Designer Embodied Carbon (EC) Calculation - Civil & Electrical

Build Table Most Contributing Materials 1%>. Embodied Carbon A1-5

Project Name:	**Kendal - Whasset OHL Section Undergrounding.**
Project Scope:	**33kV - OHL Undergrounding. 400mm2 CU XLPE Double Circuit. Route Length 1058m.**

Project Embodied Carbon Breakdown and Totals t(Co2e):	
Total A1-5w	161.57
ASa	7.16
Total A1-5 t(CO2e)	**168.73**

Note: Total A1-5w t(CO2e): Type 1&2 + Type 3&4 = Ans

Calculation Date:	**18/09/2024**
Project Code:	**50020482**
Project Completed in Financial Year:	**FY24**
Estimated Cost of Cable Works(£): (To Estimate A5a)	£1,023,032.00

Roadway	CH Start (m)	CH End (m)		PRIVATE ROAD Imported Material (m)	Footpath Imported Material (m)	Road Type 3 Imported Material (m)	AGRICULTURAL LAND SELETED EXC. MAT. (m)	Total	CROSS SECTION	USRN	COMMENTS
LAND WEST OF NETWORK RAIL (ADJACENT TO HALFPENNY LANE)	0	172						172			JB 1A - CH - 25m
FOOTPATH / FARM TRACK UNDER NETWORK RAIL	172	213			41			41			JB 1/2 - CH - 420m
LAND EAST OF NETWORK RAIL (FIELD NORTH OF LAKELAND MAZE FARM PARK)	213	561					348	348			
FARM ACCESS ENTRANCE (ADJACENT TO THE A59T THE A65T)	561	572		11				11		N/A	
LAND NORTH OF LAKELAND MAZE FARM PARK (ADJACENT TO THE A59T THE A65T)	572	608					36	36			
FARM ACCESS ENTRANCE (ADJACENT TO THE A59T THE A65T)	608	617		9				9	A-A		
LAND NORTH OF THE A59T THE A65T	617	702					85	85		35903917	
A59T THE A 65T	702	709				7		7			
LAND SOUTH OF THE A59T THE A65T (ADJACENT TO LAKELAND MAZE FARM PARK)	709	1098					349	349		N/A	JB 2/3 - CH - 879m
			Total	20	41	7	990	1,058			JB 3/4 - CH - 1029m
		Desktop Contigency	0%								

Road & Cable Calculations Table

		Cable Type & Excavation	Cable/Duct Number	Units values to input in conversion to tonnes cell	Conversion to tonnes	Quantity (t)	ECF kg(CO2e/kg) A1-3	ECF kg(CO2e/kg) A4	ECF kg(CO2e/kg) A5w	Embodied Carbon t(CO2e) A1-3	Embodied Carbon t(CO2e) A4	Embodied Carbon t(CO2e) A5w	Embodied Carbon t(CO2e) A1-5w	Total EC t(CO2e)	Total EC t(CO2e) A1-5w	Notes / Comments
Agricultural Land	Low & High Voltage	Asphalt, 8% (Bitumen) binder content (by mass) weight @ 2322kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.086	0.005	0.006	0	0	0	0	**Binder/ Suface Course layer (Tarmac)**	0	
		Ready mix concrete 32/40. 2350kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.132	0.005	0.008	0	0	0	0	**Base layer (Concrete)**	0	
		Ready Mix Expanding Foam Concrete weight @ 4.5kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.188	0.005	0.011	0	0	0	0			
		Engineering MOT		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.005	0.005	0.001	0	0	0	0	**Sub - base layer (Aggregate / MOT / DTP)**	1.45525248	
		Aggregate, 1500kg/m3 Note: aggregate density will change per m3 based on type and mm to dust of material.		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.005	0.005	0.001	0	0	0	0			
		Sand, 1600kg/m3		**input value in m3** (in 'conversion to tonnes' cell)	79.2	126.72	0.005	0.005	0.001	0.6336	0.6336	0.18805	1.45525248			Depth of soil to be calculated @ 50% imported and 50% backfill.
		Waste material content. 1m3 = 1.43 tonnes.		**input value in m3** (in 'conversion to tonnes' cell)	79.2	113.256		0.005	0.001	0	0.56628	0.13806	0.704339064	**Excavations & Backfill layer**	0.704339064	
		Soil assumed 5% cement content. 1m3 = 1.9 tonnes of clay soil.		**input value in m3** (in 'conversion to tonnes' cell)	0	0		0.005	0.001	0	0	0	0			
		Cable Ducts PVC weight @ 200mm dia 4.44kg / m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172	0	0	0	0	**Cable Ducts**	22.26401041	
		Cable Ducts PVC weight @ 150mm dia 3.3kg / m	2	**input value in meters** (in 'conversion to tonnes' cell)	990	6.534	3.23	0.005	0.172	21.10482	0.03267	1.12652	22.26401041			
		Cable Ducts PVC weight @ 100mm dia 2.16kg / m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172	0	0	0	0			
		Cable 33kV (New) : weight @ 5.22kg/m	6	**input value in meters** (in 'conversion to tonnes' cell)	990	31.0068	3.81	0.16	0.04	118.1359	4.961088	1.23655	124.3335472	**Cables**	124.3335472	Until manufacturers ECF values are available the ECF value for New Copper is used for Power Cables.
		Cable 6.6 / 11kV (New) : weight @ 1.7kg/m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.81	0.032	0.039	0	0	0	0			
														A1-5w t(CO2e)	148.7571491	

Road & Cable Calculations Table

		Cable Type & Excavation	Cable/Duct Number	Units values to input in conversion to tonnes cell	Conversion to tonnes	Quantity (t)	ECF kg(CO2e/kg) A1-3	ECF kg(CO2e/kg) A4	ECF kg(CO2e/kg) A5w	Embodied Carbon t(CO2e) A1-3	Embodied Carbon t(CO2e) A4	Embodied Carbon t(CO2e) A5w	Embodied Carbon t(CO2e) A1-5w	Total EC t(CO2e)	Total EC t(CO2e) A1-5w	Notes / Comments
Private Road, Footpath & Type 3	Low & High Voltage	Asphalt, 8% (Bitumen) binder content (by mass) weight @ 2322kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	2.72	6.31584	0.086	0.005	0.006	0.543162	0.0315792	0.03649	0.611228048	**Binder/ Suface Course layer (Tarmac)**	0.611228048	
		Ready mix concrete 32/40. 2350kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	4.9	11.515	0.132	0.005	0.008	1.51998	0.057575	0.0946	1.672150725	**Base layer (Concrete)**	1.672150725	
		Ready Mix Expanding Foam Concrete weight @ 4.5kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.188	0.005	0.011	0	0	0	0			
		Engineering MOT		**input value in m3** (in 'conversion to tonnes' cell)	5.7	8.55	0.005	0.005	0.001	0.04275	0.04275	0.01269	0.0981882	**Sub - base layer (Aggregate / MOT / DTP)**	0.198144936	
		Sand, 1600kg/m3		**input value in m3** (in 'conversion to tonnes' cell)	5.44	8.704	0.005	0.005	0.001	0.04352	0.04352	0.01292	0.099956736			
		Aggregate, 1500kg/m3 Note: aggregate density will change per m3 based on type and mm to dust of material.		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.005	0.005	0.001	0	0	0	0			Depth of soil to be calculated @ 50% imported and 50% backfill.
		Waste material content. 1m3 = 1.43 tonnes.		**input value in m3** (in 'conversion to tonnes' cell)	21.76	31.1168		0.005	0.001	0	0.155584	0.03793	0.193515379	**Excavations & Backfill layer**	0.260867149	
		Soil assumed 5% cement content. 1m3 = 1.9 tonnes of clay soil.		**input value in m3** (in 'conversion to tonnes' cell)	5.7	10.83		0.005	0.001	0	0.05415	0.0132	0.06735177			
		Cable Ducts PVC weight @ 200mm dia 4.44kg / m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172	0	0	0	0			
		Cable Ducts PVC weight @ 150mm dia 3.3kg / m	2	**input value in meters** (in 'conversion to tonnes' cell)	68	0.4488	3.23	0.005	0.172	1.449624	0.002244	0.07738	1.529245159	**Cable Ducts**	1.529245159	
		Cable Ducts PVC weight @ 100mm dia 2.16kg / m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172	0	0	0	0			
		Cable 33kV (New) : weight @ 5.22kg/m	6	**input value in meters** (in 'conversion to tonnes' cell)	68	2.12976	3.81	0.16	0.04	8.114386	0.3407616	0.08493	8.540082029	**Cables**	8.540082029	Until manufacturers ECF values are available the ECF value for New Copper is used for Power Cables.
		Cable 6.6 / 11kV (New) : weight @ 1.7kg/m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.81	0.032	0.039	0	0	0	0			
														A1-5w t(CO2e)	12.81171805	

Important note:: **All materials calculated in above sheet, includes only imported materials**

Key:

A1-3	Caculation are based on **Embodied Carbon Factors (ECF)** to **Extract & Manufacture** the material Calculated as: **Tonnes x ECF kg(CO2e/kg) = Embodied Carbon t(CO2e). Sourced IstructE**
A4	Calculation based on **kg of CO2e produced** by Distance travelled in **km**, ECF based on: **Tonnes x ECF kg(CO2e/kg) = Embodied Carbon t(CO2e)**. Distances referenced from **IStructE: Locally sourced within 50km = 0.005kg(CO2e) / Nationally Sourced within 320km = 0.32kg(COe) / European sourced within 1500km = 0.16kg(CO2e): Sourced IstructE**
A5w	Calculation based on the **Waste Factor (WF) of Materials.** So **brick** has a **waste factor of 20%, Steel 1%** etc...: Material **WF=Material ECF x Distance Travelled x Distance travelled forwaste material taken to landfill (C2) x C02 used for processing disposal (C3-4) = A5w** / Example, assumed waste of concrete is : **0.053 x (A1-3 x x A4 x C2 x C3-4) = A5w : Sourced IStructE**
Sa	Typical assumed **costat stage A1-5 of build is 50% so: 700kg(CO2e) per £100,000** so: **0.7 x (cost of build ÷ 100,000)= Ans t(CO2e)**: **Soruced IstructE**

Note:

Please fill in all relavent **cells highlighted** in **GREY** -

Profile Depths for Type 1&2:
top layer = **100mm** — Tarmac
layer = **180mm** — Concrete
MOT = **210mm**
Backfill = **210mm**
Sand layer = **200mm** (+/-300mm)
Material Waste = **Estimate 80% of total Excavated material**

Profile Depths for Type 3&4:
layer = **100mm** — Tarmac top
50mm — Concrete layer =
Backfill = **275mm** — MOT = **275mm**
Sand layer = **200mm** (+/- 300mm)
Material Waste = **Estimate 80% of total Excavated material**

Calculating for Cable & Ducts note:

When **adding** in **cable lengths** in meters, the calculation **must** include **cable numbers** for the table to **calulate** the **embodied carbon factor**

Key: **Designer to fill in all cells highlighted in light grey**

The 'Embodied Carbon t(CO2e)' cells are using a traffic light system to indicate, low- high contributing materials. Below this cell in an example of how the colour format works for each material and what they indicate.

Low		Medium		High
0	12.5	25	37.5	50

Reference note:

Ref for material Embodied Carbon Factors:	**Calculations & Embodied Carbon factors for materials used in the tableare sourced from the Brisa (ICE) & IstructE**
	A BSRIA guide: Hammond.G etal., 'Embodied Carbon'., The inventory of Cabon and Energy., (ICE).
	Embodied Carbon : The Inventory of Carbon and Energy (ICE) (greenbuildingencyclopaedia.uk)
	The Institution of Structural Engineers 'How to calculate embodied carbon'.
Ref for calculating Embodied Carbon A1-5& Cell colour formatting:	A brief guide to calculating embodied carbon (istructe.org)

Project Photographs / Drawings