EAST PARK ENERGY

East Park Energy

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Preliminary Environmental Information Report
Volume 2 – Technical Appendices

Appendix 15-1: GHG Emissions Assessment

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1.0 INTRODUCTION

1.1.1 This appendix has been written in support of **PEIR Volume 1 Chapter 15** *Climate Change*. This appendix details the inputs and assumptions within the calculation of Greenhouse Gas ('GHG') associated with the Scheme.

1.1.2 The GHG emissions scoped into the assessment are summarised in Table 15.6 of ***PEIR Volume 1 Chapter 15***.

2.0 ASSUMPTIONS AND INPUTS

2.1 Construction Phase (2027-2030)

2.1.1 It has been assumed that the construction of the Scheme would commence in late 2027 (assumed to be end of Q2 2027) and last for a period of 2.5 years.

Embodied GHG emissions within the equipment and materials

2.1.2 Embodied GHG emissions include the extraction of raw materials, transportation of raw materials to the place of manufacturing, and the manufacturing process. These can make up a significant contribution to the GHG emissions associated with the Scheme. Manufacturers are increasingly carbon footprinting their products and reporting the embodied GHG emissions associated with their product. However, at this stage the exact manufacture of the equipment is not known. Therefore, the following assumptions have been made in relation to the embodied GHG emissions associated with the equipment and materials needed to construct the Scheme.

Table 1 – Source of Equipment and materials

Equipment / material	Source
Solar PV modules	Manufacturer of a candidate module - Canadian Solar (500 kgCO_2e/kWp)
Mounting structure	Assumed total weight of candidate mounting structure is made up of steel and applied ICE database emission factor for engineering steel.

Equipment / material	Source
Cables	Manufacturer of a candidate cables from Prysmian.
Batteries	Swedish Environmental Research Institute paper (2019), associated with the manufacture of lithium-ion batteries. Range of 59-119 kg CO_2e/kWh, with a mid-point of 89 CO_2e/kWh. Applied the mid-point given the age of the paper and pushes from industry to reduce the GHG intensity of the manufacturing process.
Transformers	In lieu of any data from candidate equipment, assumed total weight of transformer is made up of steel and applied ICE database emission factor for electrogalvanized steel
Inverters	In lieu of any data from candidate equipment, assumed total weight of inverter is made up of steel and applied ICE database emission factor for electrogalvanized steel.
Aggregates	Weight of aggregates multiplied by the density of gravel and multiplied by the emission factor for “aggregates and sand from secondary resources, bulk, loose” from the ICE database.
Concrete	ICE database emission factor for general concrete.
Fencing	In lieu of any data from, weight of a candidate fence and applied the ICE database emission factor for electrogalvanized steel.

Table 2 – Material / equipment emission factors

Material	Unit	Value
Aggregates and sand, from secondary resources, bulk, loose	kgCO_2e/kg	0.063
Concrete (general)	kgCO_2e/kg	0.103
Steel, engineering steel	kgCO_2e/kg	1.270
Steel, electrogalvanised	kgCO_2e/kg	3.030
Source: Circular Ecology, 2019, Inventory of Carbon and Energy V3.0		

Table 3 – Equipment weight assumptions

Equipment	Unit	Value	Source
400kV transformer	t	18	Candidate transformer
Transformer	t	15	Candidate transformer
Inverter	t	0.12	Candidate inverter
Solar PV module	kg	38	Candidate bifacial module
Battery	t	23	Candidate battery
Mounting structure	t	0.25	Candidate mounting structure
Cables – low voltage	kg/km	470	BS 5467 1kV, round, 2 cores, 2.5mm^2
Cables – high voltage	kg/km	5,600	BS 5467 1kV, round, 2 cores, 500mm^2
Cables – extra high voltage	kg/km	11,400	BS 5467 1kV, round, 2 cores, 1000mm^2
Fencing	kg/100 m	75	

2.1.3 The following table sets out the quantity of equipment and materials required to construct the Scheme.

Table 4 – Equipment and materials required to construct the Scheme

Equipment	Unit	Value
Cables - extra high voltage	m	23,400
Cables - high voltage	m	423,000
Cables - low voltage	m	2,146,000
Solar PV modules	-	712,590
Solar PV mounting structure	-	23,753
Transformers	-	52
Inverters	-	1,400
Batteries	-	96
400kv transformer	-	2
Access track	m^3	50,000
Fencing	km	65
Concrete	t	48,000

Transportation of equipment and construction materials

2.1.4 To calculate the GHG emissions associated with the transportation of the equipment from the place of manufacture and materials to the Scheme the total weight equipment / material, and the distance to the Scheme has been calculated. The GHG emissions have been calculated by applying the appropriate emission factors from DESNZ. Where appropriate well-to-tank (WTT) emission factors have also be applied.

2.1.5 The following assumptions have been used for the place of manufacture for equipment and source of materials.

Table 5 – Place of manufacture of equipment, source of material

Equipment / material	Source
Cables	Europe – assumed central Poland
Solar PV modules	China – assumed central China
Solar PV mounting structure	Europe – assumed central Poland
Transformers	China – assumed central China
Inverters	China – assumed central China
Batteries	China – assumed central China
Aggregate	UK – assumed local to Scheme – Bradshaw Sand and Gravel
Fencing	UK – assumed local to Scheme
Concrete	UK – assumed local to Scheme

2.1.6 The following assumptions have been used for the transportation of equipment and materials from their source of manufacture.

Table 6 – Transportation assumptions

Equipment / material	Leg 1		Leg 2		Leg 3	
	Route	Method	Route	Method	Route	Method
Solar PV modules	Central China to Shanghai	HGV	Shanghai to Felixstowe	Cargo	Felixstowe to Site	HGV

Equipment / material	Leg 1		Leg 2		Leg 3	
	Route	Method	Route	Method	Route	Method
Half table mounting structures	Central Poland to Rotterdam	HGV	Rotterdam to Felixstowe	Cargo	Felixstowe to Site	HGV
Low voltage cables	Central Poland to Rotterdam	HGV	Rotterdam to Felixstowe	Cargo	Felixstowe to Site	HGV
High voltage cables	Central Poland to Rotterdam	HGV	Rotterdam to Felixstowe	Cargo	Felixstowe to Site	HGV
Extra high voltage cables	Central Poland to Rotterdam	HGV	Rotterdam to Felixstowe	Cargo	Felixstowe to Site	HGV
Battery	Central China to Shanghai	HGV	Shanghai to Felixstowe	Cargo	Felixstowe to Site	HGV
Transformer	Central China to Shanghai	HGV	Shanghai to Felixstowe	Cargo	Felixstowe to Site	HGV
400kV transformer	Central China to Shanghai	HGV	Shanghai to Felixstowe	Cargo	Felixstowe to Site	HGV
Concrete	Eastern Concrete Limited to Site	HGV				
Aggregate	Bradshaw Sand and Gravel to Site	HGV				

2.1.7 The weight of each equipment / material has been multiplied by the distance of the leg and the sum of the appropriate DESNZ emission factor and DESNZ WTT emission factor for that leg.

2.1.8 The following assumptions relating to the distances travelled have been applied.

Table 7 – Distance travelled

Parameter	Unit	Value	Source
Central China to Shanghai	km	1,000	Google maps
Central Poland to Rotterdam	km	1,000	Google maps
Shanghai to Felixstowe	km	22,052	Ports.com, Port of Shanghai to Port of Felixstowe
Rotterdam to Felixstowe	km	248	Ports.com, Port of Rotterdam to Port of Felixstowe
Felixstowe to Site	km	130	Google maps
Bradshaw Sand and Gravel to Site	km	40	Google maps
Eastern Concrete Limited to Site	km	40	Google maps
BW Fencing specialists to Site	km	70	Google maps

Plant vehicles and generators

2.1.9 The GHG emissions associated with the on-site plant vehicles and generators during the construction period have been calculated from the expected diesel fuel use and applying the appropriate DESNZ emission factor (including WTT emission factor).

Table 8 – Energy usage

Parameter	Unit	Value
Diesel usage	l	864,000

Provision of clean water and treatment of wastewater

2.1.10 The GHG emissions associated with the energy consumption from the provision of clean water has been calculated by taking the sum of the water used for cleaning the solar PV modules and the water required during construction and applying the DESNZ water supply emission factor.

2.1.11 The GHG emissions associated with the energy consumption from the treatment of wastewater has been calculated by taking the water requiring treatment during construction and applying the DESNZ water treatment emission factor.

Table 9 – Water usage

Parameter	Unit	Value
Water used on site for cleaning of solar PV modules etc	Million litres per annum	1.3
Water requiring treatment	Million litres per annum	16.7

Travel of construction workers

2.1.12 The GHG emissions associated with the travel of construction workers has been calculated using the number of construction workers on-site per month as set out in ***PEIR Volume 2 Appendix 2-1*****.** Given the source of workers is unknown, a reasonable conservative assumption that a worker would travel 50 km to the site (and then return) has been made. This has conservatively assumed each worker would travel to site as an individual. The DESNZ emission factor for average car emission factor (unknown fuel) and the DESNZ WTT average car emission factor (unknown fuel) have been applied.

Table 10 – Construction workers distance travelled

Parameter	Unit	Value	Source
Distance to work	km	50	Assumption, unknown location of workers assumed 50 km each way

2.2 Operation Phase (2030-2070)

2.2.1 It has been assumed that the Scheme would be commissioned in 2030 and operate for 40 years.

Provision of clean water and treatment of wastewater

2.2.2 The GHG emissions associated with the energy consumption from the provision of clean water has been calculated by taking the sum of the water used for cleaning the solar PV modules and the water required for the welfare facilities during operation and applying the DESNZ water supply emission factor.

2.2.3 The GHG emissions associated with the energy consumption from the treatment of wastewater has been calculated by taking the water requiring treatment during operation and applying the DESNZ water treatment emission factor.

Table 11 – Water usage

Parameter	Unit	Value
Water used on site for cleaning of solar PV modules etc	Million litres per annum	0.4
Water requiring treatment	Million litres per annum	0.1

Leakage of GHGs

2.2.4 Sulphur hexafluoride (SF_6) is one of the seven GHGs identified by the Kyoto Protocol which has an extremely high Global Warming Potential (GWP) of 23,900 for the 100-year time horizon. While SF_6 is a potential source of GHG emissions over the lifetime of the Scheme (i.e. derived from certain electric items such as gas-insulated switchgear and gas-insulated transformers during production, operation through leakage, and dismantling), it is difficult to quantify fugitive emissions from the leakage of SF_6 as there is insufficient research data available. Additionally, manufacturers are now increasingly able to offer SF_6-free components, and those that do continue to use SF_6 are sealed-for-life with extremely low leakage rates. For this reason, it is assumed that emissions of SF_6 from this Scheme will be minimal and not material to this GHG assessment.

Emissions displaced by energy generated

2.2.5 The electricity generated by the Scheme will be exported to the national grid. The following table sets out the assumptions used to calculate the energy generated.

Table 12 – Energy generated

Parameter	Unit	Value
Gross energy generation no degradation	kWh/year	433,200,000
Degradation rate	%	1st year – 2% 2nd to 20th year – 0.45% per year

Travel of workers to the Scheme

2.2.6 The GHG emissions associated with the travel of workers has been calculated based on the gross direct jobs generated (20) as outlined in ***PEIR Volume 1 Chapter 14***. Given the source of workers is unknown, a reasonable conservative assumption that a worker would travel 50 km to the site (and then return) has been made. The DESNZ emission factor for average car emission factor (unknown fuel) and the DESNZ WTT average car emission factor (unknown fuel) have been applied.

2.2.7 The GHG emissions associated with the energy consumption from the provision of clean water has been calculated by taking the sum of the water used for cleaning the solar PV modules and the water required during construction and applying the DESNZ water supply emission factor.

2.2.8 The GHG emissions associated with the energy consumption from the treatment of wastewater has been calculated by taking the water requiring treatment during construction and applying the DESNZ water treatment emission factor.

Table 13 – Operational workers distance travelled

Parameter	Unit	Value	Source
Distance to work	km	50	Assumption, unknown location of workers assumed 50 km each way

Replacement of equipment embodied and travel

2.2.9 The life expectancy of the equipment has been factored into the calculation of the GHG emissions during the operational phase. The GHG emissions have been assumed to occur in year 20 – i.e. after the typical warranty of the equipment. The emissions include those associated with the manufacture of the equipment, transport to the Scheme, and disposal and transport of waste materials (i.e. the swapped equipment).

Table 14 – Life expectancy of equipment

Equipment	Life expectancy (years)
Cables	40+
Solar PV modules	20
Solar PV mounting structure	40+
Transformers	20
Inverters	20
Batteries	20
Access track	40+
Fencing	40+
Concrete	40+

2.3 Decommissioning Phase (2070 – 2072)

2.3.1 It has been assumed that the Scheme would be decommissioned in 2070 and decommissioning would take 2 years. It has been assumed that 50% of the equipment and materials used to construct the Scheme would be sent to landfill and 50% would be sent to a licenced recycling centre.

Plant vehicles and generators

2.3.2 The GHG emissions associated with the on-site plant vehicles and generators during the decommissioning period has been assumed to be the same as construction period.

Provision of clean water and treatment of wastewater

2.3.3 The GHG emissions associated with the energy consumption from the provision of clean water has been assumed to be the same as the construction period.

Transportation of waste materials

2.3.4 To calculate the GHG emissions associated with the transportation of waste materials, the following assumptions have been applied.

Table 15 – Distance to licenced disposal / recycling centre

Parameter	Unit	Value	Source
Distance to licenced landfill	km	100	Assumption, unknown location conservative assumption
Distance to licenced recycling centre	km	100	Assumption, unknown location conservative assumption

2.3.5 The weight of equipment / material to be disposed of has been determined and The DESNZ emission factor for HGV (all diesel) emission factor and the DESNZ WTT HGV (all diesel) emission factor have been applied.

Disposal / recycling of waste materials

2.3.6 To calculate the GHG emissions associated with the disposal / recycling of waste materials, the DESNZ emission factors have been applied.

Travel for workers

2.3.7 The GHG emissions associated with the travel of workers has been assumed to be the same as construction.

3.0 RESULTS

3.1.1 The total GHG emissions over the lifetime of the Scheme are summarised in the following table.

Table 16 – GHG emissions over the lifetime of the Scheme

Parameter	Unit	Value
Construction Phase		
1. Embodied within equipment and materials	tCO_2e	309,867
2. Transportation of equipment and construction materials to the Scheme	tCO_2e	17,848
3. Plant vehicles and generators	tCO_2e	2,839
4. Provision of clean water and treatment of wastewater	tCO_2e	14.6
5. Travel of construction workers	tCO_2e	314
Total Construction Phase	**tCO_2e**	**330,882**
Operational Phase		
1. Provision of clean water and treatment of wastewater	tCO_2e	3.8
2. Leakage of GHGs	tCO_2e	-
3. Travel of workers to site	tCO_2e	0.4
4. Embodied with replacement equipment	tCO_2e	268,058
5. Transportation of replacement equipment to Scheme	tCO_2e	13,815
6. Transportation of waste materials from replaced equipment	tCO_2e	271
7. Disposal of waste materials from replaced equipment	tCO_2e	230
Total Operational Phase	**tCO_2e**	**282,378**
Decommissioning Phase		
1. Plant vehicles and generators	tCO_2e	2,839
2. Provision of clean water and treatment of wastewater	tCO_2e	14.6
3. Transportation of waste materials	tCO_2e	2,488
4. Disposal of waste materials	tCO_2e	1,081
5. Travel for workers	tCO_2e	314

Total Decommissioning Phase	**tCO_2e**	**6,736**
Total lifetime emissions	**tCO_2e**	**619,996**

3.1.2 As shown, using the conservative assumptions the total emissions over the lifetime of the Scheme are ~**620,000 tCO_2e**.

4.0 EMISSIONS FACTORS

Table 17 – Energy source emission factors

Parameter	Unit	Value
Coal	g/kWh	1,046
Natural Gas	g/kWh	375
Nuclear	g/kWh	-
Renewables	g/kWh	-
Other	g/kWh	877
Overall average	g/kWh	171

DESNZ, 2024, Fuel Mix Disclosure Table

Table 19 – GHG conversion factors

Parameter	Unit	Value
HGV (all diesel) Articulated (>33t) (100% laden)	$kgCO_2e$/tonne.km	0.058
HGV (all diesel) All HGV (100% laden)	$kgCO_2e$/tonne.km	0.072
Cargo ship General cargo (average)	$kgCO_2e$/tonne.km	0.013
Cargo ship Container (average)	$kgCO_2e$/tonne.km	0.016
Open loop recycling of electrical items (WEEE-mixed)	$kgCO_2$/tonne	6.411
Landfill of electrical items (WEEE - mixed)	$kgCO_2$/tonne	8.884
Open loop recycling of batteries	$kgCO_2$/tonne	6.411
Landfill of batteries	$kgCO_2$/tonne	8.884
Open loop recycling of aggregates	$kgCO_2$/tonne	0.985
Landfill of aggregates	$kgCO_2$/tonne	1.234
Open loop recycling of concrete	$kgCO_2$/tonne	0.985
Landfill of concrete	$kgCO_2$/tonne	1.234
Open loop recycling of scrap metal	$kgCO_2$/tonne	6.411
Landfill of scrap metal	$kgCO_2$/tonne	8.884
Diesel emission factor	$kgCO_2$/L	2.662
Water supply	$kgCO_2e$/million litres	153
Water treatment	$kgCO_2e$/million litres	186

Parameter	Unit	Value
Average car emission factor (unknown fuel)	$kgCO_2e/km$	0.167
Diesel emission factor WTT	$kgCO_2/L$	0.624
WTT HGV (all diesel) All HGV (100% laden)	$kgCO_2e/tonne.km$	0.018
WTT Cargo ship General cargo (average)	$kgCO_2e/tonne.km$	0.003
WTT Cargo ship Container (average)	$kgCO_2e/tonne.km$	0.004
WTT cars (average car) unknown	$kgCO_2e/km$	0.044

DESNZ, 2024, GHG Conversion Factors

Table 20 – Conversion factors

Parameter	Unit	Value	Source
Density of gravel	kg/m^3	2,200	Standard assumption
Density of concrete	kg/m^3	2,400	Standard assumption