Portland energy recovery facility

Environmental statement

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Carbon balance and greenhouse gas emissions

5 Carbon balance and greenhouse gas emissions

Introduction

5.1 Fichtner Consulting Engineers Ltd was appointed to undertake a carbon balance assessment of the proposed development, which determines its impact on greenhouse gas emissions. The findings of the assessment are summarised in this chapter and the full report is included as technical appendix E. The references and data sources used in the assessment are set out in table 5.1.

BEIS, 2020, Greenhouse gas reporting: conversion factors 2020
BEIS, 2007, CHPQA Guidance Note 28 The Determination of Z Ratio
Defra, 2019a, Greenhouse gas reporting: conversion factors 2019
Defra, 2019b, Fuel mix disclosure data table – 01.04.18-31.03.19
Defra, 2014a, Review of Landfill Methane Emissions Modelling (WR1908)
Defra, 2014b, Energy from waste: a guide to the debate
Defra, 2014c, Energy recovery for residual waste – a carbon based modelling approach
IEMA, 2017, Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance
IPCC, 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy
United Nations Framework for Climate Change Global Warming Potentials: https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/global-warming-potentials
WRAP, 2020, National Municipal Waste Composition, England 2017
WRAP Cymru, 2020, Commercial and Industrial Waste in Wales
Table 5.1: References and data sources

5.2 The assessment has been undertaken for both the nominal design capacity of 182,640 tonnes of RDF per year and the maximum capacity of 201,912 tonnes per year[1].

Legislation and policy

Legislation

5.3 The Climate Change Act 2008 (as amended) requires emissions of carbon dioxide and other greenhouse gases to be reduced and establishes the framework for this to occur. The Act commits the government to reducing greenhouse gas emissions by at least 100% of 1990 levels (net zero) by 2050 and sets legally binding carbon budgets to act as stepping stones towards this target. These are caps on the amount of greenhouse gases emitted in the UK over a five-year period. The first five carbon budgets have been put into legislation and run to 2032. The UK is currently in the third carbon budget (2018 to 2022), which requires a reduction of 37% below 1990 levels by 2020.

Planning policy

5.4 The National Planning Policy Framework (NPPF; 2019) sets out the government's planning policies for England and how they are expected to be applied. In relation to carbon and greenhouse gases, paragraph 148 of the NPPF states that:

[1] Rounded to 183,000 tonnes and 202,000 tonnes elsewhere in the ES to ensure a worst-case, but included as exact figures here because they are derived from specific figures for the carbon content, biocarbon and calorific value of the RDF.

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

5.5 Defra's (2013) *Waste Management Plan for England* states that *"the government supports efficient energy recovery from residual waste – of materials which cannot be reused or recycled – to deliver environmental benefits, reduce carbon impact and provide economic opportunities." Our Waste, Our Resources: A Strategy for England* (HM Government, 2018) states that *"reducing carbon emissions is fundamental to mitigating the severe risks and impacts posed by a warmer world, and, as highlighted by the IPPC (2018), urgent action is required."*

5.6 Policy 6: Recovery facilities of the adopted Bournemouth, Christchurch, Poole and Dorset Waste Plan (2019) states that proposals for the recovery of non-hazardous waste that produce energy should provide combined heat and power or, if this is demonstrated to be impracticable, recover energy through electricity production and be designed to have the capability to deliver heat in the future. The adopted West Dorset, Weymouth & Portland Local Plan (2015) and the Portland Neighbourhood Plan Referendum version (2020) do not contain any policies relating specifically to the carbon impact of waste management facilities.

Guidance

5.7 In 2019, the Committee on Climate Change, the UK's independent advisory body to the government, published *Net Zero: The UK's contribution to stopping global warming*, which sets out recommendations to the government on how to achieve the target of net zero carbon emissions by 2050. The report sets out how key biodegradable waste streams should be diverted from landfill within the UK, alongside an increase in recycling. To achieve this and deliver deep emission reductions in the waste sector, it is advised that key investment is required in alternative waste disposal facilities (such as anaerobic digestion, mechanical biological treatment and incineration). A lack of investment in these areas may encourage offshoring of waste.

5.8 The report envisages a future generation mix where renewables dominate, which includes generation from both hydro and energy from waste plants. The continued development and investment in low carbon technologies will be key in achieving a net zero future. The intermittency of renewables is recognised and there is support for baseload low carbon plants. Consequently, energy from waste would play a key role in UK power generation and achieving a net zero future.

Methodology

Introduction

5.9 The standard EIA methodology described in chapter 3 does not apply to this chapter. As the receptor for greenhouse gas emissions will be the worldwide climate, it is not feasible to assess the sensitivity of individual receptors. In addition, the magnitude of the impact of greenhouse gas emissions cannot be determined. For the purposes of this chapter, therefore, an alternative methodology has been applied.

Baseline

5.10 The Institute of Environmental Management and Assessment's (IEMA; 2017) *Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance* defines the baseline as a reference point against which the impact of a new development can be compared (sometimes referred to as 'business as usual', where assumptions are made on current and future greenhouse gas emissions). The baseline can be in the form of:

a) Greenhouse gas emissions within the agreed physical and temporal boundaries of a project, but without the proposed project; or
b) Greenhouse gas emissions arising from an alternative project design and assumptions.

5.11 The proposed ERF is a new project, so a current baseline cannot be established in relation to emissions from the site boundary of the proposed development prior to commencement of development. In this instance, there are zero greenhouse gas emissions to report. Furthermore, as the impact of greenhouse gas emissions from the development will be worldwide, physical and temporal boundaries to their impact cannot be defined. Therefore, option b) has been chosen to establish the baseline.

5.12 For this assessment, the 'alternative project design and assumptions' for the ERF will be as follows:

- Sending the waste to landfill
- Generating electricity via gas-fired power stations, as this is the 'most likely' technology if a new power station was to be built today (also known as the 'marginal' technology)

5.13 Landfill has been used as the comparator because this is the primary alternative treatment route available for residual waste. This is because the UK does not have enough ERF capacity to treat all residual waste, so a considerable amount goes to landfill. If a new ERF is built in the UK, this means that less waste overall will be sent to landfill and therefore, at a national level, the correct comparator is landfill. This approach is supported by national guidance, including Defra's (2014) *Energy from waste: a guide to the debate* and *Energy recovery for residual waste – a carbon based modelling approach.*

5.14 The elements included in the calculations are summarised in table 5.2 and full details of the methodology for establishing the emissions for the scenario of disposing of the waste to landfill are set out in technical appendix E. The assumptions used the in the assessment are summarised in the 'assumptions and limitations / uncertainties' section of this chapter below.

Comparator	Element included in assessment
Landfill	Emissions of methane (CH_4) as carbon dioxide equivalent (CO_2e) released to the atmosphere in the fraction of landfill gas that is not captured. This is calculated taking into account the following elements: • Biogenic carbon in the waste • Total degradable decomposable organic carbon content (biogenic carbon that is not sequestered) • Methane in landfill gas, split into methane captured, methane oxidised in the landfill cap and methane released directly to the atmosphere • Methane leakage through the landfill gas engines
	Emissions offset from the generation of electricity from landfill gas, taking into account the following elements: • Methane captured, including methane flared, methane leakage through the landfill gas engines and methane used in the landfill gas engines • Fuel input to the landfill gas engines • Power generated

Table 5.2: Elements of the landfill comparator scenario included in the assessment

Assessment scope

5.15 The proposed development is expected to have an operational lifetime of at least 25 years. Therefore, this has been chosen as the study period for the assessment. The elements of the proposed ERF development scoped into the carbon and greenhouse gas assessment are as follows:

- Emissions released from the combustion of fossil fuel-derived carbon in the waste
- Emissions of other greenhouse gases (nitrous oxide (N_2O) and CH_4) from the combustion of waste
- Emissions from the combustion of gas oil in auxiliary burners
- Emissions from the transport of waste, reagents and residues, based on scenarios of 100% transport by road and 100% transport by sea
- Emissions offset from the export of electricity from the proposed development
- Emissions offset from the export of heat from the proposed development, if this were to be provided
- Emissions offset from the export of power to ships moored at Portland Port, if this were to be taken up by shipping operators

5.16 The boundary of greenhouse gas emissions should consider the physical boundary, geographical location and temporal boundary. While physical and temporal boundaries cannot be defined, as stated previously, the geographical location of the proposed development has been taken into consideration via the assessment of transport emissions.

5.17 A fully comprehensive greenhouse gas assessment will typically cover all life cycle stages, including construction, operation and end-of-life stage. The IEMA guidance states that certain life cycle stages can be excluded as long as this approach is justified; it is expected, however, that direct greenhouse gas emissions from operations are covered as a minimum within the boundaries of the study. The emissions associated with construction and end-of-life stages will be relatively minor when compared to the carbon impact over the operational lifetime of the proposed development. As such, construction emissions and end-of-life emissions (e.g. decommissioning and site closure) have been scoped out of the assessment.

5.18 The detailed methodology and assumptions used in the assessment are set out in technical appendix E. The assumptions data cover both the activities to occur as part of the proposed development (i.e. project-specific data, such as transport distances) and the emissions factors for these activities. Emissions factors have been carefully selected, with multiple emissions factors considered when calculating the carbon benefit of grid displacement. The possible change in UK grid mix over time and how this affects the net impact of the proposed development has also been examined within a sensitivity analysis.

Significance

5.19 In the absence of any significance criteria or a defined threshold, it might be considered that all greenhouse gas emissions are significant. Climate change has the potential to lead to significant environmental effects on all topics in the EIA directive (population, fauna, soil etc.). The IEMA guidance states that:

> *"When evaluating significance, all new GHG emissions contribute to a significant negative environmental effect; however, some projects will replace existing developments that have higher GHG profiles. The significance of a project's emissions should therefore be based on its net impact, which may be positive or negative."*

5.20 For the purposes of this assessment, the net impacts of the proposed ERF have been calculated compared to the baseline comparator scenario of disposing of the waste to landfill. It is acknowledged that the residual waste produced in Dorset does not all go to landfill at present, so the specific waste that may be processed at the Portland ERF may not currently all go to landfill. Therefore, as requested by Dorset Council, the following alternative scenarios have also been examined:

- Sending the RDF to other ERFs in the UK
- Sending the RDF to other ERFs overseas
- Sending the waste to an ERF constructed at one of the four alternative sites allocated in the adopted Bournemouth, Christchurch, Poole and Dorset Waste Plan (2019)
- Continuing to manage the waste under Dorset Council's existing arrangements

5.21 These scenarios are examined at the end of the assessment. It should, however, be noted that the comparison of the proposed development with these scenarios does not take account of second order effects, as any ERF that is currently processing residual waste from Dorset would need to secure waste from elsewhere and it is likely that the replacement waste will currently be going to landfill.

Assumptions and limitations / uncertainties

5.22 The emissions factors and other assumptions used in the assessment are set out in table 5.3, together with the sources of the data.

Topic	Factor	Source
N_2O default emissions factor	0.044 kg N_2O/tonne waste	IPCC, 2006
CH_4 default emissions factor	0.33 kg CH_4/tonne waste	IPCC, 2006
Global warming potential: N_2O to CO_2	310 kg CO_2e/kg N_2O	UNFCC website
Global warming potential: CH_4 to CO_2	25 kg CO_2e/kg CH_4	UNFCC website
Emissions from gas oil	0.25 tCO_2e/MWh	Defra, 2019a
Offset for generating electricity from natural gas	0.349 tCO_2e/MWh	Defra, 2019b
Natural gas boiler efficiency	90%	Typical boiler efficiency
Natural gas offset factor for boilers	0.20374 kg CO_2/kWh	BEIS, 2020
Z ratio giving reduction in electrical output if heat is exported	6.6	BEIS, 2007
Offset for generating electricity from diesel fuel on ships	0.577 tCO_2e/MWh	Defra, 2019a
Degradable decomposable organic carbon content of landfilled waste	50%	Defra, 2014a
CO_2 percentage of landfill gas	43%	Defra, 2014a
CH_4 percentage of landfill gas	57%	Defra, 2014a
Molecular ratio of CH_4 to carbon	1.33	Standard values
Molecular ratio of CO_2 to CH_4	2.75	
Molecular ratio of CO_2 to carbon	3.67	
Landfill gas recovery efficiency	68%	Defra, 2014a
CH_4 captured used in landfill gas engines	90.9%	Defra, 2014a
CH_4 leakage through landfill gas engines	1.5%	Defra, 2014a
Landfill gas engine efficiency	36%	Defra, 2014a
Waste composition	--	WRAP, 2020 and WRAP Cymru, 2020

Table 5.3: Emissions factors and assumptions used in assessment

5.23 The following conservative assumptions have been used in the assessment:

- There will be 10 start-ups a year where the auxiliary burners will be in operation
- Recent bidding of ERF plants into the capacity market means they are competing primarily with combined cycle gas turbines (CCGT), gas engines and diesel engines. CCGT has been used as the comparator for displaced electricity and may possibly be conservative compared to the other options providing balancing services
- A sequestration rate of 50% for biogenic carbon in landfill has been applied
- A relatively high landfill gas capture rate of 68% gas has been used
- The carbon burden of transporting the waste by road is determined by calculating the total number of loads required and multiplying it by the transport distance to generate an annual one-way vehicle distance. This is multiplied by the respective empty and full CO_2 factor for HGVs to determine the overall burden of transport. This is conservative, as it may be possible to coordinate HGV movements to reduce the number of trips. In addition, a worst-case scenario of 100% transport by road has been assumed, whereas in reality there is likely to be a split between road and sea transport
- The ERF will generate approximately 18.1 MWe of electricity, of which approximately 15.2 MWe will be exported to the grid
- The average heat output from the ERF, in the event that this is provided, is assumed for the purposes of the assessment to be 2.29 MW, which is

based on a heat network being constructed to supply the Osprey Leisure Centre, HM Prison The Verne, HM Prison Young Offenders Institute Portland and the Ocean Views development. The export of heat would reduce the electrical output of the ERF and this has been determined using the Z ratio set out in table 5.3. Assuming an average heat export of 2.29 MWth, the electrical output would be reduced to 14.85 MWe

- Powerfuel Portland Ltd has estimated that the demand for shore power would be around 20,328 MWh in 2024, increasing to 24,423 MWh by 2045. This assumes that 60-65 cruise ships visit Portland Port each year and that the Royal Fleet Auxiliary ships spend 260 days in port a year, with a gradual increase in the fraction of ships that are capable of taking power from the shore

5.24 The following limitations and uncertainties have been identified in the assessment:

- There is considerable uncertainty in literature surrounding the amount of biogenic carbon that is sequestered in landfill
- The future of the UK electricity grid mix is uncertain, so the current 'marginal' comparator has been used to assess grid displacement, as discussed in paragraph 5.12

Baseline comparator scenario

5.25 The quantity of greenhouse gas emissions associated with the baseline landfill scenario has been assessed in accordance with the methodology summarised above and set out in detail in technical appendix E. The amount of CO_2e emissions from methane released to the atmosphere if the waste were to be disposed of to landfill has been calculated and the results are set out in table 5.4.

Item	**Value (nominal capacity)**	**Value (maximum capacity)**
Biogenic carbon	29,033 tonnes	31,571 tonnes
Total degradable decomposable organic carbon content (biogenic carbon that is not sequestered and is degradable) released and converted into landfill gas (50% of the biogenic carbon)	14,517 tonnes per year	15,785 tonnes per year
Total methane in landfill gas[2], of which: a) Methane captured (not released) b) Methane oxidised in landfill cap (not released) c) Methane released to atmosphere directly	11,033 tonnes per year 7,502 tonnes per year 353 tonnes per year 3,177 tonnes per year	11,997 tonnes per year 8,158 tonnes per year 384 tonnes per year 3,455 tonnes per year
d) Methane leakage through landfill gas engines	102 tonnes per year	111 tonnes per year
Total methane released to the atmosphere (c + d)	3,280 tonnes per year	3,566 tonnes per year
CO_2e released to atmosphere (3,280 x 25 (global warming potential of CH_4))	**81,992 tonnes per year**	**89,158 tonnes per year**
Table 5.4: Emissions from landfill gas		

5.26 The total CO_2e emissions associated with the transport of waste to landfill was calculated to take account of indirect emissions associated with transport, as set out in table 5.5.

2 Calculated as Total degradable decomposable organic carbon content x percentage of landfill gas that is methane x molecular ratio of methane to carbon.

Tonnage per year	No. loads required per year	One-way distance (km)	One-way total distance per year (km)	Total CO_2e emissions (tonnes per year)
Nominal design capacity				
182,640	7,610	80	608,800	979.21
Maximum capacity				
201,912	8,414	80	673,120	1,082.66

Table 5.5: Emissions from transporting waste to landfill

5.27 The amount of CO_2e emissions offset through electricity generation under the baseline landfill scenario was then calculated and the results are shown in table 5.6. Full details of the assumptions behind the calculations are set out in technical appendix E.

Item	Value (nominal capacity)	Value (maximum capacity)
Methane captured, of which: a) Methane flared b) Methane leakage through landfill gas engines c) Methane used in landfill gas engines	7,502 tonnes per year 682 tonnes per year 102 tonnes per year 6,718 tonnes per year	8,158 tonnes per year 742 tonnes per year 111 tonnes per year 7,305 tonnes per year
Fuel input to landfill gas engines	113,665 GJ	343,334 GJ
Power generated	31,574 MWh	34,333 MWh
Total CO_2e offset through grid displacement	**11,019 tonnes per year**	**11,982 tonnes per year**

Table 5.6: Emissions from landfill gas

Effects post-construction

5.28 The quantity of greenhouse gas emissions associated with the operation of the proposed ERF has been assessed in accordance with the detailed methodology and assumptions set out in technical appendix E. As set out in paragraph 5.15, this includes emissions associated with the combustion of fossil fuel-derived carbon in the waste, emissions from other greenhouse gases from the combustion of waste, and emissions from the combustion of gas oil in the auxiliary burners (table 5.7).

Item	**Unit**	**Value (nominal capacity)**	**Value (maximum capacity)**
Fossil fuel-derived CO_2 emissions			
Fossil carbon in waste[3]	Tonnes per year of carbon	22,873	21,071
Fossil fuel-derived CO_2 emissions (row 1 x 3.67 (the ratio of the molecular weights of CO_2 and carbon))	Tonnes per year of CO_2	83,869	77,259
Other greenhouse gas emissions			
N_2O emissions	Tonnes per year of N_2O	8.04	8.88
Equivalent CO_2 emissions from N_2O (row 3 x 310 (the global warming potential of N_2O))	Tonnes per year of CO_2e	2,491	2,754
CH_4 emissions	Tonnes per year of CH_4	60.27	66.63
Equivalent CO_2 emissions from CH_4 (row 5 x 25 (the global warming potential of CH_4))	Tonnes per year of CO_2e	1,507	1,666
Auxiliary burner emissions			
Total fuel consumption	MWh per year	7,533.9	7,553.9
Burner emissions (7,533.9 x 0.25 (the global warming potential of gas oil))	Tonnes per year of CO_2e	1,883	1,883
Total emissions CO_2e	**Tonnes per year of CO_2e**	**89,751**	**83,562**

Table 5.7: Total equivalent CO_2 emissions from the combustion of waste in the proposed ERF

5.29 The total CO_2e emissions associated with the transport of waste and reagents to the proposed ERF, and the transport of residues from the ERF, was calculated to take account of indirect emissions associated with transport, assuming 100% of the transport is by road. The results are set out in table 5.8. If waste and / or residues are transported by ship, then the emissions would be reduced. This is because there would be no net carbon emissions associated with sea transport because it is envisaged that this would divert RDF to Portland Port from existing shipments that currently pass through the English Channel. Therefore, this has not been considered further and the assessment of transport impacts is considered to be conservative and worst case, as a proportion of the waste is expected to be delivered by ship.

3 The figure is lower for the maximum capacity scenario because this assumes additional removal of dense plastics from the waste stream, given the government's focus on this waste type, in accordance with the waste's lower calorific value.

Parameter	Tonnage per year	No. loads required per year	One-way distance (km)	One-way total distance per year (km)	Total CO_2e emissions (tonnes per year)
Nominal design capacity					
Waste to site	182,640	7,610	160	1,217,600	1,958.41
Incinerator bottom ash to recovery	27,396	2,283	160	365,280	587.52
Air pollution control residues to recovery	6,210	230	160	36,800	59.19
Lime to the ERF	3,700	135	350	47,250	76.00
Carbon to the ERF	53	3	300	900	1.45
Ammonia to the ERF	900	90	300	27,000	43.43
Fuel oil to the ERF	595	19	50	950	1.53
Total transport emissions					**2,728**
Maximum capacity					
Waste to site	201,912	8,414	160	1,346,240	2,165.32
Incinerator bottom ash to recovery	30,287	2,524	160	403,840	649.54
Air pollution control residues to recovery	6,865	254	160	40,640	65.37
Lime to the ERF	3,700	135	350	47,250	76.00
Carbon to the ERF	53	3	300	900	1.45
Ammonia to the ERF	900	90	300	27,000	43.43
Fuel oil to the ERF	595	19	50	950	1.53
Total transport emissions					**3,003**

Table 5.8: Indirect CO_2e emissions from the transport of waste, reagents and residues

5.30 The amount of CO_2e emissions offset through electricity generated by the proposed ERF was then calculated. It is intended that the proposed ERF will be able to export power to ships moored in Portland Port that currently run their own engines. The carbon intensity of ship-board power is relatively high, so displacing this type of electricity would have an increased carbon benefit compared to displacing grid power. As the benefits of shore power are dependent on demand, the carbon offset for the proposed ERF has been assessed both with and without shore power (table 5.9).

Item	Value (nominal and maximum capacities)	
Net electricity for export	15.2 MW	
Net electricity exported	121,600 MWh	
Total CO_2 offset through export of electricity to grid only (121,600 x 0.349 (natural gas displacement factor))	**42,438 tonnes CO_2e per year**	
With shore power	***2024***	***2045***
Shore power output	20,328 MWh	24,423 MWh
CO_2 offset through shore power (row above x 0.577 (diesel fuel displacement factor))	11,733 tonnes CO_2e per year	14,097 tonnes CO_2e per year
Electricity output to grid	101,272 MWh	97,177 MWh
CO_2 offset through electricity to grid (row above x 0.349)	35,344 tonnes CO_2e per year	33,915 tonnes CO_2e per year
Total CO_2 offset through exported electricity with shore power	**47,077 tonnes CO_2e per year**	**48,012 tonnes CO_2e per year**

Table 5.9: Offset of CO_2e emissions from the export of electricity from the proposed ERF

5.31 The amount of CO_2e emissions that would be offset if heat is provided from the proposed ERF to a local heat network was also calculated, taking into account the associated reduction in electricity generation (table 5.10).

Item	Value (nominal and maximum capacities)	
Heat output	2.29 MWth	
Total heat output	18,307 MWh	
Natural gas offset (based on a boiler efficiency of 90%)	20,341 MWh	
CO_2 offset through natural gas offset	**4,144 tonnes CO_2e per year**	
Net electrical output (with heat output)	14.85 MWe	
Total electricity generated (with heat output)	118,826 MWh	
Total CO_2 offset through export of electricity to grid only (118,826 x 0.349 (natural gas displacement factor))	**41,470 tonnes CO_2e per year**	
With shore power	***2024***	***2045***
Shore power output	20,328 MWh	24,423 MWh
CO_2 offset through shore power	11,733 tonnes CO_2e per year	14,097 tonnes CO_2e per year
Electricity output to grid	98,489 MWh	94,403 MWh
CO_2 offset through electricity to grid	34,376 tonnes CO_2e per year	32,947 tonnes CO_2e per year
Total CO_2 offset through exported electricity with shore power	**46,109 tonnes CO_2e per year**	**47,043 tonnes CO_2e per year**

Table 5.10: Offset of CO_2e emissions from the export of electricity and heat from the proposed ERF

5.32 The results of the assessment are summarised below in table 5.11, which shows that there will be an estimated net carbon benefit of 21,912 tonnes of CO_2e per year for the nominal design capacity compared to sending the same waste to landfill, increasing to 34,132 tonnes of CO_2e per year in the maximum capacity case. These benefits increase further if power is exported to ships in the port.

Parameter	Tonnes CO_2 per year (nominal capacity)	Tonnes CO_2 per year (maximum capacity)
Releases from landfill gas	81,992	89,158
Transport of waste and outputs to landfill	979	1,083
Offset of grid electricity from landfill gas engines	-11,019	-11982
Total landfill emissions	**71,952**	**78,259**
Transport of waste to and outputs from the ERF	2,728	3,003
Offset of grid electricity with ERF generation	-42,438	-42,438
Emissions from the ERF	89,751	83,562
Total ERF emissions	**50,040**	**44,126**
Net benefit of the ERF	**21,912**	**34,132**
Net benefit with shore power, 2024	26,550	38,771
Net benefit with shore power, 2045	27,485	39,705

Table 5.11: Summary of key results from the assessment

5.33 Table 5.12 summarises the results of the assessment for the plant if heat is also provided, which shows that there will be an estimated net benefit of 25,088 tonnes of CO_2e per year for the nominal design capacity compared to sending the same waste to landfill. This is an improvement of over 3,000 tonnes compared to the power-only case. In the maximum capacity scenario, this increases to 37,308 tonnes of CO_2e per year, and increases further if power is exported to ships in the port.

Parameter	Tonnes CO_2 per year (nominal capacity)	Tonnes CO_2 per year (maximum capacity)
Releases from landfill gas	81,992	89,158
Transport of waste and outputs to landfill	979	1,083
Offset of grid electricity from landfill gas engines	-11,019	-11,982
Total landfill emissions	**71,952**	**78,259**
Transport of waste to and outputs from the ERF	2,728	3,003
Offset of boiler natural gas use	-4,144	-4,144
Offset of grid electricity with ERF generation	-41,740	-41,740
Emissions from the ERF	89,751	83,562
Total ERF emissions	**46,864**	**40,950**
Net benefit of the ERF	**25,088**	**37,308**
Net benefit with shore power, 2024	29,271	41,444
Net benefit with shore power, 2045	30,206	42,378

Table 5.12: Summary of key results from the assessment if heat is provided

5.34 The benefit of the ERF over its lifetime will vary depending on how the national electricity grid decarbonises, when shore power and district heating are implemented, and whether the capture rate of landfill gas improves. This introduces uncertainty. The carbon assessment in technical appendix E includes an illustrative, conservative, calculation that shows that the ERF could reduce greenhouse gas emissions by around 62,000 tonnes of CO_2e over its lifetime. Overall, therefore, it is concluded that the proposed development will have a significant beneficial effect as a result of reduced carbon emissions compared to the baseline.

5.35 As discussed in paragraph 5.18, an analysis was undertaken to examine the sensitivity of these calculations to different grid displacement factors and different landfill gas recovery rates. The full results are presented in technical appendix E, but in summary it found that there would only be a predicted increase in greenhouse gas emissions as a result of the proposed ERF in a scenario with a high landfill gas capture rate, a low grid displacement factor, no heat export and no export of power to ships. This is a very unlikely combination of circumstances, particularly given the global policy shift towards shore power.

Alternative assessment scenarios

5.36 As discussed in paragraph 5.20, Dorset Council requested that the carbon emissions of the proposed ERF be compared with four alternative scenarios. The findings of these assessments are summarised in this section and full details of the assumptions made and assessment methodologies are set out in technical appendix E. The direct carbon emissions from combusting waste would be the same whether it was combusted at the Portland ERF or elsewhere. This means that, from a carbon perspective, the only differences between ERFs at different locations are the impacts from transporting waste and any differences in the carbon displaced by generating power or heat.

Other ERFs in the UK

5.37 The assessment compared two alternative ERFs with the proposed development: Marchwood ERF, which is the closest alternative and is currently used by Dorset Council, and Lakeside energy from waste (EfW) plant near Slough, which is currently used by BCP Council.

5.38 The results of the comparison are summarised in table 5.13.

Element	Marchwood ERF	Lakeside EfW
Difference in transport emissions	-172 tonnes CO_2e per year	+950 tonnes CO_2e per year
Difference in grid displacement	+1,410 tonnes CO_2e per year	-3,350 tonnes CO_2e per year
Total	+1,238 tonnes CO_2e per year	-2,400 tonnes CO_2e per year

Table 5.13: Comparison between proposed ERF and plants at Marchwood and Lakeside

5.39 The assessment shows that sending waste to the Portland ERF would have a slight benefit over using the Marchwood ERF, but a slight disbenefit compared to the Lakeside EfW. However, it should be noted that this does not take account of the potential benefits of exporting power to ships, which is not available at either of the alternative plants and would improve the benefit of sending waste to the Portland ERF by approximately 4,500-5,500 tonnes of CO_2e per year. The potential benefit of providing district heating is also not taken into account, which would be an added benefit for the Portland ERF of approximately 3,000 tonnes of CO_2e per year. Therefore, the potential disbenefit compared to using the Lakeside EfW is more than outweighed by the potential advantages of exporting power to ships at Portland Port.

Other ERFs in Europe

5.40 Comparing the carbon emissions for waste exported to ERFs in Europe is complex, because there are several significant uncertainties in relation to transport emissions, the type of electricity displaced and the potential for exporting heat. If the RDF was exported to Europe from Southampton, the road transport distance would be similar to that for the proposed development, so it is assumed that the road transport emissions would be identical. Shipping 183,000 tonnes of RDF from Southampton to Rotterdam is estimated to generate 834 tonnes of CO_2e per year, while shipping the RDF to Gothenburg would generate 2,387 tonnes of CO_2e per year.

5.41 The type of electricity displaced depends on the country the RDF is sent to. However, overall it is likely that generation of electricity from RDF in Europe would lead to a reduction in fossil fuel generation similar to that in the UK. The main difference between the proposed Portland ERF and facilities in Europe relates to heat export. More European plants are connected to district heating systems than UK plants and many are connected to extensive systems with multiple heat sources and users. Therefore, there is more potential for heat displacement for European plants. If the European plant exports three times as much heat as is assumed for the proposed Portland ERF, the additional benefit would be approximately 9,000 tonnes of CO_2e per year.

5.42 It should be noted that European ERF plants, particularly those linked to district heating schemes, are likely to be running at capacity with significant quantities of waste still being sent to landfill. This means that burning UK waste in these plants means that some other European waste is not being burned and is probably being landfilled.

5.43 Overall, exporting waste to European ERF plants may have a carbon benefit over sending waste to a UK plant because the additional carbon savings from heat displacement would outweigh the additional transport emissions, but it would not contribute to diverting waste from landfill overall.

ERF on an alternative site in Dorset

5.44 The assessment assumed that an ERF constructed on one of the alternative sites would be identical to the proposed development. This meant that the only differences, in carbon terms, would be the distance travelled to deliver waste, the potential for exporting heat and the potential for exporting power directly to users. It did not take into account whether such a facility would be deliverable on the alternative sites.

5.45 The Eco Sustainable Solutions site in Parley has some potential for district heating, but no specific heat users have been identified. It is 10-15 km from Poole and Bournemouth, 50 km from Dorchester and 16 km from Canford Magna mechanical biological treatment (MBT) plant, where 60,000 tonnes of RDF is currently produced from Dorset's waste. This suggests that Dorset's waste would travel around 15 km on average, releasing 184 tonnes of CO_2e per year.

5.46 The Canford Magna, Poole site has potential to supply district heating to Magna Business Park, but no specific heat users have been identified. The site already includes the MBT plant, so the RDF produced by this plant could be processed in an ERF with no transport emissions. The site is 10-15 km from Poole and Bournemouth and 40 km from Dorchester. Allowing for zero transport for the RDF already present, this suggests that Dorset waste would travel around 10 km on average, releasing 122 tonnes of CO_2e per year.

5.47 The Mannings Heath Industrial Estate, Poole site has the potential to supply district heating within the industrial estate, but no specific heat users have been identified. The site is 10 km from the centres of Poole and Bournemouth, 40 km from Dorchester and 6 km from Canford Magna MBT plant. This suggests that Dorset waste would travel around 10 km on average, releasing 122 tonnes of CO_2e per year.

5.48 The Binnegar Environmental Park in East Stoke does not have any potential district heating customers. It is 20-30 km from Dorchester, Poole and Bournemouth and around 24 km from Canford Magna MBT plant. This suggests that Dorset waste would travel around 25 km on average, releasing 306 tonnes of CO_2e per year.

5.49 For comparison purposes, the proposed Portland ERF is 60 km from Canford Magna and a similar distance from Poole and Bournemouth, but only 20 km from Dorchester. This suggests that Dorset waste would travel around 55 km on average, releasing 673 tonnes of CO_2e per year. Therefore, carbon emissions associated with transporting waste by road to the Portland ERF would be between 370 and 550 tonnes of CO_2e greater per year than the allocated sites. However, the Portland ERF has three potential advantages that more than outweigh this disadvantage:

- The potential for district heating, with several potential customers identified, which would displace around 3,000 tonnes of CO_2e per year
- The potential for exporting power to ships in Portland Port, which would displace around 4,500 to 5,500 tonnes of CO_2e per year
- The potential for waste to be delivered by ship from further away, reducing road transport emissions

Existing management of Dorset's waste

5.50 As set out in detail in ES chapter 12, Dorset's residual local authority collected waste (including Bournemouth, Christchurch and Poole) is currently sent outside the county for energy recovery (109,984 tonnes in 2018) or disposal to landfill (51,344 tonnes in 2018). Sending the local authority collected residual waste to the proposed development, together with enough commercial waste from within Dorset to use up spare capacity at the plant, has been assumed for the purposes of the assessment to divert waste from the following three routes:

- 40,000 tonnes of waste sent to ERFs in the UK. The examination of managing RDF at the Marchwood ERF, which is the nearest plant, concluded that the carbon emissions would be similar to those of the proposed development
- 60,000 tonnes of RDF sent to ERFs in Europe. The examination of managing RDF at plants in Europe concluded that sending RDF to a plant in the Netherlands would have an estimated carbon benefit over the proposed development of around 8,000 tonnes of CO_2e for 183,000 tonnes of waste, so the benefit for 60,000 tonnes would be 2,600 tonnes
- 82,000 tonnes of waste sent to landfill in the UK. In the nominal design case, the benefit of the Portland ERF over landfill was 21,912 tonnes of CO_2e for 183,000 tonnes of waste, so the benefit for 82,000 tonnes of waste would be around 9,820 tonnes

5.51 In summary, the benefit of the proposed Portland ERF over the current residual waste management approaches for Dorset's waste is estimated to be 7,200 tonnes of CO_2e per year. It should also be noted that these calculations do not take account of the additional benefits that would be provided by shore power from the proposed Portland ERF, which would displace around 4,500 to 5,500 tonnes of CO_2e per year, or potential for district heating, with several potential customers identified, which would displace around 3,000 tonnes of CO_2e per year.

Mitigation and monitoring

5.52 As the proposed development will lead to a net carbon benefit compared to the baseline, mitigation and monitoring are not required. However, the carbon assessment is based on assumptions about the waste composition, the plant performance and the emissions avoided by exporting electricity and heat. Once the Portland ERF is operating, it will be possible to carry out a more accurate assessment of the net greenhouse gas emissions each year, taking account of the actual waste that is processed, the actual power exported for shore power and to the national grid, the actual heat exported and the carbon emissions associated with grid electricity.

5.53 Powerfuel Portland Limited suggests that a methodology for carrying out an annual greenhouse gas assessment should be agreed with the planning authority. If the results of this methodology show that the plant has released more greenhouse gas emissions than have been displaced through export of electricity and heat and avoidance of landfill, then Powerfuel Portland Limited is committed to using verified carbon offsets to ensure that the process operations are ‘net zero’ over the lifetime of the plant. This will further increase the net benefit of the proposed ERF.

Residual effects

5.54 The significant residual effects are summarised in table 5.13.

Topic	Significant residual effect	Receptor sensitivity	Impact magnitude	Nature	Duration	Degree of effect	Level of certainty
Carbon balance and greenhouse gas emissions	Net carbon benefit of between 21,912 and 42,378 tonnes CO_2e per year, based on grid offset only and grid offset, heat provision and shore power provision respectively, compared to the baseline of sending waste to landfill	N/A	N/A	Beneficial	Long-term	Significant	Reasonable

Table 5.13: Significant residual effects

Cumulative effects

5.55 As discussed in chapter 3, the potential for cumulative effects with a number of consented and proposed developments in the vicinity of the site needs to be considered. All of the other developments will generate greenhouse gas emissions during and post-construction, although these were not specifically calculated in the applications. As the proposed ERF will give rise to significant net carbon benefits, any adverse effects would be solely a result of the other developments and there is no potential for significant cumulative effects with the proposed ERF.