

Project		
Project	Cood Darcy EIA	
Client	St Modwen	
Workbook Name	Energy Benchmarking	

Workbook Contents		
Worksheet		Description
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Revision Control					
Current Revision		0			
Revision History					
Revision	Date	Revision Notes	Creator	Reviewer	Approver
Draft 1	07/10/2021		DC		

Emissions source	Emissions over appraisal period (tCO ₂ -e)	Annual emissions in opening year (tCO ₂ -e/year)
Construction		
Buildings	234,957	
Habitat / Installation processes	11,187	
Traffic	182	13
Construction process	150	
Operation		
Buildings	5,303	
Public realm	1,638	164
Water consumption	489	65
Transport	30,668	527
Maintenance and refurbishment		
Buildings	54,381	

Contextualisation of emissions	Emissions for context (tCO ₂ -e)	% of proposed development in relation to the context
Construction		
Total construction emissions per annum	20539.67096	
Combined Carbon Budgets for construction (2024 to 2036)	3911250000	0.000525143
Wales Emissions 2016	47650000	0.043105291
Wales Emissions 2019 (latest data)	23807000	0.043105291
Wales Emission Target for 2030	30496000	0.067352017
Neath Port Talbot emissions in 2019	7165000	0.286666727
Operation		
Total operational emissions per annum	1,541	
Combined Carbon Budgets for operation (2026 to 2037)	3177500000	0.001198976
Wales Emission Target for 2040	5241500	0.029405815
Neath Port Talbot emissions in 2019	7,165,000	0.021511595

Sources
https://gov.wales/sites/default/files/publications/2019-06/low-carbon-delivery-plan_1.pdf
<http://www.infobasecymru.net/IAS/themes/environmentandsustainability/environment/tabular?viewId=518&geoid=1&subsetId=>

Embodied emissions during construction														Embodied emissions during operation			
CO2 benchmarks - Carbon Leadership Forum http://carbonleadershipforum.org/data-visualization/														CO2 benchmarks - based on RICS ratios			
RICS 2012 - https://www.igbc.ie/wp-content/uploads/2015/02/RICS-Methodology_embodied_carbon_materials_final-1st-edition.pdf														WRAP Embodied Carbon Database 2014			
Total annual demands	0 2025	Benchmark Category (Operational)	GIA - Building floor area (m ²)	Benchmark Category (Embodied)	Typical benchmark (kgCO ₂ /m ²)	Emissions (kgCO ₂)	Benchmark Category (Embodied)	Typical benchmark (kgCO ₂ /m ²)	Emissions (kgCO ₂)	Benchmark Category (Embodied)	Typical benchmark (kgCO ₂ /m ²)	Emissions (kgCO ₂)	Assumptions	Benchmark Category (Embodied)	Ratio type	Typical benchmark (kgCO ₂ /m ²)	Emissions (kgCO ₂)
#REF!	1800 homes	#REF!	400,000	Residential	314	125,600,000	Mid terrace/Row house	530	212,000,000	Residential	380	152,000,000		Residential	Residential	111	44,329,412
#REF!	Land for education (a two form entry primary school only), with associated public open space	Education	26,000	Education	383	9,958,000	Primary school / Kindergarten / Nursery	690	17,940,000	Educational	540	14,040,000		Education	Office	350	9,104,457
A1, A2, A3, B1, D1 and D2 1 house	Land for commercial uses	Mixed	1,134	Mixed	416	471,744	Mixed use block	840	952,560	Retail	640	725,760		Mixed	Office	380	431,309
B2 and B8	Extension to the existing Llandarcy Business Park	Commercial	2,100	Commercial	398	835,800	Business Park	860	1,806,000	Multi-use	320	672,000		Commercial	Warehouse	246	515,706
	Associated highways works	Highways	17,780	Parking	274	4,871,583	Roads, paths and pavings	127	2,257,997	Car Parking	490	8,711,955					
Total						141,737,127			234,956,557			176,149,715					54,380,884

Ratio of embodied emissions - to practical completion vs in use

Building type	Carbon emissions to practical completion	Carbon emissions in use	Ratio
Office	35%	32%	91%
Warehouse	47%	29%	62%
Residential	51%	18%	35%

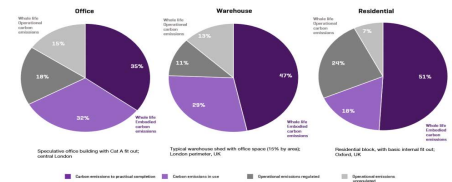


Figure 1: Total whole life carbon emissions breakdown for different building types © Sturgis Carbon Profiling

Source: RICS

http://www.rics.org/Global/Whole_life_carbon_assessment_for_the_BE_PGguidance_2017.pdf

Energy Benchmarking

Total annual demands		2025	2050	BAU - low	BAU - high														
Annual electricity consumption	kWh		4830000	4,830,000	4,830,000	4,830,000													
Annual heating consumption			8960000	8960000	8960000	12,730,000													
Annual EV consumption			2356000	2,356,000	2,356,000	2,356,000													
Solar PV generation			9180000	9180000	0	0													
Heat pump input to heating			3250000	3250000	0	0													
Total			1,256,000	1,256,000	16,146,000	19,916,000													
Public realm			Electricity (kWh)	Gas (kWh)	Electricity (kg CO ₂ e)														
Associated highways, airports, recreation, etc.				387,887		82,360													
Total			387,887																

Conversion Factors 2021 (Department for Business, Energy and Industrial Strategy)

Activity	Country	Unit	Year	kg CO ₂ e
Electricity generated	Electricity: UK	kWh	2021	0.21233

Activity	Fuel	Unit	kg CO ₂ e
Gaseous fuels	Natural gas	tonnes	2538.48
		cubic metres	2.02135
		kWh (Net CV)	0.20297
		kWh (Gross CV)	0.18316

Energy Benchmarking

Opening year	2028	Emissions from electricity over appraisal period (tCO ₂ -e)	Public realm emissions over appraisal period (tCO ₂ -e)
Appraisal period	60	5,303	1,638
			84085.1

Year	Operation year	In appraisal period?	CO ₂ emissions factor (gCO ₂ /kWh)	Building electricity consumption (kWh/year)	Emissions from electricity (tCO ₂ -e/year)	Public realm electricity consumption (kWh/year)	Public realm emissions (tCO ₂ -e/year)	Electricity emissions factor source:
2015	0	No	422	1,256,000	530	387,887	164	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69312/5Web_Figure_EEP2_019_ods_Figure_5.2
2016	0	No	351	1,256,000	441	387,887	136	
2017	0	No	300	1,256,000	377	387,887	116	
2018	0	No	290	1,256,000	365	387,887	113	
2019	0	No	156	1,256,000	196	387,887	61	
2020	0	No	147	1,256,000	185	387,887	57	
2021	0	No	137	1,256,000	172	387,887	53	
2022	0	No	127	1,256,000	160	387,887	49	
2023	0	No	119	1,256,000	150	387,887	46	
2024	0	No	128	1,256,000	161	387,887	50	
2025	0	No	108	1,256,000	136	387,887	42	
2026	1	Yes	90	1,256,000	113	387,887	35	
2027	2	Yes	85	1,256,000	107	387,887	33	
2028	3	Yes	91	1,256,000	115	387,887	35	
2029	4	Yes	98	1,256,000	124	387,887	38	
2030	5	Yes	89	1,256,000	112	387,887	35	
2031	6	Yes	83	1,256,000	104	387,887	32	
2032	7	Yes	84	1,256,000	105	387,887	32	
2033	8	Yes	85	1,256,000	106	387,887	33	
2034	9	Yes	87	1,256,000	109	387,887	34	
2035	10	Yes	78	1,256,000	98	387,887	30	
2036	11	Yes	71	1,256,000	89	387,887	28	
2037	12	Yes	67	1,256,000	85	387,887	26	
2038	13	Yes	70	1,256,000	88	387,887	27	
2039	14	Yes	69	1,256,000	86	387,887	27	
2040	15	Yes	67	1,256,000	84	387,887	26	
2041	16	Yes	67	1,256,000	84	387,887	26	
2042	17	Yes	67	1,256,000	84	387,887	26	
2043	18	Yes	67	1,256,000	84	387,887	26	
2044	19	Yes	67	1,256,000	84	387,887	26	
2045	20	Yes	67	1,256,000	84	387,887	26	
2046	21	Yes	67	1,256,000	84	387,887	26	
2047	22	Yes	67	1,256,000	84	387,887	26	
2048	23	Yes	67	1,256,000	84	387,887	26	
2049	24	Yes	67	1,256,000	84	387,887	26	
2050	25	Yes	67	1,256,000	84	387,887	26	
2051	26	Yes	67	1,256,000	84	387,887	26	
2052	27	Yes	67	1,256,000	84	387,887	26	
2053	28	Yes	67	1,256,000	84	387,887	26	
2054	29	Yes	67	1,256,000	84	387,887	26	
2055	30	Yes	67	1,256,000	84	387,887	26	
2056	31	Yes	67	1,256,000	84	387,887	26	
2057	32	Yes	67	1,256,000	84	387,887	26	
2058	33	Yes	67	1,256,000	84	387,887	26	
2059	34	Yes	67	1,256,000	84	387,887	26	
2060	35	Yes	67	1,256,000	84	387,887	26	
2061	36	Yes	67	1,256,000	84	387,887	26	
2062	37	Yes	67	1,256,000	84	387,887	26	
2063	38	Yes	67	1,256,000	84	387,887	26	
2064	39	Yes	67	1,256,000	84	387,887	26	
2065	40	Yes	67	1,256,000	84	387,887	26	
2066	41	Yes	67	1,256,000	84	387,887	26	
2067	42	Yes	67	1,256,000	84	387,887	26	
2068	43	Yes	67	1,256,000	84	387,887	26	
2069	44	Yes	67	1,256,000	84	387,887	26	
2070	45	Yes	67	1,256,000	84	387,887	26	
2071	46	Yes	67	1,256,000	84	387,887	26	
2072	47	Yes	67	1,256,000	84	387,887	26	
2073	48	Yes	67	1,256,000	84	387,887	26	
2074	49	Yes	67	1,256,000	84	387,887	26	
2075	50	Yes	67	1,256,000	84	387,887	26	
2076	51	Yes	67	1,256,000	84	387,887	26	
2077	52	Yes	67	1,256,000	84	387,887	26	
2078	53	Yes	67	1,256,000	84	387,887	26	
2079	54	Yes	67	1,256,000	84	387,887	26	
2080	55	Yes	67	1,256,000	84	387,887	26	
2081	56	Yes	67	1,256,000	84	387,887	26	
2082	57	Yes	67	1,256,000	84	387,887	26	
2083	58	Yes	67	1,256,000	84	387,887	26	
2084	59	Yes	67	1,256,000	84	387,887	26	
2085	60	Yes	67	1,256,000	84	387,887	26	
2086	61	No	67	1,256,000	84	387,887	26	
2087	62	No	67	1,256,000	84	387,887	26	
2088	63	No	67	1,256,000	84	387,887	26	

Energy Benchmarking

Building		Litres	Cubic litres	kg CO2e/day	kgCO2e/year		Source for benchmark		Assumptions		
Water supply	1800 homes	606132	606 132	90.3	32964.5	Project Masterplan	https://stats.wales.gov.wales/Catalogue/Environment-and-Courtyside/State-of-the-Environment/Sustainable-Use-of-Resources/CHART-PerCapita/Consumption/Water-by-Year BEIS Greenhouse gas reporting conversion factors 2021		149 litres per person per day. Assumed 2.26 person household as average. This matches the average for Wales		
Water Treatment	1800 homes	606132	606 132	164.9	60176.8	Project Masterplan	https://stats.wales.gov.wales/Catalogue/Environment-and-Courtyside/State-of-the-Environment/Sustainable-Use-of-Resources/CHART-PerCapita/Consumption/Water-by-Year BEIS Greenhouse gas reporting conversion factors 2021		149 litres per person per day. Assumed 2.26 person household as average. This matches the average for Wales		
Opening year		2026		Emissions from electricity over appraisal period (tCO ₂ e)							
Appraisal period		60		489							
Year	Operation year	In appraisal period?	Welsh Water's emissions target (net zero by 2040) (%)	Emissions from water supply and treatment (kgCO2e/year)	Emissions from water supply and treatment (tCO2e/year)	Emissions from water supply and treatment with target's applied (tCO2e/year)	Water Supply				
2015	1	No	100	93 141	93	93	Conversion Factors 2021 (Department for Business, Energy and Industrial Strategy)				
2016	2	No	100	93 141	93	93	Activity	Type	Unit	kg CO ₂ e	
2017	3	No	100	93 141	93	93	Water supply	Water supply	cubic metres million	0 149	
2018	4	No	100	93 141	93	93			litres	149.0	
2019	5	No	100	93 141	93	93					
2020	6	No	100	93 141	93	93					
2021	7	No	95	93 141	93	88	Water Treatment				
2022	8	No	90	93 141	93	84	Conversion Factors 2021 (Department for Business, Energy and Industrial Strategy)				
2023	9	No	85	93 141	93	79	Activity	Type	Unit	kg CO ₂ e	
2024	10	No	80	93 141	93	75	Water treatment	Water treatment	cubic metres million	#####	
2025	11	No	75	93 141	93	70			litres	#####	
2026	12	Yes	70	93 141	93	65					
2027	13	Yes	65	93 141	93	61					
2028	14	Yes	60	93 141	93	56					
2029	15	Yes	55	93 141	93	51					
2030	16	Yes	50	93 141	93	47					
2031	17	Yes	45	93 141	93	42					
2032	18	Yes	40	93 141	93	37					
2033	19	Yes	35	93 141	93	33					
2034	20	Yes	30	93 141	93	28					
2035	21	Yes	25	93 141	93	23					
2036	22	Yes	20	93 141	93	19					
2037	23	Yes	15	93 141	93	14					
2038	24	Yes	10	93 141	93	9					
2039	25	Yes	5	93 141	93	5					
2040	26	Yes	-	93 141	93	-					
2041	27	Yes	-	93 141	93	-					
2042	28	Yes	-	93 141	93	-					
2043	29	Yes	-	93 141	93	-					
2044	30	Yes	-	93 141	93	-					
2045	31	Yes	-	93 141	93	-					
2046	32	Yes	-	93 141	93	-					
2047	33	Yes	-	93 141	93	-					
2048	34	Yes	-	93 141	93	-					
2049	35	Yes	-	93 141	93	-					
2050	36	Yes	-	93 141	93	-					
2051	37	Yes	-	93 141	93	-					
2052	38	Yes	-	93 141	93	-					
2053	39	Yes	-	93 141	93	-					
2054	40	Yes	-	93 141	93	-					
2055	41	Yes	-	93 141	93	-					
2056	42	Yes	-	93 141	93	-					
2057	43	Yes	-	93 141	93	-					
2058	44	Yes	-	93 141	93	-					
2059	45	Yes	-	93 141	93	-					
2060	46	Yes	-	93 141	93	-					
2061	47	Yes	-	93 141	93	-					
2062	48	Yes	-	93 141	93	-					
2063	49	Yes	-	93 141	93	-					
2064	50	Yes	-	93 141	93	-					
2065	51	Yes	-	93 141	93	-					
2066	52	Yes	-	93 141	93	-					
2067	53	Yes	-	93 141	93	-					
2068	54	Yes	-	93 141	93	-					
2069	55	Yes	-	93 141	93	-					
2070	56	Yes	-	93 141	93	-					
2071	57	Yes	-	93 141	93	-					
2072	58	Yes	-	93 141	93	-					
2073	59	Yes	-	93 141	93	-					
2074	60	Yes	-	93 141	93	-					
2075	61	Yes	-	93 141	93	-					
2076	62	Yes	-	93 141	93	-					
2077	63	Yes	-	93 141	93	-					
2078	64	Yes	-	93 141	93	-					
2079	65	Yes	-	93 141	93	-					
2080	66	Yes	-	93 141	93	-					
2081	67	Yes	-	93 141	93	-					
2082	68	Yes	-	93 141	93	-					
2083	69	Yes	-	93 141	93	-					
2084	70	Yes	-	93 141	93	-					
2085	71	Yes	-	93 141	93	-					
2086	72	Yes	-	93 141	93	-					
2087	73	No	-	93 141	93	-					
2088	74	No	-	93 141	93	-					

Conversion Factors 2021 (Department for Business, Energy and Industrial Strategy)

Activity	Country	Unit	Year	kg CO ₂ e
Electricity generated	Electricity	KWh	2021	0.21233

Activity	Fuel	Unit	kg CO ₂ e
Gaseous / Natural gas	Gaseous / Natural gas	litres	2538.48
		cubic metres	#####
		MWh (Net CV)	#####
		MWh (Gross CV)	#####

Energy Benchmarking

Year	Emissions without development (tCO2-e)	Emissions with development (tCO2-e)	Additional emissions due to development (tCO2-e)
Construction			
2023	15689	15702	13
2024	15689	15702	13
2025	15689	15702	13
2026	15689	15702	13
2027	15689	15702	13
2028	15689	15702	13
2029	15689	15702	13
2030	15689	15702	13
2031	15689	15702	13
2032	15689	15702	13
2033	15689	15702	13
2034	15689	15702	13
2035	15689	15702	13
2036	15689	15702	13
Total	219646	219828	182
Operation			
2026	15812	16339	527
2027	15812	16339	527
2028	15812	16339	527
2029	15812	16339	527
2030	15812	16339	527
2031	15812	16339	527
2032	15812	16339	527
2033	15812	16339	527
2034	15812	16339	527
2035	15812	16339	527
2036	16363	16861	498
2037	16363	16861	498
2038	16363	16861	498
2039	16363	16861	498
2040	16363	16861	498
2041	16363	16861	498
2042	16363	16861	498
2043	16363	16861	498
2044	16363	16861	498
2045	16363	16861	498
2046	16363	16861	498
2047	16363	16861	498
2048	16363	16861	498
2049	16363	16861	498
2050	16363	16861	498
2051	16363	16861	498
2052	16363	16861	498
2053	16363	16861	498
2054	16363	16861	498
2055	16363	16861	498
2056	16363	16861	498
2057	16363	16861	498
2058	16363	16861	498
2059	16363	16861	498
2060	16363	16861	498
2061	16363	16861	498
2062	16363	16861	498
2063	16363	16861	498
2064	16363	16861	498
2065	16363	16861	498
2066	16363	16861	498
2067	16363	16861	498
2068	16363	16861	498
2069	16363	16861	498
2070	16363	16861	498
2071	16363	16861	498
2072	16363	16861	498
2073	16363	16861	498
2074	16363	16861	498
2075	16363	16861	498
2076	16363	16861	498
2077	16363	16861	498
2078	16363	16861	498
2079	16363	16861	498
2080	16363	16861	498
2081	16363	16861	498
2082	16363	16861	498
2083	16363	16861	498
2084	16363	16861	498
2085	16363	16861	498
2086	16363	16861	498
Total	992,633	1,023,391	30,668

All stock factors taken or amended from Natural England. 2021. NERR094 - Edition 1: Carbon Storage and Sequestration by Habitat. Available at: <http://publications.naturalengland.org.uk/file/6726246198411264>

Construction emissions	Onsite carbon stocks within existing habitats (tCO2)	Onsite carbon stocks within remaining habitats (tCO2)	Total Lost during construction (tCO2)
	42645	31457	11187

Historic baseline

Phase 1 Habitat	Area (ha)	Habitat category for assessment	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Conversion to tCO2
Semi-natural broadleaved woodland	34.98	30 year mixed broadleaved native woodland (to 15cm soil depth)	55	114	5911.6	21676
Dense scrub	16.7	Scrub - (S Alps, Italy example used as a proxy for this assessment, 10-35 year old, highest estimates used as a precautionary approach for potential loss; soil 72 and vegetation 60)	72	60	2204.4	8083
Semi-improved neutral grassland	8.27	Neutral grassland (soil depth 15cm)	60	No vegetation stocks are given – as management (grazing and cutting) removes biomass annually	496.2	1819
Improved grassland	3.17	Improved grassland (amended to soil depth of 15cm from 100cm in Natural England paper to equivalent assumption on soil depths across habitat types)	19.5		61.8	227
Wet grassland	3.6	Floodplains	109.4	0	393.8	1444
Tall ruderal	42.45	Neutral grassland (soil depth 15cm)	60		2547.0	9339
Length (m)		inversion to ha				0
Native species-rich intact hedge	270	Minimal/ Unmanaged Hedgerows	98.7	45.8	11.7	43
Scattered trees – line	230	30 year mixed broadleaved native woodland (to 15cm soil depth)	55	114	3.8	14
				Total carbon lost as a result of construction phase	11630.4	42645

Proposed development

Phase 1 Habitat	Area (ha)	Habitat category	Carbon stock factor (tC/ha) (Soil)	Carbon stock factor (tC/ha) (Vegetation)	Carbon Stock (tC)	Conversion to tCO2
Semi-natural broadleaved woodland	31.02	30 year mixed broadleaved native woodland (to 15cm soil depth)	55	114	5242.4	19222.1
Dense scrub	4.01	Scrub - (S Alps, Italy example used as a proxy for this assessment, 10-35 year old, lowest estimates used as a precautionary approach for mitigation; soil 51 and vegetation 3)	51	3	216.5	794.0
Semi-improved neutral grassland	8.27	Neutral grassland (soil depth 15cm)	60	No vegetation stocks are given – as management (grazing and cutting) removes biomass annually	496.2	1819.4
Improved grassland	3.16	Improved grassland (amended to soil depth of 15cm from 100cm in Natural England paper to equivalent assumption on soil depths across habitat types)	19.5	No vegetation stocks are given – as management (grazing and cutting) removes biomass annually	61.6	225.9
Wet grassland	0				0.0	0.0
Tall ruderal	42.45	Neutral grassland (soil depth 15cm)	60	No vegetation stocks are given – as management (grazing and cutting) removes biomass annually	2547.0	9339.0
Length (m)		inversion to ha				
Native species-rich intact hedge	270	Minimal/ Unmanaged Hedgerows	98.7	45.8	11.7	42.9
Scattered trees – line	230	30 year mixed broadleaved native woodland (to 15cm soil depth)	55	114	3.8	13.9
				Onsite carbon gains in operational phase due to mitigation	8579.2	31457.2

Construction emissions	Recycling excess material	Emissions associated with recycling materials (tCO2)
	150,000	150

Aggregate and soil exported off-site	Recycled	tonnes	Waste	0.001	tCO ₂ e/t	1	Carbon factor taken directly from Government Carbon Factors 2021. Waste disposal > Aggregates
	Re-use off site	tonnes	Waste	0	tCO ₂ e/t	1	The carbon emissions factor is zero and no direct carbon emissions will be accounted for. Transport emissions should still be captured.
	Landfill	tonnes	Waste	0.001	tCO ₂ e/t	1	Carbon factor taken directly from Government Carbon Factors 2021. Waste disposal > Aggregates

Energy Benchmarking

Road type		Light Intens	Units
2 m wide pedestrian walk		6	W/m
Cycle routes		8	W/m
Internal main road		8	W/m
Energy benchmarks			
Operational hours per day		12	
		Electricity typical benchmark (kWh/m)	
2 m wide pedestrian walk		26.298	
Cycle routes		35.064	
Internal main road		35.064	
Length (m)		kWh/m	
Site Road Networks	3031	79709.238	
Cycle Routes	3544	124266.82	
Pedestrian Routes	5245	183910.68	
Lighting Total (kWh)		387886.73	