b>Emissions factor data source</b>	<b>Emissions (tCO<sub>2</sub>e)</b>	<b>Assumptions</b>
Worker commuting (total car journeys)	8,000,000	km	0.16691	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,335	Assuming 400 workers, average of 1.5 workers per car, average of 60 km roundtrip distance per day and 500 total days of decommissioning.
Total fuel consumption – Plant	520,000	Litres	2.75541	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	1,433	Plant and machinery are assumed to consume 5,000 litres of diesel per week across full decommissioning period of 2 years.
Total fuel consumption - generators	308,880	Litres	2.75541	Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2024 <sup>5</sup>	851	Generators are assumed to consume 16.5 litres per hour, 6 hours a day, 26 days a month. An average of 5 generators assumed to be running throughout the 2-year decommissioning period.
<b>Total</b>					<b>3,619</b>	