

Rosefield Solar Farm

Environmental Statement

Volume 4
Appendix 8.1: Climate Data Sources and
Assumptions

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Rosefield Energyfarm Limited

APFP Regulation 5(2)(a)
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1. Introduction

- 1.1 This technical appendix to **ES Volume 2, Chapter 8: Climate [EN010158/APP/6.2]** presents the raw climate data sources, assumptions and emissions factors used to carry out the greenhouse gas assessment. This appendix is intended to be read in conjunction with **ES Volume 2, Chapter 8: Climate [EN010158/APP/6.2]**, which includes the methodology and assumptions used within the assessment.
- 1.2 Emissions calculations within this technical appendix apply the following format:
- Activity data x emissions factor = emissions in mass of CO₂e

2. Construction of the Proposed Development

- 2.1 A large number of data sources have been supplied by the design and engineering team to estimate emissions from construction. These are summarised at a high-level below (**Table 1**), alongside assumptions that have been applied in the assessment.
- 2.2 It has been assumed that the construction period will last for approximately 30 months.

Table 1: Construction stage assumptions and data sources

Component	Quantity / specification	Assumption methodology	Distance travelled by sea (km)	Distance travelled by Heavy Good Vehicle (km)
Battery Energy Storage System (BESS)	1,020,000 kWh for the entire development	10 kg per kWh, provided by the engineering team	10,000 [Ref. 1]	500
BESS containers	408 No. BESS containers	Using publicly available research 2,300 kg per container, this weight is based on a steel shipping container [Ref. 2]	10,000	500
Solar photovoltaic (PV) modules	470,529 No.	Weight of 36.8 kg per module provided by the engineering team	10,000	500
String Inverters	670 No.	116 kg per unit provided by engineering team	10,000	500
PV framework	1.5 kg per module assumed	Using publicly available data [Ref. 3]	10,000	500
PV foundation	20,046,000 kg total assumed, steel piles	Weight assumed steel foundation 60 tonnes/MW [Ref. 4]	10,000	500
BESS Switchgear	9 No.	654.27 kg per unit based on average of Environmental Product Declarations (EPD) [Ref. 5][Ref. 6]	10,000	500

Component	Quantity / specification	Assumption methodology	Distance travelled by sea (km)	Distance travelled by Heavy Good Vehicle (km)
Rosefield Substation Buildings	720 m ² support buildings, 35m ² security cabin	Assumed constructed in the United Kingdom (UK). Modelled using One Click LCA software [Ref. 7]	N/A	Default material delivery distances supplied by One Click LCA software
Main Transformers	7 No.	120,600 kg per transformer excl. oil. 67,000 litres mineral oil per transformer provided by engineering team	10,000	500
PV Transformers	62 No.	20,000 kg per transformer provided by engineering team	10,000	500
Inverter Transformer Stations	62 No.	Using publicly available research 2,300 kg per container, this weight is based on an empty steel shipping container [Ref. 2]	10,000	500

3. Operation of the Proposed Development

- 3.1 The Proposed Development is anticipated to generate 324,864 MWh in the first year. A degradation factor of 0.4% has been applied each year to account for year-on-year reduction in yield. The operational energy generation is displayed below (**Table 2**).

Table 2: Operational energy generation per year

Year of operation	Year	Energy generation (MWh)
1	2031	324,864.00
2	2032	323,564.54
3	2033	322,270.29
4	2034	320,981.20
5	2035	319,697.28
6	2036	318,418.49
7	2037	317,144.82
8	2038	315,876.24
9	2039	314,612.73
10	2040	313,354.28
11	2041	312,100.86
12	2042	310,852.46
13	2043	309,609.05
14	2044	308,370.61
15	2045	307,137.13
16	2046	305,908.58

Year of operation	Year	Energy generation (MWh)
17	2047	304,684.95
18	2048	303,466.21
19	2049	302,252.35
20	2050	301,043.34
21	2051	299,839.16
22	2052	298,639.81
23	2053	297,445.25
24	2054	296,255.47
25	2055	295,070.44
26	2056	293,890.16
27	2057	292,714.60
28	2058	291,543.74
29	2059	290,377.57
30	2060	289,216.06
31	2061	288,059.19
32	2062	286,906.96
33	2063	285,759.33
34	2064	284,616.29
35	2065	283,477.83
36	2066	282,343.91
37	2067	281,214.54

Year of operation	Year	Energy generation (MWh)
38	2068	280,089.68
39	2069	278,969.32
40	2070	277,853.45
Total lifecycle generation		12,030,492

4. Emissions Factors

4.1 The emission factors used in the assessment are summarised below (**Table 3**).

Table 3: Emission factors used in the assessment

	Description	Emissions Factors	Unit	Source	Notes
Materials	Weathering steel	3.28	kgCO ₂ e/kg	TATA Steel 2020 [Ref. 8]	Produced EU
	Aluminium	5.58	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	Produced in China
	Aluminium	14.60	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	Produced in Europe
	Steel - cold rolled	2.73	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	World average
	Steel - plate	2.46	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	World average
	Insulating paper	1.76	kgCO ₂ e/kg	Guo et al., 2022 [Ref. 10]	
	Copper	2.71	kgCO ₂ e/kg	Dong et al., 2020 [Ref. 11]	Produced in China, assumes primary material production
	Copper	3.42	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	Produced in Europe
	Mineral Oil	3204.91	kgCO ₂ e/t	DESNZ 2024 [Ref. 12]	Primary material production
	ABS Plastic	3.76	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	Not location specific
	Polycarbonate plastic	7.62	kgCO ₂ e/kg	ICE 2019 [Ref. 9]	Not location specific

	Description	Emissions Factors	Unit	Source	Notes
Transport	Diesel	2.51	kgCO ₂ e/l	DESNZ 2024 [Ref. 12]	Biofuel blend
	All rigids	0.18	kgCO ₂ e/tkm	DESNZ 2024 [Ref. 12]	Average laden
	Average container ship	0.02	kgCO ₂ e/tkm	DESNZ 2024 [Ref. 12]	Average
	All rigids	0.21	kgCO ₂ e/tkm	DESNZ 2024 [Ref. 12]	50% laden
	Average petrol car	0.16	kgCO ₂ e/km	DESNZ 2024 [Ref. 12]	
Disposal	Mineral Oil - recycling	6.41	kgCO ₂ e/t	DESNZ 2024 [Ref. 12]	
	Other metals recycling	<0.01	kgCO ₂ e/kg	One Click 2024 [Ref. 7]	e.g., Aluminium recycling
	Structural steel recycling	<0.01	kgCO ₂ e/kg	One Click 2024 [Ref. 7]	Steel recycling
	PVC incineration	2.07	kgCO ₂ e/kg	One Click 2024 [Ref. 7]	
Water	Consumption	0.15	kgCO ₂ e/m ³	DESNZ 2024 [Ref. 12]	
	Treatment	0.19	kgCO ₂ e/m ³	DESNZ 2024 [Ref. 12]	

Description		Emissions Factors	Unit	Source	Notes
Electricity	China	IEA 2023 (Unable to share due to contractual obligations)	kgCO ₂ e/kwh	IEA 2023 [Ref. 13]	Location based factor
	China	IEA 2023 (Unable to share due to contractual obligations)	kgCO ₂ e/kwh	IEA 2023 [Ref. 13]	

5. Environmental Product Declarations

- 5.1 The Environmental Product Declarations used in the assessment are outlined below (**Table 4**).

Table 4: Environmental Product Declarations

Asset	Emission category	Emissions Factors	Unit	Source
Solar PV modules	A1-3 Product Stage	217	kgCO _{2e} /m ²	Average of various Environmental Product Declarations sourced from One Click LCA [Ref. 7]
Solar PV modules	C1-4 End of Life	4	kgCO _{2e} /m ²	Average of various Environmental Product Declarations sourced from One Click LCA [Ref. 7]
BESS	A1-3 Product Stage	175	kgCO _{2e} /kwh	Romare and Dahllöf 2017. [Ref. 14]
BESS	C3-4 End of Life	8	kgCO _{2e} /kg	Li et al., 2023 [Ref. 15]
Main Transformers	A1-3 Product Stage	515,811	kgCO _{2e} /unit	Guo et al., 2022 [Ref. 10]
Main Transformers	C1-4 End of Life	8,959	kgCO _{2e} /unit	Guo et al., 2022 [Ref. 10]
PV Transformers	A1-3 Product Stage	221,500	kgCO _{2e} /unit	EPD Italy, 2023 [Ref. 16]
PV Transformers	C1-4 End of Life	3,000	kgCO _{2e} /unit	EPD Italy, 2023 [Ref. 16]
String Inverters	A1-3 Product Stage	3,990	kgCO _{2e} /unit	EPD Italy, 2023 [Ref. 17]
String Inverters	C3-4 End of Life	30	kgCO _{2e} /unit	EPD Italy, 2023 [Ref. 17]

Asset	Emission category	Emissions Factors	Unit	Source
Switchgear	A1-3 Product Stage	2,560	kgCO ₂ e/unit	EPD Norge, 2023 [Ref. 5]
Switchgear	A1-3 Product Stage	6,505	kgCO ₂ e/unit	EPD Norge, 2024 [Ref. 6]
Switchgear	C3-4 End of Life	176	kgCO ₂ e/unit	EPD Norge, 2023 [Ref. 5]
Switchgear	C1-4 End of Life	125	kgCO ₂ e/unit	EPD Norge, 2024 [Ref. 6]

6. General Assumptions

6.1 The general assumptions used within the assessment are included in (Table 5) below.

Table 5: General assumptions

Category	Assumption	Source
Construction worker water use	60 litres/worker/day	BS8551:2015 [Ref. 18]
PV cleaning water use	76 litres/mwh	SEIA 2023 [Ref. 19]
HGVs - deliveries	43% empty running factor	RICS 2023 [Ref. 1]
Sea - deliveries	0% empty running factor	RICS 2023 [Ref. 1]
Repair	10% of A1-3 for MEP or 25% maintenance	RICS 2023 [Ref. 1]
Landfill disposal distance	100 km	NP assumption based on distance to specialist disposal facilities
Recycling disposal distance	100 km	NP assumption based on distance to specialist disposal facilities
Service life	40 years	Provided by engineering team
Steel foundation assumption	60 tonnes/MW	Publicly available information [Ref. 4]
Maintenance	1% of A1-5	RICS 2023 [Ref. 1]
Generator (750 Kva) diesel consumption	149.8 l/hr	Cummings, 2021 [Ref. 20]
Generator (250 Kva) diesel consumption	62.5 l/hr	Cummings, 2019 [Ref. 21]

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