# Medworth Energy from Waste Combined Heat and Power Facility

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Applicant's Response to ISH4 Action Point 7 Technical Note: Climate Additional Sensitivity Assessment

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# 1. Introduction

## 1.1 Background

This technical note has been prepared in response to a request from Cambridgeshire County Council (CCC) at Issue Specific Hearing 4 (ISH 4) on 17 May 2023, where it was considered that further details on the original sensitivity analysis for the Greenhouse Gas (GHG) assessment accompanying the Environmental Statement (ES) (**Appendix 14C (Volume 6.4) [APP-088]**) should be provided. See **ISH 4, action point No.7 [EV-059]**:

Submission of full sensitivity analysis for alternative scenarios to those provided in Appendix 14C of [APP-088] or signposting to existing submissions containing this information. At present in the sensitivity analysis both cases reduce plastics and food waste content and Cambridgeshire County Council wish to see these represented separately.

- The original sensitivity analysis for the ES (**Appendix 14C (Volume 6.4) [APP-088]**) sought to illustrate a range of scenarios in terms of the variables contributing to the assessment of greenhouse gas emissions, i.e. waste composition with increased recycling; offsets for UK energy supplies, including UK grid decarbonisation; and implementation of CHP for the EfW CHP Facility.
- Following discussions with CCC on 20 October 2022 supplementary analysis was submitted in November 2022 (**Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036]**), providing a more detailed sensitivity analysis considering future UK grid decarbonisation applied to the scenario presented as the core case in the ES (ES Case) over the 40 year lifetime of the Proposed Development, and including construction, operational and decommissioning stages (i.e. rather than the net annual operational emissions for the years 2035 and 2050, selected as representative samples in the original ES sensitivity analysis).
- 1.1.4 The purpose of this additional GHG sensitivity analysis is to extend the variables considered for alternative scenarios, particularly with regard to waste composition scenarios proposed by CCC, and to address some of the main shortcomings identified by CCC in the original ES sensitivity analysis with respect to:
  - Consideration of future UK grid decarbonisation across all the alternative scenarios, rather than just the ES Case.
  - Presenting full 40-year lifetime emissions for each alternative scenario (including construction, operational and decommissioning stages, as per the main ES GHG assessment).
  - Presenting gross emissions for the Proposed Development as well as net emissions.
- Additionally, the extended GHG sensitivity analysis includes alternative scenarios that consider other issues raised by CCC during the course of the DCO examination, as well as those included in the original ES sensitivity analysis.



# 1.2 Methodology

- 1.2.1 The Applicant held a call with CCC's Carbon and Energy Manager on 07 June 2023 to agree the scope and methodology for the extended GHG sensitivity analysis, within the timescales of the DCO Examination. Following the discussion and additional correspondence with CCC by email on 20 June 2023 a methodology for the sensitivity analysis was agreed. This also considered the approach used by CCC in their own assessment of GHG emissions for the Proposed Development (Deadline 1 Submission Joint Local Impact Report with Cambridgeshire County Council (paras 9.4.9 to 9.4.10) [REP1-074] and Deadline 4 Submission Deadline 4 Submission Cover letter and Appendices [REP4-028]). The agreed methodology is documented in *Technical Meeting Note Climate Change v2.pdf* (see Appendix A).
- In summary, the methodology for assessing GHG emissions for this sensitivity analysis is in line with Section 14.8 of ES Chapter 14 Climate Change (Volume 6.2) [APP-041], but in addition to the approach used for the original ES sensitivity analysis (Appendix 14C (Volume 6.4) [APP-088]) and subsequent Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036], includes the following:
  - Emissions for the construction, operation and decommissioning stages for each scenario (where relevant for the EfW CHP Facility, Landfill and infrastructure associated with Carbon Capture and Storage).
  - Lifetime operational emissions for each scenario.
  - Presentation of gross emissions for EfW and for Landfill, excluding the offset of emissions for electricity in each case.
- <sup>1.2.3</sup> The Applicant and CCC have acknowledged that, although there are expected to be discrepancies between the ES and CCC approaches, the agreed methodology and proposed alternative scenarios should ensure for a complete assessment of the lifetime net and gross emissions, and consistency for comparison with the GHG assessment reported in the ES.
- <sup>1.2.4</sup> In total, 31 scenarios are included in the extended GHG sensitivity analysis. These are described in Section 2, including the key assumptions for each scenario. CCC's view is that only those scenarios that consider future UK grid decarbonisation are relevant, which the Applicant has sought to address as a significant aspect in the sensitivity analysis.
- <sup>1.2.5</sup> The Applicant considers that Carbon Capture and Storage (CCS) technology will have a significant role in the future decarbonisation of energy supplies, including for EfW CHP facilities. Therefore, in addition to the 23 scenarios confirmed with CCC for the methodology (see **Appendix A**), the Applicant has included 8 additional scenarios that consider the adoption of CCS alongside future decarbonisation of the UK grid. The addition of scenarios for CCS was confirmed with CCC in a meeting on 05 July 2023.



- 1.2.6 This technical note sets out:
  - The scenarios included in the sensitivity analysis, including the assumptions for inputs to be used for each scenario.
  - Results and comment on the sensitivity analysis outputs, presenting gross and net GHG emissions determined for each scenario alongside the ES Case and compared to Landfill and, where relevant, presented for the EfW CHP Facility as a standalone entity.
  - Summary discussion of the sensitivity analysis findings, including consideration of technology, regulations and developing policy.



# 2. Sensitivity Scenarios

- 2.1.1 The scenarios for the extended sensitivity analysis fall under the following broad categories:
  - Waste composition.
  - Electricity generation offsetting.
  - Combined Heat and Power (CHP).
  - Landfill Gas (LFG) capture rate.
  - Adoption of CCS.
- A key aspect for **ISH 4, action point No.7 [EV-059]** was to consider alternatives for waste composition. **Table 2.1** below provides a summary of the variation in waste composition for the agreed scenarios, including a breakdown of the waste categories, equivalent % carbon content, net calorific value (NCV) and annual waste throughput.
- The original ES sensitivity analysis considered the maximum waste throughput of 625,600 tonnes/year as a worse case for each of the variations in waste composition. However, in response to consultation comments, the waste throughput for each waste composition scenario has been adjusted according to the NCV for the waste and capped at the maximum throughput of 625,600 tonnes/year. This results in a reduced waste throughput of 613,573 tonnes/year for the ES Case (applied to the EfW CHP Facility and Landfill). Where relevant, the operating hours and MWe output parameters for the EfW CHP Facility have also been adjusted for each waste composition scenario, which are also identified in **Table 2.1**.
- <sup>2.1.4</sup> The 31 scenarios are set out in **Table 2.2**, along with the key assumptions used for each scenario. General assumptions applicable to the scenarios are included in **Appendix B**.



### Table 2.1 Residual waste composition scenarios and operational parameters

Waste Stream	ES Case	ES Case with reduced recyclables	ES Case with 90% food & plastic	CCC: current residual waste	CCC: 50% reduced plastics	CCC: 50% reduced organics
Recyclable Paper	5.9%	5.5%	8.5%			
Card	6.3%	5.9%	9.1%	12.4% <sup>a</sup>	23.1% <sup>a</sup>	26.1% <sup>a</sup>
Non-recyclable Paper	8.9%	10.4%	16.0%			
Dense Plastic	7.8%	7.3%	1.4%	13.2% <sup>b</sup>	8.0% <sup>b</sup>	19.8% <sup>b</sup>
Plastic film	8.2%	7.7%	1.5%			
Textiles	5.5%	5.1%	7.9%	3.9%	6.0%	6.8%
Misc. Combustible	9.3%	10.9%	16.7%	14.1%	10.2%	11.5%
Misc. Non- Combustible	3.6%	4.2%	6.5%	5.8%	3.9%	4.4%
Other Wastes	0.3%	0.4%	0.5%	-	0.9%	1.0%
Glass	2.6%	2.4%	3.7%			
Ferrous Metals	2.4%	2.2%	3.5%	5.0% <sup>c</sup>	6.7% <sup>c</sup>	7.5% <sup>c</sup>
Non-Ferrous Metals	1.1%	1.0%	1.6%			



Waste Stream	ES Case	ES Case with reduced recyclables	ES Case with 90% food & plastic	CCC: current residual waste	CCC: 50% reduced plastics	CCC: 50% reduced organics
Food Waste	27.0%	25.2%	4.9%			
Garden Waste	2.7%	2.5%	3.9%	41.4% <sup>d</sup>	35.0% <sup>d</sup>	16.0% <sup>d</sup>
Other Organic	2.3%	2.7%	4.1%			
Wood	2.3%	2.1%	3.3%	1.0%	2.5%	2.8%
WEEE	1.1%	1.3%	2.0%	3.3%	3.6%	4.1%
Hazardous	0.5%	0.6%	0.9%	-	-	-
Fines	2.2%	2.6%	4.0%	-	-	-
<b>Operational Parameters</b>						
Total Carbon (% by weight)	26.20%	26.21%	25.49%	24.87%	24.07%	29.91%
Biogenic Carbon (% of Total Carbon)	57.20%	58.35%	74.58%	55.92%	66.96%	50.26%
Non-Biogenic Carbon (% of Total Carbon)	42.80%	41.65%	25.42%	44.08%	33.04%	49.74%



Waste Stream	ES Case	ES Case with reduced recyclables	ES Case with 90% food & plastic	CCC: current residual waste	CCC: 50% reduced plastics	CCC: 50% reduced organics
Net Calorific Value (MJ/kg)	9.53	9.50	8.85	9.05	8.50	11.45
Total waste input (tonnes/yr)	613,573	615,668	625,600	625,600	625,600	503,804
EfW CHP Facility operations (hours/yr)	8,000	8,000	7,667	7,713	7,667	8,000
EfW CHP Facility electricity generation output (MWe)	55.00	55.00	54.08	55.00	51.94	55.00
Notes on EfW CHP operational parameters for variations in waste composition	100% design point with 55 MWe net power output and waste throughput <625,600 t/yr	100% design point with 55 MWe net power output and waste throughput <625,600 t/yr	Reduced boiler load and MWe output plus reduced operation hours not to exceed max. waste throughput of 625,600 t/yr	100% design point with 55 MWe net power output, but reduced operation hours not to exceed max. waste throughput of 625,600 t/yr	Reduced boiler load and MWe output plus reduced operation hours not to exceed max. waste throughput of 625,600 t/yr	100% design point with 55 MWe net power output and waste throughput <625,600 t/yr

<sup>a</sup> CCC waste composition – paper and card combined under one waste stream category

<sup>b</sup> CCC waste composition – all plastics combined under one waste stream category

<sup>c</sup> CCC waste composition – glass and metals combined under one waste stream category

<sup>d</sup> CCC waste composition – food, garden and other organic waste combined under one waste stream category



#### Table 2.2 Extended GHG sensitivity analysis scenarios

(\* indicates scenarios considered as part of the original ES sensitivity analysis or technical note update)

Scenario	Description	Input Assumptions
1	The ES Case	Assumptions and inputs for the ES Case are as described in <b>Section 14.8 of ES Chapter</b> <b>14 Climate Change (Volume 6.2) [APP-041]</b> (noting adjustment for ES Case waste throughput in Table 2.1). In summary:
Waste Cor	nposition – variations with respect to the ES Case	<ul> <li>Assessment of lifetime emissions and project lifecycle stages</li> <li>Waste composition based on WRAP 2017 profile for England<sup>Error! Bookmark not defined.</sup></li> <li>Electricity generation offset based on emissions factor in ES for UK grid average<sup>1</sup></li> <li>Electricity export only for the EfW CHP Facility, no steam export</li> <li>68% landfill gas capture rate for modern, large UK landfill<sup>2</sup></li> <li>No carbon capture and storage</li> <li>Operational parameters are as shown in Table 2.1</li> </ul>
2*	ES Case with reduced recyclables (65% target) (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b>	Assume waste composition as per <b>'<i>Reduced Recyclables'</i></b> in <b>Table 14C.1</b> of <b>Appendix 14C (Volume 6.4) [APP-088].</b> This is as for Scenario 1 ES Case, with a further reduction in recyclables in residual waste, in-line with UK Government policy to achieve a recycling rate of 65% for municipal solid waste by 2035 <sup>3</sup> .
	[APP-088])	Operational parameters are as shown in Table 2.1 – noting adjustment for waste throughput compared to ES Case.

<sup>1</sup> BEIS (2021). Fuel Mix Disclosure Data Table 2020-2021

<sup>&</sup>lt;sup>2</sup> DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling

<sup>&</sup>lt;sup>3</sup> HM Government (2018). England's National Waste Strategy. OUR WASTE, OUR RESOURCES: A STRATEGY FOR ENGLAND



Scenario	Description	Input Assumptions
3*	ES Case with 90% less food and plastics (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> <b>[APP-088]</b> )	Assume waste composition as per ' <b>Reduced Food &amp; Plastic'</b> in <b>Table 14C.1</b> of <b>Appendix 14C (Volume 6.4) [APP-088]</b> . This is as for Scenario 1 ES Case, with a 90% reduction in food and plastics in residual waste, in addition to the 65% recycling rate for other recyclables. Operational parameters are as shown in Table 2.1 – noting adjustment for waste throughput (maximum), operating hours and net electricity generation compared to ES Case.
4	CCC: current residual waste	Assume waste composition as per the 'Cambridgeshire Current Residual Waste Composition' scenario (provided by CCC in Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices [REP4-028]). Operational parameters are as shown in Table 2.1 – noting adjustment for waste throughput (maximum) and operating hours compared to ES Case.
5	CCC: 50% reduced plastics	Assume waste composition as per the ' <i>Reduced Plastics (50% Less than Baseline)</i> ' scenario (provided by CCC in Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices [REP4-028]). Operational parameters are as shown in Table 2.1 – noting adjustment for waste throughput, operating hours and net electricity generation compared to ES Case.
6	CCC: 50% reduced organics	Assume waste composition as per the ' <i>Reduced Food and Garden Waste (50% Less than Baseline</i> )' scenario (provided by CCC in Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices [REP4-028]). Operational parameters are as shown in Table 2.1 – noting adjustment for waste throughput compared to ES Case.



Scenario	Description	Input Assumptions
Electricity	generation offset – variations with respect to the ES Case	
7*	Gas-fired power stations (CCGT) (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> [ <b>APP-088]</b> )	Assume latest emissions factor for electricity generation from natural gas <sup>4</sup>
8*	UK grid decarbonisation – for ES Case (included as previous sensitivity scenarios for annual emissions comparison for 2035 and 2050 in <b>Appendix 14C</b> (Volume 6.4) [APP-088], and 40 year emissions comparison in Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036])	Assume waste composition as per Scenario 1, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>5</sup> over 40 years (for the period 2026 to 2065)
9	UK grid decarbonisation – with reduced recyclables	Assume waste composition as per Scenario 2, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065)
10	UK grid decarbonisation – with 90% less food and plastics	Assume waste composition as per Scenario 3, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065)
11	UK grid decarbonisation – CCC: current residual waste	Assume waste composition as per Scenario 4, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065)

<sup>&</sup>lt;sup>4</sup> DESNZ (2023). Fuel Mix Disclosure Data Table 2021-2022

<sup>&</sup>lt;sup>5</sup> BEIS (2023). Treasury Green Book – Data Tables 1-19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)



Scenario	Description	Input Assumptions
12	UK grid decarbonisation – CCC: 50% reduced plastics	Assume waste composition as per Scenario 5, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065)
13	UK grid decarbonisation – CCC: 50% reduced food	Assume waste composition as per Scenario 6, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065)
Combined	I Heat and Power (CHP) – variations with respect to the ES	Case
14*	CHP, export of steam from the EfW CHP Facility (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> [ <b>APP-088]</b> )	Assume that the EfW CHP Facility would export 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam. Assume latest emissions factors for offsetting UK grid electricity generation <sup>Error! Bookmark not</sup> defined. Assume latest emissions factor for offsetting the use of natural gas as fuel for heating <sup>6</sup> .
15	CHP, export of steam from the EfW CHP Facility UK – including grid decarbonisation	Assume that the EfW CHP Facility would export 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam. Assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not</sup> defined. over 40 years (for the period 2026 to 2065). Assume latest emissions factor for offsetting the use of natural gas as fuel for heating <sup>Error!</sup> Bookmark not defined. up to 2035, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> as source for heating after 2035.

Landfill Gas (LFG) capture rate – variations with respect to the ES Case

<sup>&</sup>lt;sup>6</sup> UK Government (2023). Greenhouse gas reporting: conversion factors 2023



Scenario	Description	Input Assumptions
16	52% LFG capture rate	Assumption based on the LFG collection efficiency reported for older operational UK landfills (Type 3 in MELMod) <sup>7</sup> .
17	52% LFG capture rate – including grid decarbonisation	Assume LFG capture rate as per Scenario 16, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065).
18	85% LFG capture rate	Assumption based on experts' assumptions for the upper instantaneous LFG capture rate for landfill once gas collection infrastructure is installed <sup>Error! Bookmark not defined.</sup> .
19	85% LFG capture rate – including grid decarbonisation	Assume LFG capture rate as per Scenario 18, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065).
Carbon Ca	apture & Storage (CCS) – variations with respect to the ES	Case
20	2030 adoption of CCS by the EfW CHP Facility	Assume incorporation of carbon capture technology for the EfW CHP Facility from 2030 onwards
		The CCS scenario considers emissions related to:
		<ul> <li>carbon capture and CO<sub>2</sub> separation (use of steam and electricity, raw materials and catalysts)</li> <li>compression (use of electricity)</li> <li>transmission by pipeline (construction of pipeline (from the nearby power station only), use of electricity to drive further compression along the pipeline)</li> <li>underground storage (use of electricity)</li> <li>leakage factors</li> </ul>

<sup>7</sup> DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling



Scenario	Description	Input Assumptions
21	2030 adoption of CCS by the EfW CHP Facility – including grid decarbonisation	Assume adoption of CCS as per Scenario 20, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065).
22	2040 adoption of CCS by the EfW CHP Facility	Assume incorporation of carbon capture technology for the EfW CHP Facility from 2040 onwards
		As for Scenario 20, the CCS scenario considers emissions related to:
		<ul> <li>carbon capture and CO<sub>2</sub> separation (use of steam and electricity, raw materials and catalysts)</li> <li>compression (use of electricity)</li> <li>transmission by pipeline (construction of pipeline (from the nearby power station only), use of electricity to drive further compression along the pipeline)</li> <li>underground storage (use of electricity)</li> <li>leakage factors</li> </ul>
23	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation	Assume adoption of CCS as per Scenario 22, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> over 40 years (for the period 2026 to 2065).
In-combin	ation scenarios for UK grid decarbonisation and CCS	
24	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and reduced recyclables (65% target)	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume waste composition as per Scenario 2.
25	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and 90% less food and plastics	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume waste composition as per Scenario 3.
26	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: current residual waste	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume waste composition as per Scenario 4.



Scenario	Description	Input Assumptions
27	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: 50% plastics	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume waste composition as per Scenario 5.
28	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: 50% organics	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume waste composition as per Scenario 6.
29		Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23.
	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CHP, export of steam from the EfW CHP Facility	As for Scenario 15, assume that the EfW CHP Facility would export 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam, and assume latest emissions factor for offsetting the use of natural gas as fuel for heating <sup>Error! Bookmark not defined.</sup> up to 2035, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>Error! Bookmark not defined.</sup> as source for heating after 2035.
30	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation at 52% LFG capture rate	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume a 52% LFG capture rate for older operational UK landfills, as for Scenario 16.
31	2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation at 85% LFG capture rate	Assume adoption of CCS and factors for future UK grid electricity generation as per Scenario 23, and assume an upper limit of 85% LFG instantaneous capture rate for modern UK landfill, as for Scenario 18.



# 3. Sensitivity Analysis Results

# 3.1 Summary Results

- 3.1.1 Summary results for the sensitivity analysis for each scenario are provided in **Table 3.1** below, presenting lifetime gross GHG emissions (excluding emissions avoided for generation of energy by Landfill and the EfW CHP Facility) and lifetime net GHG emissions (including emissions avoided for generation of energy by Landfill and the EfW CHP Facility).
- <sup>3.1.2</sup> For the net emissions a comparison is also included showing the estimated change in emissions from the Proposed Development compared to the Landfill alternative: scenarios indicating a reduction in net GHG emissions from the EfW CHP Facility are highlighted in green in **Table 3.1**; scenarios indicating an increase in net GHG emissions from the EfW CHP Facility are highlighted in red in **Table 3.1**.
- 3.1.3 Observations on some of the key findings of the sensitivity analysis are provided in proceeding sub-sections, with additional graphical representation of the GHG emissions for the scenarios included in the following figures:

### Lifetime gross GHG emissions

- **Figure 3.1**: EfW CHP Facility as a standalone entity for all scenarios.
- Figure 3.2: EfW CHP Facility and landfill for all scenarios.

### Lifetime net GHG emissions

- Figure 3.3: EfW CHP Facility and landfill for all scenarios.
- **Figure 3.4**: EfW CHP Facility and landfill for waste composition scenarios (including UK grid decarbonisation and CCS scenarios).
- **Figure 3.5**: EfW CHP Facility and landfill for CCGT and grid decarbonisation scenarios for the ES Case.
- **Figure 3.6**: EfW CHP Facility and landfill for CHP scenarios (including UK grid decarbonisation and CCS scenarios).
- **Figure 3.7**: EfW CHP Facility and landfill for LFG capture scenarios (including UK grid decarbonisation and CCS scenarios).
- Figure 3.8: EfW CHP Facility and landfill for CCS scenarios.



### Table 3.1 Summary of lifetime gross and net GHG emissions for each scenario

Scenario	Lifetime Gross GHG Emissions (ktCO2e)		Lifetime Net GHG Emissions (kttCO2e)			
	EfW CHP Facility	Landfill	EfW CHP Facility	Landfill	Net change from Proposed Development	
1) ES Case	11,243	11,397	8,040	10,611	-2,572	
Waste Composition – variations with respect to the ES Case						
2) ES Case with reduced recyclables	11,011	11,673	7,808	10,868	-3,060	
3) ES Case with 90% less food and plastics	7,074	14,704	4,055	13,688	-9,632	
4) CCC: current residual waste	11,197	10,792	8,109	10,048	-1,940	
5) CCC: 50% reduced plastics	8,409	12,487	5,509	11,625	-6,116	
6) CCC: 50% reduced organics	12,143	9,413	8,940	8,765	175	
Electricity generation offset – variations with respect to the ES Case						
7) Gas-fired power stations (CCGT)	11,243	11,397	4,696	9,791	-5,095	
8) UK grid decarbonisation – for ES Case	11,243	11,397	10,970	11,330	-361	
9) UK grid decarbonisation – with reduced recyclables	11,011	11,673	10,738	11,604	-866	
10) UK grid decarbonisation – with 90% less food and plastics	7,074	14,704	6,816	14,618	-7,801	



Scenario	Lifetime Gross GHG Emissions (ktCO2e)		Lifetime Net GHG Emissions (kttCO2e)		
	EfW CHP Facility	Landfill	EfW CHP Facility	Landfill	Net change from Proposed Development
11) UK grid decarbonisation – CCC: current residual waste	11,197	10,792	10,934	10,729	205
12) UK grid decarbonisation – CCC: 50% reduced plastics	8,409	12,487	8,161	12,414	-4,253
13)UK grid decarbonisation – CCC: 50% reduced food	12,143	9,413	11,870	9,357	2,512
Combined Heat and Power (CHP) – variations with respect to the ES Case					
14) CHP, export of steam from the EfW CHP Facility	11,243	11,397	5,139	10,542	-5,404
15)CHP, export of steam from the EfW CHP Facility UK – including grid decarbonisation	11,243	11,397	10,138	11,330	-1,193
Landfill Gas (LFG) capture rate – variations with respect to the ES Case					
16)52% LFG capture rate	11,243	17,032	8,040	16,431	-8,391
17)52% LFG capture rate – including grid decarbonisation	11,243	17,032	10,970	16,980	-6,011
18)85% LFG capture rate	11,243	5,411	8,040	4,428	3,611
19)85% LFG capture rate – including grid decarbonisation	11,243	5,411	10,970	5,327	5,642
Carbon Capture & Storage (CCS) – variations with respect to the ES Case					
20)2030 adoption of CCS by the EfW CHP Facility	11,285	11,397	1,185	10,611	-9,427



Scenario	Lifetime Gross GHG Emissions (ktCO2e)		Lifetime Net GHG Emissions (kttCO2e)		
	EfW CHP Facility	Landfill	EfW CHP Facility	Landfill	Net change from Proposed Development
21)2030 adoption of CCS by the EfW CHP Facility – including grid decarbonisation	11,285	11,397	3,397	11,330	-7,933
22)2040 adoption of CCS by the EfW CHP Facility	11,285	11,397	3,100	10,611	-7,511
23)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation	11,285	11,397	5,496	11,330	-5,834
In-combination scenarios for UK grid decarbonisation and CCS					
24)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and reduced recyclables (65% target)	11,053	11,673	5,392	11,604	-6,212
25)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and 90% less food and plastics	7,116	14,704	3,625	14,618	-10,992
26)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: current residual waste	11,239	10,792	5,478	10,729	-5,251
27)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: 50% plastics	8,451	12,487	4,226	12,414	-8,187
28)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: 50% organics	12,185	9,413	5,897	9,357	-3,460
29)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CHP, export of steam from the EfW CHP Facility	11,285	11,397	5,110	11,330	-6,221



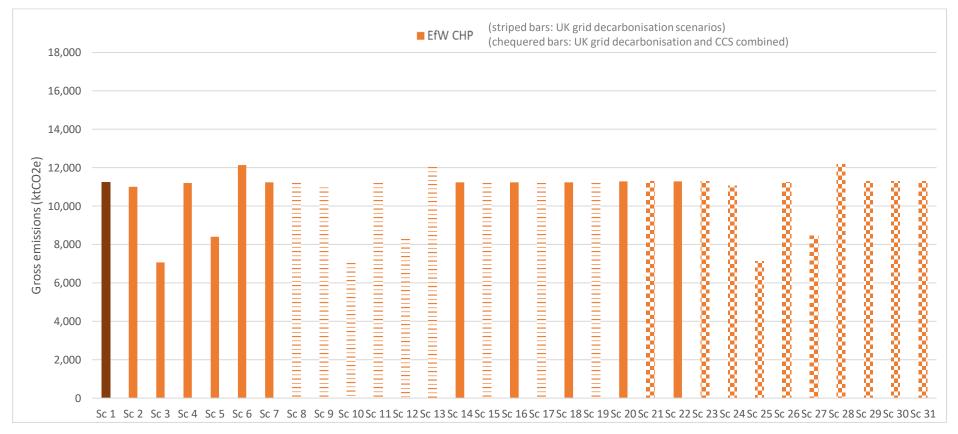
Scenario		Lifetime Gross GHG Emissions (ktCO2e)		Lifetime Net GHG Emissions (kttCO2e)		
	EfW CHP Facility	Landfill	EfW CHP Facility	Landfill	Net change from Proposed Development	
30)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and 52% LFG capture rate	11,285	17,032	5,496	16,980	-11,484	
31)2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and 85% LFG capture rate	11,285	5,411	5,496	5,327	169	

## 3.2 Lifetime Gross Emissions

This section summarises the lifetime gross emissions for each sensitivity scenario, presenting emissions for the EfW CHP Facility as a standalone entity (**Figure 3.1**), and also in comparison to landfill (**Figure 3.2**).



### Figure 3.1 Gross Emissions: EfW CHP Facility – ES Case vs all other scenarios



Lifetime gross GHG emissions for the ES Case are estimated to be 11,243 ktCO<sub>2</sub>e (which as discussed in Section 2 takes account of the representative waste throughput of 613,573 tonnes/year for residual waste with an NCV of 9.53MJ/kg).

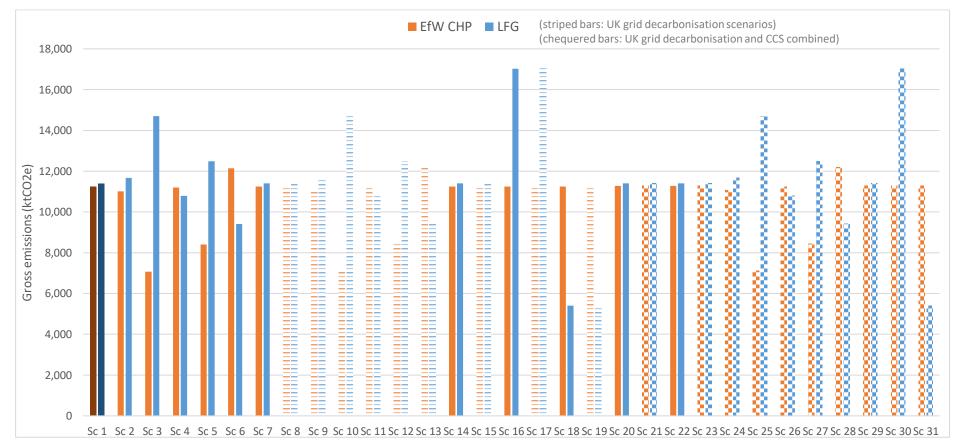
Gross emissions for the EfW CHP Facility are comparatively lower for the scenarios that consider a reduction in plastics alone (Scenarios 5,12 and 27, CCC: 50% less plastic), or a combined reduction in plastics and food (Scenarios 3, 10 and 25, ES Case with 90% reduced food and plastic), which is attributable to the relatively low non-biogenic carbon content of the residual waste for these scenarios (<40% of total carbon, see **Table 2.1**).



- <sup>3.2.4</sup> The maximum gross emissions of 12,143 to 12,185 ktCO<sub>2</sub>e are estimated for Scenarios 6, 13 and 28, which consider a 50% reduction in organic material for the CCC waste profile. This is attributable to an increase in plastics in the residual waste and a related increase in sources of fossil (non-biogenic) carbon emissions for the EfW CHP Facility.
- The other scenarios that indicate potential for a marginal increase in gross emissions compared to the ES Case are some of those that consider adoption of CCS (11,285 ktCO<sub>2</sub>e estimated for Scenarios 20 to 23 and 29 to 31). This relates to the emissions included for the construction and decommissioning of CCS infrastructure (i.e. a connecting pipeline for the EfW CHP Facility).
- For all of the other scenarios the gross emissions are the same as the ES Case (Scenarios 7, 8, 14, 15, 16, 17, 18, 19 and 26, where the waste composition is assumed to be the same as the ES Case), or there is a marginal decrease in gross emissions compared to the ES Core Case (Scenarios 2, 9 and 24, ES Core Case with reduced recyclables, and Scenarios 4, 11 and 26, CCC Current Case).
- <sup>327</sup> When considering lifetime gross emissions for the EfW CHP Facility and landfill (see Figure 3.2 below), the majority of scenarios indicate that gross emissions would be less with the EfW CHP Facility, with the greatest reduction in gross emissions estimated to be for Scenarios 3, 10 and 25 (ES Case with 90% reduced food & plastic). The exceptions to this, where gross emissions are higher for the EfW CHP Facility than landfill, are for Scenarios 4, 11 and 26 (CCC: current residual waste); Scenarios 6, 13 and 28 (CCC: 50% less organics); and Scenarios 18, 19 and 31 (85% LFG capture rate).
- <sup>3.2.8</sup> The scenarios for the 85% LFG capture rate represent the greatest difference in additional gross emissions for the EfW CHP Facility compared to landfill (at 5,832 to 5,874 ktCO<sub>2</sub>e of additional gross emissions), which considers the highest estimate for instantaneous capture of LFG from landfill. Conversely, scenarios for the 52% LFG capture rate (included as the LFG collection efficiency reported for older operational UK landfills<sup>7</sup>) represents some of the greatest reductions in gross emissions for the EfW CHP Facility compared to landfill (5,747 to 5,789 ktCO<sub>2</sub>e reduction in gross emissions).



## Figure 3.2 Gross Emissions: EfW CHP Facility and Landfill (LFG) – ES Case vs all other scenarios



In terms of the waste composition scenarios that were considered by CCC in their own assessment of GHG emissions for the Proposed Development (**Deadline 1 Submission - Joint Local Impact Report with Cambridgeshire County Council** (paras 9.4.9 to 9.4.10) [REP1-074] and **Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices** [REP4-028]), there is alignment in this sensitivity analysis with the pattern identified in the CCC analysis with regard to the following waste composition scenarios (noting that a direct comparison is not possible as the scenarios in this sensitivity analysis now account for lifetime emissions rather than annual operational emissions):

• Scenario 3 (ES Case: 90% reduced food & plastic): gross emissions lower for the EfW CHP Facility than landfill.



- Scenario 4 (CCC: current residual waste): gross emissions higher for the EfW CHP Facility than landfill.
- Scenario 5 (CCC: 50% less plastics): gross emissions lower for the EfW CHP Facility than landfill.
- Scenario 6 (CCC: 50% less organics): gross emissions higher for the EfW CHP Facility than landfill.
- <sup>32,10</sup> This sensitivity analysis differs to the pattern identified in the CCC analysis with regard to Scenarios 1 and 2 (ES Case and ES Case with reduced recyclables), as the CCC analysis identifies that emissions for landfill would be marginally lower than the EfW CHP Facility (in the order of 2 to 5% lower for landfill), whereas for this sensitivity analysis the EfW CHP Facility has marginally lower emissions than landfill (in the order of 1 to 6% lower for the EfW CHP Facility). Aside from the indirect comparison of annual operational emissions and lifetime emissions, the difference between the patterns observed for Scenarios 1 and 2 may be attributable to the carbon content values assigned to the material sub-categories for waste in each sensitivity analysis (i.e. paper/card, plastics etc). This was identified as a potential source of discrepancy in the Technical Meeting Note for this sensitivity analysis (see Appendix A), where it was agreed to use the WRATE model<sup>8</sup> to derive carbon content values, as this was able to accommodate additional detail for material sub-categories in the waste composition.

<sup>&</sup>lt;sup>8</sup> WRATE (2011), Greenhouse Gas Calculator for Municipal Waste. WRATE v2

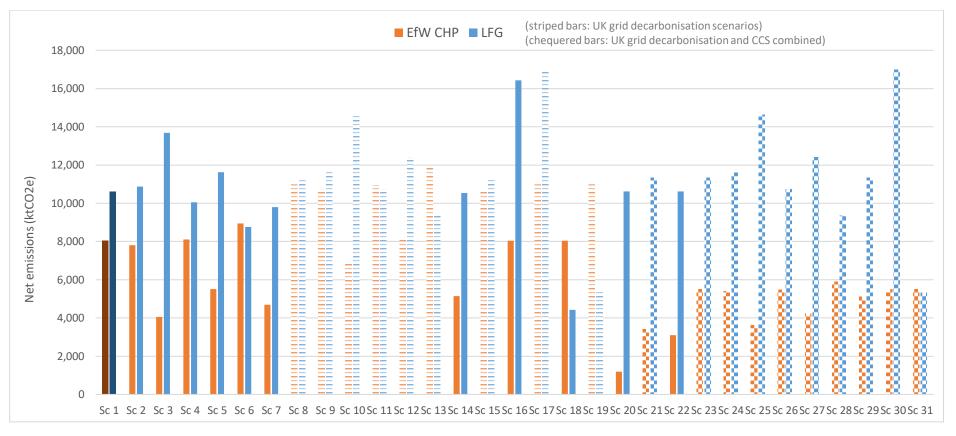


# 3.3 Lifetime Net Emissions

### Net Emissions – all scenarios

<sup>33.1</sup> This section summarises the lifetime net emissions for the sensitivity scenarios, presenting emissions for all of the scenarios in **Figure 3.3**.

### Figure 3.3 Net Emissions: ES Case vs all other scenarios





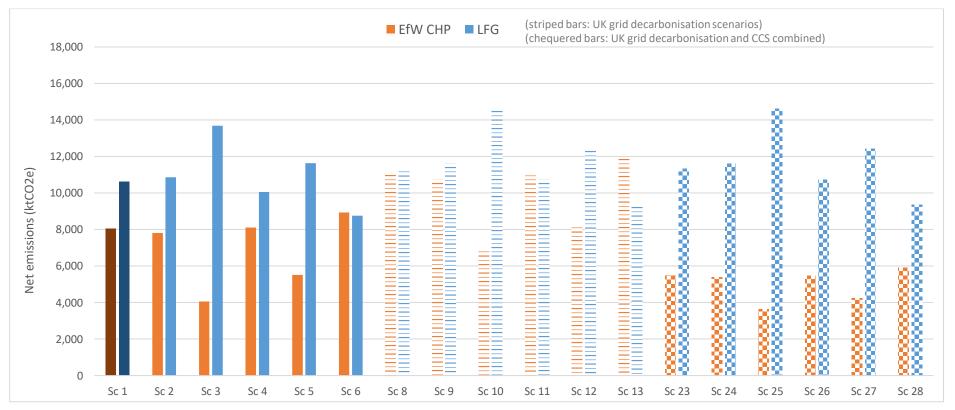
- The lifetime net emissions for each scenario includes consideration of avoided emissions for energy generation (and carbon capture and storage where relevant). The following general observations are made with respect to the lifetime net emissions estimated for the EfW CHP Facility and landfill:
  - As for the gross emissions the majority of scenarios indicate that net emissions would be less for the EfW CHP Facility compared to landfill. Again, among the scenarios with the greatest reduction in estimated net emissions compared to landfill is where there is a combined reduction in plastic and food in residual waste (Scenarios 3 and 25: ES Case with 90% reduced food & plastic); although the highest reduction in estimated net emissions is where decarbonisation and CCS are considered for a LFG capture rate of 52% (Scenario 30).
  - The scenarios where lifetime net emissions are higher for the EfW CHP Facility than landfill are:
    - ► Scenario 11 (CCC: current residual waste with UK grid decarbonisation).
    - Scenarios 6 and 13 (CCC: 50% less organics for the current UK grid average and with UK grid decarbonisation).
    - Scenarios 18 and 19 (85% LFG capture rate for the current UK grid average and with UK grid decarbonisation).
  - Other than the scenarios referred to above, the scenarios with the greatest savings in net emissions compared to landfill (>70% reduction) are those that account for adoption of CCS, i.e. Scenarios 20 to 22 (adoption of CCS by 2030 for the current UK grid average and with UK grid decarbonisation, and adoption of CCS by 2040 for the current UK grid average).
  - As expected, and as identified in the original ES sensitivity analysis, accounting for UK grid decarbonisation (without considering adoption of CCS) reduces the avoided emissions attributable to energy generated by both the EfW CHP Facility and landfill.
- <sup>333</sup> Key observations related to the main categories for the sensitivity analysis (waste composition, electricity generation offsetting, CHP, LFG capture and CCS) accompany the respective **Figures 3.4** to **3.8** below.



Net Emissions – waste composition scenarios

This section considers the lifetime net emissions for the waste composition scenarios, presenting emissions for the relevant scenarios (including for UK grid decarbonisation and adoption of CCS by 2040) in **Figure 3.4**.

### Figure 3.4 <u>Net Emissions:</u> ES Case vs waste composition scenarios



With the exception of Scenario 6 (CCC: 50% reduced organics) the waste composition scenarios that consider current UK grid average emissions (Scenarios 1 to 6) all show a reduction in net lifetime missions for the EfW CHP Facility compared to landfill. In the case of Scenario 6, where organic material in residual waste is reduced but plastics are not, the higher net emissions for the EfW CHP Facility are attributable to an increase in plastics in the residual waste and a related increase in sources of fossil (non-biogenic) carbon emissions for the EfW CHP Facility. The greatest reduction in lifetime net emissions



for the EfW CHP Facility for these scenarios is for Scenario 3 (ES Case with 90% reduced food & plastic) at 9,632 ktCO<sub>2</sub>e, which is in line with the findings of the original ES sensitivity analysis. This is followed by Scenario 5 (CCC: 50% reduced plastics) at 6,116 ktCO<sub>2</sub>e, although this scenario does not allow for an accompanying reduction in organic material in the residual waste.

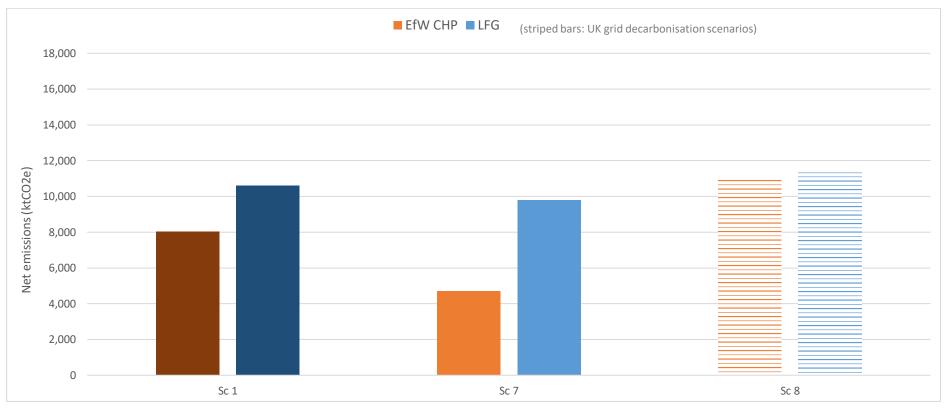
- <sup>3.3.6</sup> When UK grid decarbonisation (without the adoption of CCS) is considered for the waste composition scenarios there is an overall increase in the net emissions for the EfW CHP Facility and for landfill, and the savings attributable to the EfW CHP Facility are reduced; although for most scenarios the EfW CHP Facility would still provide net savings in emissions. However, a change is noted in the case of Scenario 11 (CCC: current residual waste with UK grid decarbonisation), where the analysis indicates that the EfW CHP Facility would no longer provide emissions savings and would have marginally higher emissions than landfill (2% higher net emissions for the EfW CHP Facility for UK grid decarbonisation, compared to net savings of 19% for the EfW CHP Facility for the current UK grid average).
- <sup>33.7</sup> When adoption of CCS by the EfW CHP Facility is considered as part of future UK grid decarbonisation (Scenarios 23 to 28), the analysis indicates the Proposed Development would provide a reduction in net lifetime missions for all of the variations in waste composition, including for CCC: 50% reduced organics and CCC: current residual waste.



Net Emissions - alternative electricity generation scenarios

<sup>33.8</sup> This section focusses on the lifetime net emissions for the ES Case considering sources of electricity generation that would be replaced by the EfW CHP Facility or landfill. Emissions for the relevant scenarios (CCGT and UK grid decarbonisation applied to the ES Case) are presented in **Figure 3.5**.

## Figure 3.5 Net Emissions: ES Case vs replacing CCGT Power Plants and UK grid decarbonisation scenarios





- <sup>3.3.9</sup> Scenario 7 considers the case where electricity generated by both the EfW CHP Facility and landfill would replace electricity generated by gas-fired power stations (CCGT), which is in line with guidance from DEFRA<sup>9</sup> as the reasonable substitute for energy generated by EfW facilities (which was used at PEIR and has been used as a comparator in several development applications<sup>10</sup>, see **Appendix C**). The analysis shows that for this electricity generation scenario there would be a further improvement in the net emissions savings for the EfW CHP Facility compared to landfill, from 24% (for the current UK grid average) to 52% (for CCGT electricity generation).
- Scenario 8 considers the case for future decarbonisation of UK grid average electricity generation, which is a progression on the existing ES Case that considers that the EfW CHP Facility would replace current UK grid average electricity generation. The analysis shows that for this electricity generation scenario there would continue to be net savings for the EfW CHP Facility compared to landfill; however, the savings would be reduced from 24% (for the current UK grid average) to 3% (for UK grid decarbonisation). This is in line with the findings of Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036], submitted in November 2022.

<sup>&</sup>lt;sup>9</sup> DEFRA (2014). *Energy from waste. A guide to the debate.* 

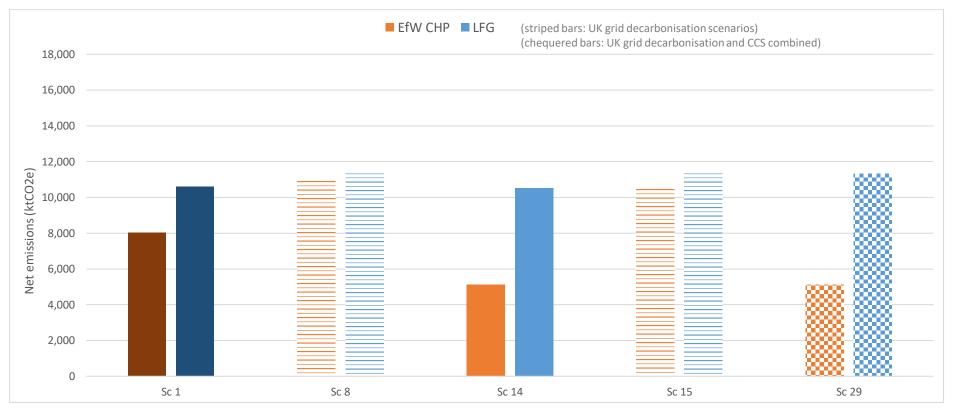
<sup>&</sup>lt;sup>10</sup> Longfield Solar Farm: PINS Ref: EN010118; Wheelabrator Kemsley Generating Station (K3) and Wheelabrator Kemsley North (WKN) Waste to Energy Facility: PINS Ref: EN010083; Mallard Pass Solar Project: PINS Ref: EN010127; North Lincolnshire Green Energy Park: PINS Ref: EN010116; South Humber Bank Energy Centre: PINS Ref: EN010107.



### Net Emissions – CHP scenarios

<sup>3.3.11</sup> This section considers the lifetime net emissions for the CHP scenarios. **Figure 3.6** provides a comparison of net emissions for the ES Case (including with decarbonisation) with scenarios that include CHP for the EfW CHP Facility, with the export of steam for heating as well as the generation of electricity.

### Figure 3.6 Net Emissions: ES Case vs CHP scenarios



For each of the comparison scenarios the implementation of CHP for the EfW CHP Facility would continue to deliver net emissions savings compared to landfill. For Scenario 14 (CHP at the current UK grid average) the net emissions savings would increase to 51%; for Scenario 15 (CHP with UK grid decarbonisation) the net emissions savings would be the lowest



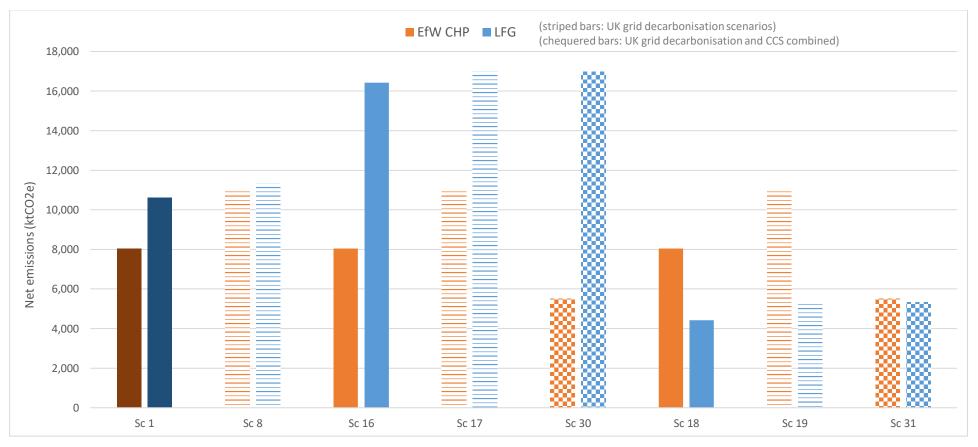
at 6%; and for Scenario 29 (CHP with UK grid decarbonisation and adoption of CCS) the net emissions savings would be greatest at 55%.



#### Net Emissions – LFG capture rate scenarios

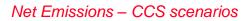
<sup>33.2</sup> This section considers the lifetime net emissions for the LFG capture rate scenarios. **Figure 3.7** provides a comparison of net emissions for the ES Case with variations in LFG capture rates reported for landfills in the UK. For the ES Case a 68% LFG capture rate has been used, which is considered to be representative of the instantaneous capture rate for modern, large landfill operations in the UK<sup>7</sup>.

### Figure 3.7 Net Emissions: ES Case vs LFG capture rate scenarios





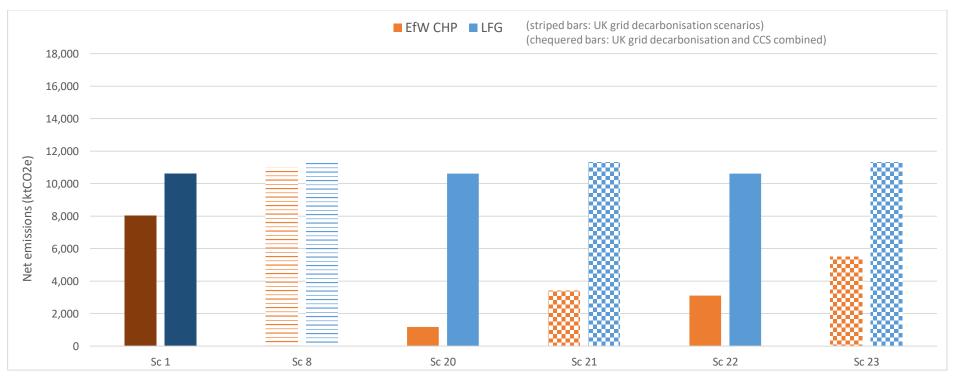
- <sup>3333</sup> Scenarios 16, 17 and 30 assume an LFG capture rate reported for older operational UK landfills, at 52%<sup>7</sup>. For each of these scenarios there is an increase in the net emissions attributable to landfill compared to the ES Case as more methane is considered to escape to the atmosphere. Compared to the ES Case the net emissions savings for the EfW CHP Facility over landfill for these scenarios would increase to between 35% (with UK grid decarbonisation) and 67% (UK grid decarbonisation combined with adoption of CCS).
- <sup>33.4</sup> Conversely, Scenarios 18, 19 and 31 assume an instantaneous LFG capture rate of 85%, reported by experts as the upper bound capture rate once gas collection infrastructure has been installed<sup>7</sup>. For each of these scenarios there is a decrease in the net emissions attributable to landfill, to the point where the EfW CHP Facility would have higher emissions than landfill: 82% higher than landfill for Scenario 18 (current UK grid average); 106% higher than landfill for Scenario 19 (UK grid decarbonisation); and marginally higher than landfill at 3% for Scenario 31 (UK grid decarbonisation combined with adoption of CCS). With the exception of Scenario 31, the 85% LFG capture rate scenarios represent the highest net emissions for the EfW CHP Facility compared to landfill.





<sup>3.3.5</sup> This section considers the lifetime net emissions for the CCS scenarios (excluding those CCS scenarios already discussed in previous sections for waste composition, CHP and LFG capture). **Figure 3.8** provides a comparison of net emissions for the ES Case with scenarios that consider the adoption of CCS technology for capturing carbon dioxide emissions from the EfW CHP Facility by 2030 (Scenarios 20 and 21) and 2040 (Scenarios 22 and 23).

### Figure 3.8 Net Emissions: ES Case vs CCS scenarios



Each of the comparison scenarios show that the adoption of CCS technology at the EfW CHP Facility in the timescales indicated would deliver further improvements in the lifetime net emissions savings for the EfW CHP Facility compared to landfill. Compared to the ES Case, adoption of CCS would increase net emissions savings for the EfW CHP Facility from 24%, to between 51% and 89%. The CCS scenarios represent among the highest net emissions savings for the EfW CHP Facility compared to landfill.



## 4. Summary Discussion

4.1.1 Key findings from the sensitivity analysis and additional context are discussed in the following sections.

### Waste composition

- <sup>4.1.2</sup> The majority of waste composition scenarios indicate that net emissions would be less for the EfW CHP Facility compared to the landfill alternative.
- <sup>4.1.3</sup> The waste composition scenarios with the greatest reduction in estimated net emissions compared to landfill are where there is a combined reduction in plastic and food in residual waste (Scenarios 3, 9 and 25) or a reduction in plastics only in residual waste (Scenarios 5, 12 and 27).
- The waste composition scenarios where lifetime net emissions are higher for the EfW CHP Facility than landfill are where there is a reduction in organics only in residual waste (Scenarios 6 and 13), or the case where the CCC current waste profile is considered in combination with UK grid decarbonisation (Scenario 11).
- 4.1.5 While sensitivity testing can consider scenarios where only plastics or only organics are reduced in residual waste, this does not necessarily align with polices that are seeking to achieve reductions in both plastics and organics in residual waste, i.e. the scenarios may not be mutually exclusive. Further discussion regarding the characteristics of residual waste to be treated at the Proposed Development are included in the Waste Fuel Availability Assessment (WFAA (Volume 7.3) [REP5-019] (Rev 3.0)).
- <sup>4.1.6</sup> Policies targeting a reduction in organics and plastics in waste are described in the recent DEFRA consultation document<sup>11</sup>, seeking evidence to support the elimination of biodegradable waste in landfill as part of the waste sector's road to Net Zero. Amongst other policies and regulations the document includes reference to: working towards eliminating food waste to landfill by 2030; achieving a 65% municipal waste recycling rate by 2035; implementation of the Plastic Packaging Tax (2022); and introduction of the Extended Producer Responsibility for Packaging (pEPR) scheme by 2024. The document also states:

Reforming the way in which recyclable material is collected will be essential to increasing recycling and minimising the volume of biodegradable municipal waste sent to landfill. This will be achieved through the mandatory consistent collection and recycling of a core set of materials (paper and card; glass; metal; plastic; food waste; and garden waste (from households only).

<sup>4.1.7</sup> Based on these policies the likelihood is that plastics and organics would both be reduced in residual waste (along with other recyclable materials), which is considered in part in Scenarios 3, 9 and 25 (ES Case with 90% less food and

<sup>&</sup>lt;sup>11</sup> DEFRA (2023). Call for evidence to support the near elimination of biodegradable waste disposal in landfill from 2028



plastics), although the extent to which a 90% reduction of these materials in residual waste can be achieved is uncertain.

### Electricity generation offsetting

- The scenarios considering the sensitivity of the ES Case with respect to sources of electricity generation replaced by the EfW CHP Facility (CCGT and UK grid decarbonisation) both indicate that net emissions would be less for the EfW CHP Facility compared to landfill.
- 4.1.2 Compared to the net emissions savings for ES Case, there would be an increase in emissions savings where the EfW CHP Facility replaces electricity generated by CCGT (Scenario 7), but the scale of emissions savings would be reduced when compared to electricity generated taking into account UK grid decarbonisation (Scenario 8).
- The grid is expected to be decarbonised in future years and sensitivity tests considering this are included in this sensitivity analysis (and in the **Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036]**), as requested by stakeholders.

### CHP, export of steam from the EfW CHP Facility

- The scenarios that consider implementation of CHP for the EfW CHP Facility show that the export of steam in combination with electricity generation would deliver net emissions savings compared to landfill. The net emissions savings range from 6% for Scenario 15 (UK grid decarbonisation), to 55% for Scenario 29 (CHP with UK grid decarbonisation and adoption of CCS).
- 4.1.2 Operating in CHP mode is the preferred option for the EfW CHP Facility but has not been accounted for in the ES Case on a precautionary basis. As noted in the original sensitivity analysis for the ES opportunities to export steam in combination with electricity are subject to ongoing review to ensure the most effective application of this capability for the EfW CHP Facility.

### LFG capture rate

- <sup>4.1.3</sup> The scenarios for LFG capture rates provide potentially the greatest disparity between estimated savings and increases in net emissions for the EfW CHP Facility compared to landfill.
- At one end of the scale, the 52% LFG capture rate reported for older operational UK landfills<sup>7</sup> would result in net emissions savings for the EfW CHP Facility of between 35% and 67% (Scenarios 16, 17 and 30). Conversely, the 85% LFG capture rate reported by experts as the upper bound capture rate once gas collection infrastructure has been installed<sup>7</sup>, would result in higher emissions for the EfW CHP Facility compared to landfill, in the order of 82% to 105% (for Scenarios 18 and 19); however, the difference is marginal when the adoption of CCS is also considered, i.e. in the order of 3% higher emissions for the Proposed Development for Scenario 31.



- <sup>4.1.5</sup> For the ES Case a 68% LFG capture rate has been used, which is considered to be representative of the instantaneous capture rate for modern, large landfill operations in the UK<sup>7</sup>.
- <sup>4.1.6</sup> There is ongoing debate regarding the most appropriate LFG capture rate to use for landfill emissions. It is noted that in the Climate Change Committee's 6<sup>th</sup> Carbon Budget report for the waste sector<sup>12</sup>, that although LFG capture rates increased significantly in the period up to the early 2010s, LFG capture rates have peaked and are now declining. The 6<sup>th</sup> Carbon Budget for the waste sector includes a baseline LFG capture rate of 60%; an aspirational LFG capture rate by 2050 of 80%; and includes the 68% LFG capture rate used in the ES Case (in the 'Widespread Engagement' scenario for 2030 and 2050). In a supplementary progress report<sup>13</sup> the Climate Change Committee identifies that the Government's pathway to Net Zero assumes no improvement to methane capture rates; the Climate Change Committee's own Balanced Pathway identifies an ambition to capture 80% landfill methane by 2050.

### CCS

- 4.1.7 The scenarios that consider adoption of CCS for the EfW CHP Facility (by 2030 or 2040) show that for each of the scenarios there would be an improvement in the lifetime net emissions savings for the EfW CHP Facility compared to landfill. Compared to the ES Case, adoption of CCS would increase net emissions savings for the EfW CHP Facility from 24%, to between 51% and 89%. The CCS scenarios represent some of the highest net emissions savings for the EfW CHP Facility compared to landfill.
- As identified in **Table 14.15, ES Chapter 14 Climate Change (Volume 6.2) [APP-041**], the EfW CHP Facility will be carbon capture retrofit ready with land set aside for a CCS Facility. It is noted that to support UK grid decarbonisation a carbon dioxide transmission pipeline is being considered at Kings Lynn. A connecting pipeline for carbon captured from the Proposed Development to this transmission pipeline is considered a viable option, which would support the adoption of CCS technology at the EfW CHP Facility.
- <sup>4.1.9</sup> The avoided emissions calculated for each of the scenarios that include adoption of CCS account for the capture of carbon dioxide from fossil sources only and does not include any carbon dioxide captured from biogenic carbon sources.

### Evaluation of Likelihood

It is evident from the outputs of this sensitivity analysis (and previous sensitivity assessments) that there are several variables that can affect the determination of GHG emissions associated with treatment of residual waste by the EfW CHP Facility and its comparison with landfill.

<sup>&</sup>lt;sup>12</sup> Climate Change Committee (2020). *The Sixth Carbon Budget, Waste* 

<sup>&</sup>lt;sup>13</sup> Climate Change Committee (2022). *Progress in reducing emissions, 2022 Report to Parliament* 



The likelihood of each scenario has been considered in terms of the supporting technologies and national policies using the framework presented in **Table 4.1**.

#### Table 4.1 Parameters for determining likelihood for the sensitivity scenarios

Likelihood	Technology and its implementation	<b>Regulations / National Policy</b>
Highly Likely	Existing practice with numerous examples of permitted activity operating for ten years or more in England.	Regulations in place to ensure the change in practice occurs or the new conditions are met.
Likely	Existing practice with one or more examples of permitted activity operating for three years or more in England.	Policies in place and Regulations drafted or proposed to ensure the change in practice occurs or the new conditions are met.
Just as likely as unlikely	May not be existing practice but is identified as Best Available Technique (BAT) with one or more examples of permitted activity in the UK or Europe.	The change in practice or new conditions are the subject of policy consultation or recommendations made by the Climate Change Committee.
Unlikely	May not be existing practice and does not meet the definition of Best Available Technique (BAT).	The change in practice or new conditions have not been the subject of policy consultation or recommended by the Climate Change Committee.

- **Table 4.2** evaluates the scenarios in terms of likelihood with respect to technology and with respect to the status of existing regulations and national policies. This does not necessarily remove the uncertainties but provides a sense-check on the relative significance of the scenarios when considering GHG emissions for the EfW CHP Facility.
- <sup>4.1.13</sup> Of the 31 scenarios, seven are considered *Highly Likely* both in terms of technology and policy. Compared to landfill, six of these scenarios would result in a net reduction in carbon emissions if the Proposed Development went ahead. The reduction in emissions for these six scenarios ranges between -361 and -5,404 ktCO<sub>2</sub>e. There is one scenario (Scenario 11) that is *Highly Likely* and predicted to result in increased emissions, although the increase is only marginal (205 ktCO<sub>2</sub>e).
- 4.1.14 Nine of the scenarios are considered *Likely* in terms of both technology and policy. Compared to landfill, all of these scenarios would result in a net reduction in carbon emissions if the Proposed Development went ahead. The reduction in emissions for these nine scenarios ranges between -3,460 and -11,484 ktCO<sub>2</sub>e.
- <sup>4.1.15</sup> Ten of the scenarios are considered *Just as Likely as Unlikely* for either technology or policy. Eight of these scenarios would result in a net reduction in carbon emissions (-866 to -9,632 ktCO<sub>2</sub>e) and two would result in a net increase (175 to 2,512 ktCO<sub>2</sub>e) if the Proposed Development went ahead.
- <sup>4.1.16</sup> Three of the scenarios are considered *Likely* in terms of technology but *Unlikely* in terms of policy (scenarios 18, 19 and 31). Each of these scenarios include achieving an 85% LFG capture rate and would result in a net increase in carbon emissions for the Proposed Development (169 to 5,642 ktCO2e).
- <sup>4.1.17</sup> The remaining two scenarios are considered *Highly Likely* in terms of technology and *Likely* in terms of policy (scenarios 16 and 17). Both of these scenarios include achieving a 52% LFG capture rate and would result in a net reduction in carbon emissions for the Proposed Development (-6,011 to -8,391 ktCO2e).



### Table 4.2 Review of sensitivity scenario likelihood

Scenario	Difference in net lifetime emissions	Like	lihood	Comments
	between Proposed Development and Landfill (ktCO2e)	Technology and its implementation	Regulations / National Policy	
				This scenario is already being achieved in the UK using existing technology, Local Authority (LA) waste management infrastructure, so is considered <i>Highly Likely</i> for implementation. EfW is preferable to landfill with respect to the waste management hierarchy and therefore remains <i>Highly Likely</i> with respect to existing regulations and national policy.
1) ES Case	-2,572	Highly Likely	Highly Likely	Guidance from DEFRA <sup>14</sup> indicates that in 2014, replacement of electricity generated by CCGT was considered to be the source of energy that would be replaced by EfW plants (as the marginal energy factor was approximately the same as CCGT). However, the guidance recognises that the marginal energy mix is expected to vary over time as a result of the decarbonisation of the grid. As such, the electricity generation offset is based on emissions factor in ES for the current UK grid average (accounting for decarbonisation of the grid since 2014). This is considered to be the source of energy that would be replaced by the EfW CHP Facility.
Waste Composition – variations with respec	t to the ES Case			
2) ES Case with reduced recyclables (65% target)	-3,060	Just as likely as unlikely	Likely	It is considered that technology is available for achieving a 65% recycling rate. However, the latest DEFRA data indicates that current (2021) UK recycling rates are at 44.6% (44.1% for England), which shows limited improvement to the UK recycling

<sup>14</sup> DEFRA (2014). Energy recovery for residual waste A carbon based modelling approach



Scenario	Difference in net lifetime emissions	Like	elihood	Comments
	between Proposed Development and Landfill (ktCO <sub>2</sub> e)	Technology and its implementation	Regulations / National Policy	
				rate in 2015, at 44.5% (44.3% for England) <sup>15</sup> , and there is uncertainty regarding the effectiveness of LA waste management infrastructure to support the level of recycling considered for this scenario.
				National policies include targets to achieve 65% recycling by 2035 for local authority collected waste only. The EfW CHP Facility would also treat industrial and commercial waste for which there is no statutory recycling target.
3) ES Case with 90% less food and plastics	-9,632	Just as likely as unlikely	Likely	Technologies and infrastructure for the separate collection of food and plastic waste are available in the UK. However, the latest DEFRA data <sup>15</sup> indicates minimal improvement in recycling rates since 2015 (see comment for Scenario 2), so considering the implementation of existing LA waste management infrastructure it is unclear whether the 90% reduction in food and plastics in residual waste for this scenario is achievable.
				National policies are in place targeting a reduction in food and plastics in residual waste <sup>11</sup> .
4) CCC: current residual waste	-1,940	Highly Likely	Highly Likely	This scenario is already being achieved by CCC using existing technology, waste management infrastructure and regulations.
5) CCC: 50% reduced plastics	-6,116	Just as likely as unlikely	Likely (but not in isolation)	Technologies and infrastructure for the separate collection of plastics are available in the UK; however, the latest DEFRA data <sup>15</sup> indicates minimal improvement in recycling rates since 2015 (see comment for Scenario 2), so considering the

<sup>15</sup> DEFRA (2023). <u>https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste</u>



Scenario	Difference in net lifetime emissions	Like	elihood	Comments
	between Proposed Development and Landfill (ktCO2e)	Technology and its implementation	Regulations / National Policy	
				implementation of existing LA waste management infrastructure it is unclear whether a 50% reduction in plastics in residual waste for this Scenario is achievable.
				National policies are in place targeting a reduction in plastics in residual waste <sup>11</sup> ; however, for Scenario 5 this unlikely to occur in isolation as policies are also targeting a reduction in organic material in residual waste.
6) CCC: 50% reduced organics	175	Just as likely as unlikely	Likely (but not in isolation)	Technologies and infrastructure for the separate collection of organic material are available in the UK; however, the latest DEFRA data <sup>15</sup> indicates minimal improvement in recycling rates since 2015 (see comment for Scenario 2), so considering the implementation of existing LA waste management infrastructure it is unclear whether a 50% reduction in organics in residual waste for this Scenario is achievable.
				National policies are in place targeting a reduction in organic material in residual waste <sup>11</sup> ; however, for Scenario 6 this unlikely to occur in isolation as policies are also targeting a reduction in plastic material in residual waste.
Electricity generation offset – variations wit	h respect to the ES Case	)		
7) Gas-fired power stations (CCGT)	-5,095	Highly Likely	Highly Likely	CCGT electricity generation is well established and the replacement of electricity generated by CCGT is in line with existing guidance from DEFRA <sup>9</sup> as the reasonable substitute for energy generated by EfW plants.
8) UK grid decarbonisation – for ES Case	-361	Highly Likely	Highly Likely	



Scenario	Difference in net Like		elihood	Comments
	between Proposed Development and Landfill (ktCO <sub>2</sub> e)	Technology and its implementation	Regulations / National Policy	
9) UK grid decarbonisation – with reduced recyclables (65% target)	-866	Just as likely as unlikely	Likely	
10) UK grid decarbonisation – with 90% less food and plastics	-7,801	Just as likely as unlikely	Likely	Grid decarbonisation is a key part of UK Government policy to achieve carbon net zero. The technologies and policies to make this happen are all considered <i>Highly Likely</i> . It is noted that as part of UK grid decarbonisation it is likely that CCS technology
11) UK grid decarbonisation – CCC: current residual waste	205	Highly Likely	Highly Likely	would be installed for the EfW CHP Facility, so the additional benefits identified for Scenarios 21 and 23 may be applicable for each of the UK grid decarbonisation scenarios.
12) UK grid decarbonisation – CCC: 50% reduced plastics	-4,253	Just as likely as unlikely	Likely (but not in isolation)	For the purposes of this sensitivity analysis, the technology and policy likelihood is based on the underlying scenario. For example, Scenario 2 underlines Scenario 9.
<ul> <li>UK grid decarbonisation – CCC:</li> <li>50% reduced food</li> </ul>	2,512	Just as likely as unlikely	Likely (but not in isolation)	
Combined Heat and Power (CHP) – variatior	ns with respect to the ES	Case		
14) CHP, export of steam from the EfW CHP Facility	-5,404	Highly Likely	Highly Likely	This scenario is already being achieved in the UK using existing technology and regulations. Potential to use the heat generated by the EfW CHP Facility is supported the UK Government's Energy Bill <sup>16</sup> , which includes

<sup>&</sup>lt;sup>16</sup> UK Government (2022). *The Energy Bill 2022-23, parts 7-10: heat networks, smart appliances, load control and energy performance of buildings.* <u>https://commonslibrary.parliament.uk/research-briefings/cbp-9787/</u>



Scenario	Difference in net Likelihood		lihood	Comments
	between Proposed Development and Landfill (ktCO <sub>2</sub> e)	Technology and its implementation	Regulations / National Policy	
				provisions for the creation and regulation of designated heat network zones, where zoning will be used to require heat network installation in new buildings as the first option for heat provision.
(E) CUD expert of steep from the				As for Scenario 14
15) CHP, export of steam from the EfW CHP Facility UK – including grid decarbonisation	-1,193	Highly Likely	Highly Likely	(see comment above for Scenarios 8-13 regarding relevance of grid decarbonisation in relation to technology and regulation/policy).
Landfill Gas (LFG) capture rate – variations	with respect to the ES C	ase		
16) 52% LFG capture rate	-8,391	Highly Likely	Likely	This scenario is already being achieved in the UK using existing technology and regulations.
				As for Scenario 17
17) 52% LFG capture rate – including grid decarbonisation	-6,011	Highly Likely	Likely	(see comment above for Scenarios 8-13 regarding relevance of grid decarbonisation in relation to technology and regulation/policy).
18) 85% LFG capture rate	3,611	Likely	Unlikely	An instantaneous LFG capture rate of 85% is considered to be the upper bounds of what is achievable for UK landfill once gas collection infrastructure has been installed, although it is not certain how widely this is achieved in the UK and whether this can be sustained over the lifetime of a landfill. The Climate Change Committee identifies an ambition to achieve a lower LFG capture rate of 80% by 2050, and also



Scenario	Difference in net lifetime emissions	Like	lihood	Comments
	between Proposed Development and Landfill (ktCO₂e)	Technology and its implementation	Regulations / National Policy	
				identifies that the Government's pathway to Net Zero assumes no improvement to methane capture rates <sup>13</sup> .
19) 85% LFG capture rate – including grid decarbonisation	5,642	Likely	Unlikely	As for Scenario 18 (see comment above for Scenarios 8-13 regarding relevance of grid decarbonisation in relation to technology and regulation/policy).
Carbon Capture & Storage (CCS) – variatior	is with respect to the ES	Case		
20) 2030 adoption of CCS by the EfW CHP Facility	-9,427	Just as likely as unlikely	Likely	There are no examples of CCS technology being applied to EfW facilities in the UK but CCS technology has been adopted by energy generation facilities in Europe and the UK, including use with Anaerobic Digestion facilities and trials for application to EfW facilities. For 2030 the implementation of CCS technology for EfW is considered <i>Just as likely as unlikely</i> , including trials for application to EfW facilities. The implementation of CCS technology for EfW by 2030 is considered <i>Just as likely as unlikely</i> .
				UK Government has laid out its goal of CCS being available for widespread deployment by 2030 <sup>17</sup> . Additionally, the recent consultation response from the UK Government confirming that EfW facilities will be included in the UK Emissions Trading Scheme (UK ETS) from 2028, also highlights the potential incentive that UK ETS introduces to encourage the adoption of

<sup>17</sup> <u>https://www.gov.uk/guidance/uk-carbon-capture-and-storage-government-funding-and-support</u>



Scenario	Difference in net lifetime emissions	Likelihood		Comments	
	between Proposed Development and Landfill (ktCO <sub>2</sub> e)	Technology and its implementation	Regulations / National Policy		
				CCS by EfW facilities and financial support to be available through the CCS Infrastructure Fund <sup>18</sup> .	
				As for Scenario 20	
21) 2030 adoption of CCS by the EfW CHP Facility – including grid decarbonisation	-7,933	Just as likely as unlikely	Likely	(see comment above for Scenarios 8-13 regarding relevance of grid decarbonisation in relation to technology and regulation/policy).	
22) 2040 adoption of CCS by the EfW	7 544	Likely	Litaka	There are no examples of CCS technology being applied specifically to EfW facilities in the UK but CCS technology has been adopted in Europe and the UK, including use with Anaerobic Digestion facilities and trials for application to EfW facilities. For 2030 the implementation of CCS technology for EfW is considered <i>Just as likely as unlikely</i> , including trials for application to EfW facilities. The implementation of CCS technology for EfW facilities. The implementation of CCS technology for EfW by 2040 is considered <i>Likely</i> .	
CHP Facility	-7,511		Likely	UK Government has laid out its goal of CCS being available for widespread deployment by 2030 <sup>17</sup> . Additionally, the recent consultation response from the UK Government confirming that EfW facilities will be included in the UK Emissions Trading Scheme (UK ETS) from 2028, also highlights the potential incentive that UK ETS introduces to encourage the adoption of CCS by EfW facilities and financial support to be available through the CCS Infrastructure Fund <sup>18</sup> .	

<sup>&</sup>lt;sup>18</sup> UK Government (2023). *Developing the UK Emissions Trading Scheme: Main Response*. <u>https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets</u>



Scenario	Difference in net L		lihood	Comments
	between Proposed Development and Landfill (ktCO₂e)	Technology and its implementation	Regulations / National Policy	
23) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation	-5,834	Likely	Likely	As for Scenario 22 (see comment above for Scenarios 8-13 regarding relevance of grid decarbonisation in relation to technology and regulation/policy).
In-combination scenarios for UK grid decar	bonisation and CCS			
24) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and reduced recyclables (65% target)	-6,212	Likely	Likely	On balance, with respect to implementation of CCS technology by 2040 this scenario is considered to be <i>Likely</i> (see Scenario 22). Noting the development of national policy with respect to CCS and incentives to adopt CCS prompted by the inclusion of EfW in UK ETS (see Scenario 20), this scenario is considered <i>Likely</i> .
25) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and 90% less food and plastics	-10,992	Likely	Likely	As for Scenario 24
26) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: current residual waste	-5,251	Likely	Likely	As for Scenario 24



Scenario	Difference in net lifetime emissions	Like	lihood	Comments
	between Proposed Development and Landfill (ktCO2e)	Technology and its implementation	Regulations / National Policy	
27) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: 50% plastics	-8,187	Likely	Likely	As for Scenario 24
28) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CCC: 50% organics	-3,460	Likely	Likely	As for Scenario 24
29) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation and CHP, export of steam from the EfW CHP Facility	-6,221	Likely	Likely	As for Scenario 24
30) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation at 52% LFG capture rate	-11,484	Likely	Likely	As for Scenario 24
31) 2040 adoption of CCS by the EfW CHP Facility – including grid decarbonisation at 85% LFG capture rate	169	Likely	Unlikely	As for Scenario 24 but noting comments under Scenario 18 with respect to the likelihood of achieving a LFG capture rate of 85% this scenario is considered to be Unlikely in terms of regulation and National policy.



### Sensitivity analysis summary

- <sup>4.1.18</sup> The majority of scenarios show that the EfW CHP Facility would be expected to deliver a reduction in GHG emissions compared to landfill over the lifetime of the Proposed Development.
- Future residual waste composition may vary, particularly when considering ambitions to increase recycling of plastics and organic materials; however, noting the latest data available on recycling rates for the UK and England<sup>15</sup>, there is uncertainty regarding the ability of the UK to achieve its existing recycling targets for 2035, and the current assumed residual waste composition is considered to be appropriate for the ES Case. Feasible future scenarios where organics and plastics in the waste stream reduce in combination also indicate that the EfW CHP Facility would have lifetime GHG emissions lower than the landfill alternative.
- If assessment considers decarbonisation of UK Grid electricity generation on an annual basis towards 2050, this would reduce the scale of savings derived from avoided emissions for the EfW CHP Facility; however, comparing the carbon intensity to the UK current grid average emissions (i.e. the current energy generation facilities that would be replaced by new developments) is considered to be appropriate for the ES Case (rather than CCGT, which was considered to be an appropriate comparator in 2014). It is also noted that as part of UK grid decarbonisation it is likely that CCS technology may be expected to be installed for the EfW CHP Facility as part of UK grid decarbonisation, so the additional benefits identified for Scenarios 21 and 23 to 31 may be applicable for each of the UK grid decarbonisation scenarios.
- 4.1.21 Exporting steam from the EfW CHP Facility in addition to electricity, and the adoption of CCS, would enhance the net savings in emissions attributable to the EfW CHP Facility. These were not considered in the ES Case as there are technical and commercial decisions that need to be made, but the Applicant is committed to these technologies (as set out in Requirements 22, 23 and 25 of Schedule 2 to the draft DCO Volume 3.1 (Rev 5) (Deadline 6 submission), so the benefits (that are not feasible in the landfill alternative) are considered *Highly Likely* (steam export) and *Likely* (CCS).
- <sup>4.1.22</sup> The additional sensitivity assessment presented in this document demonstrates the complexity in determining GHG emissions for a range of scenarios. Noting the points above, and that there is potential for variation in the factors for estimating GHG emissions for conceivable future scenarios, the assessment of GHG emissions presented in the original ES (the ES Case) is considered to be a reasonable and appropriate approach for the Proposed Development.



## Appendix A Technical Meeting Note Climate Change v2.pdf

## Medworth Energy from Waste Combined Heat and Power Facility

PINS ref. EN010110 Document Reference: N/A June 2023



# **Technical Note**

**Climate Change** 

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# 1. Introduction

This technical note has been prepared in response to a request from Cambridgeshire County Council (CCC) at Issue Specific Hearing 4 (ISH 4) on 17 May 2023, where it was considered that further details on the original sensitivity analysis for the GHG assessment accompanying the Environmental Statement (ES) (Appendix 14C (Volume 6.4) [APP-088]) should be provided. See ISH 4, action point No.7 [EV-059]:

Submission of full sensitivity analysis for alternative scenarios to those provided in Appendix 14C of [APP-088] or signposting to existing submissions containing this information. At present in the sensitivity analysis both cases reduce plastics and food waste content and Cambridgeshire County Council wish to see these represented separately.

- As requested the Applicant has provided the details of the original sensitivity analysis to CCC.
- The original sensitivity analysis for the ES sought to illustrate a range of scenarios in terms of the variables contributing to the assessment of greenhouse gas emissions, i.e. waste composition with increased recycling; offsets for UK energy supplies, including UK grid decarbonisation; and implementation of CHP for the EfW CHP facility. Stakeholders consider that it would be helpful to provide additional alternative scenarios, particularly with regard to waste composition.
- The Applicant held a call with CCC's Carbon and Energy Manager on 07 June 2023 to agree the scope of additional sensitivity analysis, within the timescales of the DCO Examination. Following the discussion this technical note has been prepared outlining the approach to be agreed with CCC for carrying out further sensitivity analysis.
- 1.1.5 The technical note sets out:
  - the methodology for assessment of GHG emissions;
  - scenarios proposed to be included in the additional sensitivity analysis, including the assumptions for inputs to be used for each scenario; and
  - the outline schedule to provide the additional sensitivity analysis by Deadline 6.



## 2. Assessment methodology

- The methodology used for the GHG assessment in the ES is described in detail in Section 14.8 of ES Chapter 14 Climate Change (Volume 6.2) [APP-041], with additional detail relevant to the sensitivity analysis for the ES included in Appendix 14C (Volume 6.4) [APP-088] and the subsequent Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036].
- The methodology used by CCC for a comparable assessment of GHG emissions for additional waste composition scenarios is summarised in Fenland District Council's (FDC) **Deadline 1 Submission - Joint Local Impact Report with Cambridgeshire County Council (paras 9.4.9 to 9.4.10) [REP1-074]** and described in CCC and FDC's **Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices [REP4-028]**. This is reported to be based on the Waste Emissions Calculator for local authorities, from Local Partnerships; developed as part of a research project by University College London and CCC, funded by the Local Government Association.
- A high-level comparison of the methodologies used by the Applicant and CCC is provided in Table 2.1. This highlights key differences between the approaches used and comments on how this can be addressed in the methodology for the additional sensitivity analysis (please note, this does not include assumptions regarding aspects such as waste composition or UK grid decarbonisation as these are included with the scenarios proposed in Section 3).

Assessment item	ES methodology	CCC methodology	Comment
Project lifecycle stages	The core case presented in the ES considered emissions for <b>construction, operation</b> and <b>decommissioning</b> of the EfW CHP facility, and emissions for operation of Landfill. The sensitivity analysis presented in ES Appendix C considered <b>operational process</b> emissions only for the EfW CHP facility and Landfill.	consideredtheoperationalprocessemissionsonlyfortheEfWCHPfacilityandLandfill(inorderto	For completeness, and in line with the main ES Chapter 14, each of the scenarios proposed for the additional sensitivity analysis will include each project lifecycle stage, i.e. <b>construction, operation</b> (process and transport) and <b>decommissioning</b> (excluding construction and decommissioning for landfill).



Assessment item	ES methodology	CCC methodology	Comment
Lifetime emissions	The core case presented in the ES considered operational lifetime emissions (over 40 years) for the EfW CHP facility and Landfill. The sensitivity analysis presented in ES Appendix C considered annual operational process emissions for the EfW CHP facility and Landfill.	As well as an annual assessment the CCC assessment included <b>lifetime operational</b> <b>process emissions</b> (over 40 years) for the EfW CHP facility and Landfill.	<b>Operational lifetime</b> <b>emissions (over 40</b> <b>years)</b> will be presented for each of the scenarios proposed for the additional sensitivity analysis (and as noted above, this will also include construction and decommissioning for the EfW CHP facility).
Gross emissions and net emissions	The ES core case presented a summary of <b>net emissions</b> for comparison of the EfW CHP facility and Landfill, which included offsetting of emissions for electricity generation in both cases. The sensitivity analysis in ES Appendix C presented a summary of <b>net annual</b> <b>emissions savings</b> for comparison of the EfW CHP facility with Landfill, which included offsetting of emissions for electricity generation for EfW and Landfill.	The CCC assessment presented a summary of <b>gross emissions</b> for comparison of the EfW CHP facility and Landfill, which excluded offsetting of emissions for electricity generation in both cases.	As well as presenting <b>net</b> <b>emissions</b> , the additional sensitivity analysis will clearly present the <b>gross</b> <b>emissions</b> for the EfW CHP facility as a standalone entity (irrespective of, or as well as, any comparison to Landfill), i.e. prior to accounting for any emissions saved by replacing alternative sources of electricity generation.
Waste composition categories	The waste composition for the ES core case and the sensitivity analysis in Appendix C is based on <b>19 waste category</b> <b>items</b> (based on WRAP 2017 residual waste composition data <sup>1</sup> ).	The waste composition for the CCC assessment is based on <b>10 waste</b> category items, which combines some of the categories presented in the ES (e.g. 'Paper', 'Card' and 'Non- recyclable paper' under 'Paper and card'; 'Food',	This is not considered to be a likely material difference between the methodologies but is highlighted as a potential source of discrepancy between the scale of emissions calculated for the same waste composition (as

<sup>&</sup>lt;sup>1</sup> WRAP (2020). National Municipal Waste Composition, England 2017, Table 3.

Assessment item	ES methodology	CCC methodology	Comment
		<i>'Garden' and 'Other Organic'</i> under <i>'Organic</i> <i>Waste'</i> ).	combining waste category items may lead to differences in the carbon content derived). The additional sensitivity analysis will use the <b>most</b> <b>detailed breakdown of</b> <b>waste category items</b>
			available.
Waste carbon content	The carbon content and NCV value used in the ES core case and the sensitivity analysis in Appendix C is based on the WRATE Greenhouse Gas Calculator for Municipal Waste model <sup>2</sup> (and WRAP 2017 residual waste composition data <sup>1</sup> ), which assigns factors to 15 separate waste categories.	The carbon content for the CCC assessment is based on allocation for waste categories in <b>IPCC</b> <b>Guidelines</b> <sup>3</sup> , which assigns factors to 10 separate waste categories	This is not considered to be a likely material difference between the methodologies but as above regarding the level of detail for waste composition, is highlighted as a potential source of discrepancy between the scale of emissions calculated for the same waste composition. The additional sensitivity analysis will use the <b>WRATE model to derive</b> <b>carbon content and</b> <b>NCV values</b> , as this will be able to greater accommodate the additional detail in waste composition breakdown.

In summary, it is proposed that the methodology for assessing GHG emissions for the additional sensitivity analysis will be in line with Section 14.8 of ES Chapter 14 Climate Change (Volume 6.2) [APP-041], but in addition to the approach used for the original ES sensitivity analysis (Appendix 14C (Volume 6.4) [APP-088]) and subsequent Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036], will include the following:

 $<sup>^{\</sup>rm 2}$  WRATE (2011), Greenhouse Gas Calculator for Municipal Waste. WRATE v2

<sup>&</sup>lt;sup>3</sup> IPCC (2006). Table 2.4 in 2006 IPCC Guidelines, Vol. 5, Ch. 2



- Emissions for the construction, operation and decommissioning stages for each scenario (where relevant for the EfW CHP facility and Landfill)
- Lifetime operational emissions for each scenario.
- Presentation of gross emissions for EfW and for Landfill, excluding offset of emissions for electricity in each case.
- Allowing for expected discrepancies between the ES and CCC approaches identified in Table 2.1, this should ensure for a complete assessment of the lifetime net and gross emissions, and consistency for comparison with the GHG assessment reported in the ES.



# 3. Proposed scenarios and assumptions

- The proposed scenarios for additional sensitivity analysis are set out in Table 3.1, along with the assumptions for inputs (subject to further review and agreement by CCC and the Applicant). This follows discussions with CCC on 07 June 2023, which as well as taking account of the request for greater consideration of alternatives for waste composition (**ISH 4, action point No.7 [EV-059]**), also considers other issues raised by CCC during the course of the DCO examination. Following feedback from CCC via email on 15 June 23 on the initial draft of the technical note (submitted to CCC on 14 June 2023), five additional scenarios are included to also consider UK grid decarbonisation for the scenarios relating to CHP, LFG capture rate and adoption of CCS. The proposed scenarios for sensitivity testing fall under the following broad categories:
  - Waste composition;
  - Electricity generation offsetting;
  - Combined heat and power (CHP);
  - Landfill gas (LFG) capture rate; and
  - Adoption of Carbon Capture and Storage (CCS).
- In total, 23 scenarios (including the ES core case) will be provided for comparison of lifetime net emissions for the EfW CHP facility and Landfill (i.e. including the offset of emissions for electricity generation). In addition, for each of the 23 scenarios gross emissions will be presented for the EfW CHP facility as a standalone entity (prior to the offset of emissions for electricity generation), as well as gross emissions in comparison to Landfill.



### Table 3.1 Proposed scenarios for GHG assessment sensitivity analysis

(\* indicates scenarios considered as part of the original ES sensitivity analysis or technical note update)

Scenario	Description	Input Assumptions
1	The ES Core Case	Assumptions and inputs for the ES Core Case are as described in <b>Section</b> <b>14.8 of ES Chapter 14 Climate Change (Volume 6.2) [APP-041]</b> ). In summary:
		<ul> <li>Assessment of lifetime emissions and project lifecycle stages</li> <li>Waste composition based on WRAP 2017 profile for England<sup>1</sup></li> <li>Electricity generation offset based on emissions factor in ES for UK grid average<sup>4</sup></li> <li>Electricity export only for the EfW CHP facility, no steam export</li> <li>68% landfill gas capture rate for modern, large UK landfill<sup>5</sup></li> <li>No carbon capture and storage</li> </ul>
Waste Con	position – variations with respect to the ES Core Case	
2*	ES Core Case with reduced recyclables (65% target) (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> [ <b>APP-088</b> ])	Assume waste composition as per <b>'Reduced Recyclables'</b> in <b>Table 14C.1</b> of <b>Appendix 14C (Volume 6.4) [APP-088].</b> This is as for Scenario 1 ES Core Case, with a further reduction in recyclables in residual waste, in-line with UK Government policy to achieve a recycling rate of 65% for municipal solid waste by 2035 <sup>6</sup> .
3*	ES Core Case with 90% less food and plastics	Assume waste composition as per ' <i>Reduced Food &amp; Plastic</i> ' in Table 14C.1 of Appendix 14C (Volume 6.4) [APP-088]. This is as for Scenario 1 ES Core

 $<sup>^{\</sup>rm 4}$  BEIS (2021). Fuel Mix Disclosure Data Table 2020-2021

<sup>&</sup>lt;sup>5</sup> DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling

<sup>&</sup>lt;sup>6</sup> HM Government (2018). England's National Waste Strategy. OUR WASTE, OUR RESOURCES: A STRATEGY FOR ENGLAND



Scenario	Description	Input Assumptions
	(included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> [ <b>APP-088]</b> )	Case, with a 90% reduction in food and plastics in residual waste, in addition to the 65% recycling rate for other recyclables.
4	CCC: current residual waste	Assume waste composition as per the <b>'Cambridgeshire Current Residual</b> <b>Waste Composition'</b> scenario (provided by CCC <b>in Deadline 4 Submission</b> <b>- Deadline 4 Submission - Cover letter and Appendices [REP4-028]</b> ).
5	CCC: 50% reduced plastics	Assume waste composition as per the ' <i>Reduced Plastics (50% Less than Baseline)</i> ' scenario (provided by CCC in Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices [REP4-028]).
6	CCC: 50% reduced organics	Assume waste composition as per the ' <i>Reduced Food and Garden Waste</i> (50% Less than Baseline)' scenario (provided by CCC in Deadline 4 Submission - Deadline 4 Submission - Cover letter and Appendices [REP4-028]).
Electricity	generation offset – variations with respect to the ES Core	Case
7*	Gas-fired power stations (CCGT) (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> [ <b>APP-088]</b> )	Assume latest emissions factor for electricity generation from natural gas <sup>7</sup>

<sup>&</sup>lt;sup>7</sup> DESNZ (2023). Fuel Mix Disclosure Data Table 2021-2022



Scenario	Description	Input Assumptions
8*	UK grid decarbonisation – for ES Core Case (included as previous sensitivity scenarios for annual emissions comparison for 2035 and 2050 in <b>Appendix 14C</b> (Volume 6.4) [APP-088], and 40 year emissions comparison in Technical Meeting Note (TNCC01) (provided at Appendix 9.2c (Part 9) [REP1-036])	Assume waste composition as per Scenario 1, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065)
9	UK grid decarbonisation – with reduced recyclables	Assume waste composition as per Scenario 2, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065)
10	UK grid decarbonisation – with 90% less food and plastics	Assume waste composition as per Scenario 3, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065)
11	UK grid decarbonisation – CCC: current residual waste	Assume waste composition as per Scenario 4, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065)
12	UK grid decarbonisation – CCC: 50% reduced plastics	Assume waste composition as per Scenario 5, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065)
13	UK grid decarbonisation – CCC: 50% reduced food	Assume waste composition as per Scenario 6, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065)

<sup>8</sup> BEIS (2023). Treasury Green Book – Data Tables 1-19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)



Scenario	Description	Input Assumptions
Combined	Heat and Power (CHP) – variations with respect to the ES	Core Case
14*	CHP, export of steam from the EfW CHP facility (included as previous sensitivity scenario for annual emissions comparison in <b>Appendix 14C (Volume 6.4)</b> [ <b>APP-088]</b> )	Assume that the EfW CHP Facility would export 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam. Assume latest emissions factors for offsetting UK grid electricity generation <sup>7.</sup> Assume latest emissions factor for offsetting the use of natural gas as fuel for heating <sup>9</sup> .
15	CHP, export of steam from the EfW CHP facility UK – including grid decarbonisation	Assume that the EfW CHP Facility would export 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam. Assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065). Assume latest emissions factor for offsetting the use of natural gas as fuel for heating <sup>9</sup> up to 2035, and assume BEIS forecast emissions factors for UK grid
Landfill Ga	is (LFG) capture rate – variations with respect to the ES C	electricity generation <sup>8</sup> as source for heating after 2035.
16	52% LFG capture rate	Assumption based on average LFG collection efficiency reported for all UK landfills <sup>10</sup> .

<sup>&</sup>lt;sup>9</sup> UK Government (2023). Greenhouse gas reporting: conversion factors 2023

<sup>&</sup>lt;sup>10</sup> DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling



Scenario	Description	Input Assumptions	
17	52% LFG capture rate – including grid decarbonisation	Assume LFG capture rate as per Scenario 16, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065).	
18	85% LFG capture rate	Assumption based on experts' assumptions for the upper instantaneous LFG capture rate for landfill once gas collection infrastructure is installed <sup>10</sup> .	
19	85% LFG capture rate – including grid decarbonisation	Assume LFG capture rate as per Scenario 18, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065).	
Carbon Capture & Storage (CCS) – variations with respect to the ES Core Case			
20	2030 adoption of CCS by the EfW CHP facility	Assume incorporation of carbon capture technology for the EfW CHP facility from 2030 onwards	
		<ul> <li>The CCS scenario will include emissions related to:</li> <li>carbon capture and CO<sub>2</sub> separation (use of steam and electricity, raw materials and catalysts)</li> <li>compression (use of electricity)</li> <li>transmission by pipeline (construction of pipeline (from the nearby power station only), use of electricity to drive further compression along the pipeline)</li> <li>underground storage (use of electricity)</li> <li>leakage factors</li> </ul>	
21	2030 adoption of CCS by the EfW CHP facility – including grid decarbonisation	Assume adoption of CCS as per Scenario 20, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065).	



Scenario	Description	Input Assumptions
22	2040 adoption of CCS by the EfW CHP facility	Assume incorporation of carbon capture technology for the EfW CHP facility from 2040 onwards
		<ul> <li>As for Scenario 20, the CCS scenario will include emissions related to:</li> <li>carbon capture and CO<sub>2</sub> separation (use of steam and electricity, raw materials and catalysts)</li> <li>compression (use of electricity)</li> <li>transmission by pipeline (construction of pipeline (from the nearby power station only), use of electricity to drive further compression along the pipeline)</li> <li>underground storage (use of electricity)</li> <li>leakage factors</li> </ul>
23	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation	Assume adoption of CCS as per Scenario 22, and assume BEIS forecast emissions factors for UK grid electricity generation <sup>8</sup> over 40 years (for the period 2026 to 2065).

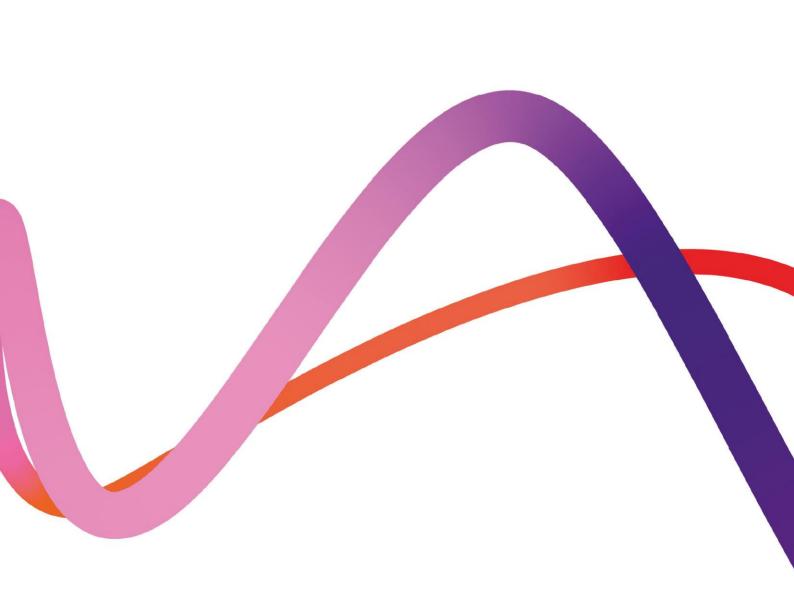


# 4. Schedule

Table 4.1 sets out the schedule for providing the additional sensitivity analysis to the ExA by deadline 6 (12 July 2023), which allows for further discussion between the Applicant and CCC to agree the approach and review of the outputs.

Date	Actions
14 June 2023	Draft technical note to be issued to CCC
16 June 2023	CCC to review GHG emissions calculation methodology in the EIA and provide feedback for Deadline 5
23 June 2023	CCC to provide any further feedback on the draft technical note (noting that feedback has already been received via email on 15 June 23). MVV and CCC to agree: • methodology for GHG assessment • selection of scenarios • input assumptions for each scenario
30 June 2023	Final sensitivity test calculations and analysis report to be issued to CCC
05 July 2023	Conference call for MVV to present results of the sensitivity analysis to CCC, including analysis on existing and emerging policy to determine the likelihood of each scenario.
12 July 2023	MVV to submit sensitivity Analysis to ExA
(Deadline 6)	CCC to confirm agreement and/or any areas of disagreement, with the methodologies, scenarios and input assumptions and outputs, and may provide its own commentary on the scenario outputs.

 Table 4.1
 Schedule for additional sensitivity analysis





# Appendix B Assumptions

## ES Case – general assumptions

(variations to the general assumptions below for the ES Case are identified for each scenario in the next section)

As	ssumption	Reference
1	The GHG assessment methodology is based on the Carbon Assessment carried out by the Carbon Trust for the Cory Riverside EfW Facility, comparing emissions from the combustion of residual waste as a fuel source in the EfW Facility, with the alternative scenario of landfill disposal with electricity generation from the collection of landfill gas (LFG)	Carbon Trust 2017. Cory Riverside Energy: A Carbon Case, Carbon Trust Peer Review https://www.corygroup.co.uk/application/files/7016/1890 /4663/Cory-Carbon-Report-v1.1.pdf
2	Waste to be used as fuel for the Medworth EfW Facility is assumed to be the residual portion of commercial and household municipal solid waste (MSW) after recycling	WRAP 2020, National Municipal Waste Composition, England 2017, Table 3 https://wrap.org.uk/sites/default/files/2020-11/WRAP- National%20municipal%20waste%20composition_%20 England%202017.pdf
3	The following is assumed for MSW biogenic carbon, non- biogenic (fossil) carbon and Net Calorific Value (NCV) values used in the assessment: - The separate WRAP categories for 'Recyclable Paper' and 'Card' are assumed to be equivalent to the WRATE category for 'Paper and Card' - The WRAP categories for 'Other Organic' and 'Wood' wastes are assumed to be equivalent to the WRATE category for 'Garden Organics' - The WRAP category for 'Other Waste' is assumed to be equivalent to the WRATE category for 'Misc Non- Combustibles'. - Assumed no carbon content or NCV for metals	<ul> <li>WRAP 2020, National Municipal Waste Composition, England 2017, Table 3 https://wrap.org.uk/sites/default/files/2020-11/WRAP- National%20municipal%20waste%20composition_%20 England%202017.pdf</li> <li>WRATE (2011), Greenhouse Gas Calculator for Municipal Waste. WRATE v2. (provided by MVV)</li> <li>Zero Waste Scotland, 2020, The climate change impacts of burning municipal waste in Scotland - Technical Report, Table 2 The estimated composition and carbon content of municipal waste in Scotland in 2018 https://www.zerowastescotland.org.uk/content/climate- change-impact-burning-municipal-waste-scotland</li> </ul>
4	The Proposed Development ES Case is based on receiving 625,000 tonnes of residual (non-recyclable) waste per annum at a NCV of 9.53 MJ/kg. The net electricity generation for the EfW CHP Facility, operating in electricity only mode is 55 MWe (allowing for 5 MWe parasitic load). The EfW CHP Facility is designed to maintain a constant fuel input capacity, so the quantity of waste inputs may be adjusted according to the calorific value of the material. i.e. less waste may be required for material with a higher calorific value and vice versa.	Based on design information confirmed by MVV 02Feb22 (Medworth ES - questions for MVV_SG.docx) and NCV value calculated from WRAP and WRATE info
5	The GHG assessment includes an estimate of N <sub>2</sub> O and CH <sub>4</sub> emissions associated with Stationary Combustion Processes, based on IPCC Guidelines for Greenhouse Gas Inventories and factors for Global Warming Potential (GWP): - N <sub>2</sub> O default emissions factor for Stationary Combustion, municipal wastes (non-biomass fraction) = 4 kg N <sub>2</sub> O/TJ - N <sub>2</sub> O to CO <sub>2</sub> GWP = 265 kg CO <sub>2e</sub> /kg N <sub>2</sub> O - CH <sub>4</sub> default emissions factor for Stationary Combustion, municipal wastes (non-biomass fraction) = 30 kg CH <sub>4</sub> /TJ - CH <sub>4</sub> to CO <sub>2</sub> GWP = 28 kg CO <sub>2e</sub> /kg CH <sub>4</sub>	IPCC 2006. IPCC Guidelines for Greenhouse Gas Inventories, Vol 2, table 2.2 Default Emissions Factors for Stationary Combustion in the Energy Industries https://www.ipcc- nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch 2_Stationary_Combustion.pdf IPCC 2014. IPCC 5th Assessment Report (AR5) https://www.ipcc.ch/pdf/assessmentreport/ar5/wg1/WG 1AR5_Chapter08_FINAL.pdf

As	sumption	Reference
6	The GHG assessment includes an estimate of GHG emissions for the use of fuel in auxiliary burners during the start-up and shut-down of the EfW CHP Facility. It is assumed that: - The EfW CHP Facility would use 1,939,360 litres per annum of gas oil (diesel), 90% of which would be used for the auxiliary burners and the remaining 10% would be used for maintenance, repair, replacement and refurbishment activities. - 'Gas Oil' represents the type of fuel that would be used in the auxiliary burners, with an equivalent CO2 emissions factor of 2.75857 kgCO2e/litre (BEIS 2021)	Based on design information confirmed by MVV 02Feb22 (Medworth ES - questions for MVV_SG.docx) BEIS UK Government GHG Conversion Factors for Company Reporting 2021 https://www.gov.uk/government/publications/greenhous e-gas-reporting-conversion-factors-2021
7	The GHG assessment includes an estimate of GHG emissions offset by electricity generated by the EfW (the benefits for generated heat is not included in the main GHG assessment). It is assumed that: - the net electrical output for export to local users and the national grid is 55MWe (allowing 5MWe for parasitic load) - for the assessment it is assumed that the EFW Facility would operate for a minimum of 8,000 hrs per year (not stated in the PEIR) - for the ES Case electricity generated by the EfW Facility would displace the use of UK gid average electricity with an equivalent CO2 emissions factor of 182 g/kWh (BEIS 2020- 2021)	Based on design information confirmed by MVV 02Feb22 (Medworth ES - questions for MVV_SG.docx) BEIS Fuel Mix Disclosure Data Table 2020-2021 https://www.gov.uk/government/publications/fuel-mix- disclosure-data-table
8	The estimate of GHG emissions associated with landfill disposal of residual waste and electricity generation from landfill gas (LFG) is based on the following factors referenced in a DEFRA report on landfill methane emissions modelling based on a UK scenario: - The percentage of biogenic carbon which is converted to LFG is 50% - The ratio of methane to carbon dioxide in UK landfill gas is calculated to be 57:43% rather than the generally assumed 50:50% - The quantum of methane that is flared from operational sites with landfill gas utilisation is estimated to be 1/11th of the methane utilised in gas engines. (i.e. 9.1%) - Net electrical efficiency assumption of 36% (including losses for parasitic load) - The collection efficiency for a subset of modern, large landfill operations in the UK is 68% (data from 2011) - Landfill Methane Oxidation. It is recommended that until further measurements are made at UK landfill sites, the IPCC default value for methane oxidation of 10% is retained.	DEFRA 2014. DEFRA Review of Landfill Methane Emissions Modelling http://randd.defra.gov.uk/Document.aspx?Document=1 2439_WR1908ReviewofMethaneEmissionsModelling.p df
9	The GHG assessment includes an estimate of GHG emissions offset by electricity generated by the use of LFG in gas engines at landfill sites. It is assumed that: - the calorific value of methane is 50 MJ/kg - for the ES Case electricity generated by LFG combustion would displace the use the use of UK gid average electricity with an equivalent CO2 emissions factor of 182 g/kWh (BEIS 2020-2021)	DEFRA 2014. DEFRA Review of Landfill Methane Emissions Modelling http://randd.defra.gov.uk/Document.aspx?Document=1 2439_WR1908ReviewofMethaneEmissionsModelling.p df

	Imptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
	nario 1) ES Case	
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	hario 2) ES Case with reduced recyclables (65% target	t)
1a	Waste composition based on: target 65% of municipal waste is recycled by 2035, with 44.5% already recycled in 2019	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017), with a 20% reduction in paper, card, food, plastics, glass, metals, garden and wood in residual waste
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 615,668 t/yr)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	hario 3) ES Case with 90% less food and plastics	
1a	Waste composition based on: 90% reduction in food and plastics, in addition to 20% reduction in other recyclables	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017), with a 90% reduction in food and plastics, in addition to 20% reduction in other recyclables for the residual waste
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,667 per yr; MWe = 54.08)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	nario 4) CCC: current residual waste	
1a	Waste composition based on: Cambridgeshire Current Residual Waste Composition	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028])

## Sensitivity Scenarios – variations to assumptions for the ES Case

Acci	Imptions for Sensitivity Scenarios	Reference
	type indicates variation with respect to the ES Case)	
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,713 per yr)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	nario 5) CCC: 50% reduced plastics	
1a	Waste composition based on: Cambridgeshire current residual waste with plastics reduced 50% less than baseline	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028])
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,667 per yr; MWe = 51.94)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	hario 6) CCC: 50% reduced organics	
1a	Waste composition based on: Cambridgeshire current residual waste with organics reduced 50% less than baseline	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028])
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 503,804 t/yr)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	nario 7) Gas-fired power stations (CCGT)	
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1a 1b		
	England EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr;	Municipal Waste Composition, England 2017)

(red	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
	nario 8) UK grid decarbonisation – for ES Case	1
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	hario 9) UK grid decarbonisation - with reduced recyc	lables (65% target)
1a	Waste composition based on: target 65% of municipal waste is recycled by 2035, with 44.5% already recycled in 2019	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017), with a 20% reduction in paper, card, food, plastics, glass, metals, garden and wood in residual waste
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 615,668 t/yr)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	nario 10) UK grid decarbonisation - with 90% less food	d and plastics
1a	Waste composition based on: 90% reduction in food and plastics, in addition to 20% reduction in other recyclables	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017), with a 90% reduction in food and plastics, in addition to 20% reduction in other recyclables for the residual waste
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,667 per yr; MWe = 54.08)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	nario 11) UK grid decarbonisation - CCC: current resid	dual waste
1a	Waste composition based on: Cambridgeshire Current Residual Waste Composition	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028])
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,713 per yr)	Operating Parameters for NCV provided by MVV

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scei	nario 12) UK grid decarbonisation - CCC: 50% reduced	d plastics
1a	Waste composition based on: Cambridgeshire current residual waste with plastics reduced 50% less than baseline	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028])
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,667 per yr; MWe = 51.94)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scei	nario 13) UK grid decarbonisation - CCC: 50% reduced	d organics
1a	Waste composition based on: Cambridgeshire current residual waste with organics reduced 50% less than baseline	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028])
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 503,804 t/yr)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scei	nario 14) CHP, export of steam from the EfW CHP Fac	
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 48.8)	Operating Parameters for NCV provided by MVV
2a	Electricity generation offset for 40 years based on latest UK grid average emissions factor 2021/22 = 198 g/kWh	DESNZ (2023). Fuel Mix Disclosure Data Table 2021 2022
2b	Fuel for heating offset for 40 years based on latest natural gas emissions factor 2021/22 = 202.67 g/kWh	UK Government (2023). Greenhouse gas reporting: conversion factors 2023
3	CHP EfW Facility exports 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam	MVV design info

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	nario 15) CHP, export of steam from the EfW CHP Fac	
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 48.8)	Operating Parameters for NCV provided by MVV
2a	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
2b	Fuel for heating offset to 2035 based on latest natural gas emissions factor 2021/22 = 202.67 g/kWh Fuel for heating offset after 2035 based on BEIS forecast emissions factors for UK grid electricity generation	UK Government (2023). Greenhouse gas reporting: conversion factors 2023; BEIS (2023). Treasury Green Book – Data Tables 1-19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	CHP EfW Facility exports 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam	MVV design info
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	hario 16) 52% LFG Capture Rate	
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for older operational UK landfill (Type 3 MELMod) = 52%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scer	hario 17) 52% LFG Capture Rate – including grid deca	rbonisation
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for older operational UK landfill (Type 3 MELMod) = 52%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
	nario 18) 85% LFG Capture Rate	1
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	Upper limit for instantaneous LFG capture rate for a modern UK landfill = 85% based on experts' opinion	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scei	nario 19) 85% LFG Capture Rate – including grid deca	rbonisation
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	Upper limit for instantaneous LFG capture rate for a modern UK landfill = 85% based on experts' opinion	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5	No CCS	N/A
Scei	nario 20) 2030 adoption of CCS by the EfW CHP Facili	ty
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2030 onwards (36 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
Scer	nario 21) 2030 adoption of CCS by the EfW CHP Facili	
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2030 onwards (36 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn

(red	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
Scer	nario 22) 2040 adoption of CCS by the EfW CHP Facili	ty
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh	BEIS (2021). Fuel Mix Disclosure Data Table 2020- 2021
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
Scer	nario 23) 2040 adoption of CCS by the EfW CHP Facili	ty – including grid decarbonisation
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A

	Imptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
	nario 24) 2040 adoption of CCS by the EfW CHP Facili clables (65% target)	ty – including grid decarbonisation and reduced
1a	Waste composition based on: target 65% of municipal waste is recycled by 2035, with 44.5% already recycled in 2019	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017), with a 20% reduction in paper, card, food, plastics, glass, metals, garden and wood in residual waste
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 615,668 t/yr)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes

	Imptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
	hario 25) 2040 adoption of CCS by the EfW CHP Facili and plastics	ty – including grid decarbonisation and 90% less
1a	Waste composition based on: 90% reduction in food and plastics, in addition to 20% reduction in other recyclables	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017), with a 90% reduction in food and plastics, in addition to 20% reduction in other recyclables for the residual waste
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,667 per yr; MWe = 54.08)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
	hario 26) 2040 adoption of CCS by the EfW CHP Facili ent residual waste	ty – including grid decarbonisation and CCC:
1a	Waste composition based on: Cambridgeshire Current Residual Waste Composition	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028]
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,713 per yr)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
	hario 27) 2040 adoption of CCS by the EfW CHP Facili ced plastics	ty – including grid decarbonisation and CCC: 50%
1a	Waste composition based on: Cambridgeshire current residual waste with plastics reduced 50% less than baseline	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028]
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 625,600 t/yr; hours = 7,667 per yr; MWe = 51.94)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)

(red	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
Scer redu	hario 28) 2040 adoption of CCS by the EfW CHP Facili ced organics	ty – including grid decarbonisation and CCC: 50%
1a	Waste composition based on: Cambridgeshire current residual waste with organics reduced 50% less than baseline	CCC Deadline 4 Submission - Cover letter and Appendices [REP4-028]
1b	EfW CHP Facility operating parameters adjusted for NCV (waste = 503,804 t/yr)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
	nario 29) 2040 adoption of CCS by the EfW CHP Facili eam from the EfW CHP Facility	ty – including grid decarbonisation and CHP, export
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2a	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
2b	Fuel for heating offset to 2035 based on latest natural gas emissions factor 2021/22 = 202.67 g/kWh Fuel for heating offset after 2035 based on BEIS forecast emissions factors for UK grid electricity generation	UK Government (2023). Greenhouse gas reporting: conversion factors 2023; BEIS (2023). Treasury Green Book – Data Tables 1-19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	CHP EfW Facility exports 48.8MWe of electricity (allowing for 5MWe parasitic load) and 23.6MWth of steam	MVV design info
4	LFG capture rate for modern, large UK landfill = 68%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
Scer Capt	nario 30) 2040 adoption of CCS by the EfW CHP Facili	ty – including grid decarbonisation at 52% LFG
1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	LFG capture rate for older operational UK landfill (Type 3 MelMOD) = 52%	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples
	hario 31) 2040 adoption of CCS by the EfW CHP Facili	ty – including grid decarbonisation at 85% LFG
Capt 1a	Waste composition based on WRAP 2017 profile for England	ES Case waste composition (WRAP 2020, National Municipal Waste Composition, England 2017)

	umptions for Sensitivity Scenarios type indicates variation with respect to the ES Case)	Reference
1b	EfW CHP Facility operating parameters for NCV of 9.53 MJ/kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)	Operating Parameters for NCV provided by MVV
2	BEIS forecast emissions factors for UK grid electricity generation over 40 years (for the period 2026 to 2065)	BEIS (2023). Treasury Green Book – Data Tables 1- 19: supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting errors)
3	Electricity export only for the EfW CHP Facility, no steam export	N/A
4	Upper limit for instantaneous LFG capture rate for a modern UK landfill = 85% based on experts' opinion	DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling
5a	CCS post-combustion systems from 2040 onwards (26 years)	N/A
5b	CCS - fossil derived CO2 capture rate = 85%	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Section 5.3
5c	CCS - electricity for capture = 300kWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5d	CCS - electricity for compression (including pipeline transport) = 120KWh/tCO2	Jackson and Brodal (2019). Optimization of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
5e	CCS - electricity for storage = 120KWh/tCO2	Average assumed to be same as electricity for compression
5f	CCS - fugitive CO2 emissions during pipeline transport: High = 0.014 Gg/km/yr)	IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 5: Carbon Dioxide Transport, Injection and Geological Storage, Table 5.2
5g	CCS - transmission pipeline length = 110 km	MVV estimate for connection to CO2 storage at Bacton cluster
5h	CCS - leakage rate for CO2 during storage (less than 0.1%)	DESNZ (2023). Deep geological storage of carbon dioxide (CO2), offshore UK: containment certainty
5i	CCS - connecting pipeline length = 15km	MVV estimate for connection to main pipeline at Kings Lynn
5j	CCS - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 tCO2e/km	Internal estimate based on other project examples



# Appendix C Grid Offset Comparator – Development Application Examples

## Grid Offset Comparators – Development Application Examples

Example of grid offset comparator for development application	Reference
Longfield Solar Farm	PINS Ref: EN010118
6.7.34 Comparing the Scheme against a gas fired Combined Cycle Gas Turbine (CCGT) generating facility, currently the most carbon-efficient fossil-fuelled technology available, a representative figure for the carbon intensity of a CCGT is 354g CO2e/kWh (Ref 6-37). The operational carbon intensity of the Scheme is therefore 95.2% lower than that of the counterfactual CCGT. Each kilowatt hour of electricity generated by the Scheme will emit 337g CO2e less than if it was generated by a gas fired CCGT generating facility.	https://infrastructure.planninginspectora te.gov.uk/projects/eastern/longfield- solar- farm/?ipcsection=docs&stage=app&filte r1=Environmental+Statement https://infrastructure.planninginspectora te.gov.uk/wp- content/ipc/uploads/projects/EN010118/ EN010118-000163- 6.1%20ES%20Chapter%206%20_%/20
Wheelabrator Kemsley Generating Station (K3) and Wheelabrator	Climate%20Change.pdf PINS Ref: EN010083
<i>Kemsley North (WKN) Waste to Energy Facility</i> 6.3.18 The baseline for electricity generation that would be displaced by electricity exported by either facility is assumed in WRATE to be 0.349 tCO2e/MWh (representative of a combined cycle gas turbine [CCGT] power station). The marginal source will change over time, and so for future years in the main scenario, the BEIS projections of the carbon intensity of long-run marginal electricity generation [Ref. 6.22] have also been considered in this chapter	https://infrastructure.planninginspectora te.gov.uk/projects/south- east/wheelabrator-kemsley-generating- station-k3-and-wheelabrator-kemsley- north-wkn-waste-to-energy- facility/?ipcsection=docs&stage=app&fil ter1=Environmental+Statement https://infrastructure.planninginspectora te.gov.uk/wp- content/ipc/uploads/projects/EN010083/ EN010083-000381-EN010083%20- %203.1%20- %202019%20ES%20Chapter%206%20 Climate%20Change.pdf
Mallard Pass Solar Project	PINS Ref: EN010127
<ul> <li>13.4.15 The generation of electricity from the Proposed Development will displace and would replace the generation of electricity from other conventional power sources over time. The Digest of UK Energy Statistics (DUKES) [Ref 13-22, Ref 13-23] indicate across the mix of sources of electricity that currently contribute power to the grid, the average emission of CO2 in 2020 was estimated as 182 kg/MWh. If this emission of CO2 was avoided as a result of the Proposed Development, it would equate to a reduction of approximately 64,000 teCO2/y entering the atmosphere over the operational lifetime of the Proposed Development.</li> <li>Grid decarbonisation will reduce the average emissions of CO2 and therefore the total reduction of savings above associated with the Proposed Development correspondingly. To achieve decarbonisation of the grid, energy sources such as the Proposed Development are required to meet</li> </ul>	https://national-infrastructure- consenting.planninginspectorate.gov.uk /projects/EN010127/documents?catego ry- Developer%27s+Application=Environm ental+Statement&date-from- day=&date-from-month=&date-from- year=&date-to-day=&date-to- month=&date-to- year=&searchTerm=climate&itemsPerP age=25 https://infrastructure.planninginspectora te.gov.uk/wp-
Government targets relating to GHG emissions. Therefore, whilst the decarbonisation of the grid would reduce the savings associated with the Proposed Development, infrastructure such as the Proposed Development is a pre-requisite to such decarbonisation. In the National Grid Future Energy Scenario (FES) 'best case' decarbonisation scenario, grid CO2 intensities and the output of Proposed Development accounting for panel degradation have been utilised to calculate the potential reduction of CO2 emissions avoided as a result of the Proposed Development, which accounts for decarbonisation and degradation with results in Plate 13-1. This shows a total reduction in CO2 of 423,580 teCO2 across the lifetime of the Proposed Development and an average of 10,589 teCO2/y.	content/ipc/uploads/projects/EN010127/ EN010127-000115- 13%20Climate%20Change.pdf

Example of grid offset comparator for development application	Reference
North Lincolnshire Green Energy Park	PINS Ref: EN010116
5.3.3.8 Electricity generated by the ERF will be exported to the national grid or used by other facilities within the Project, including the PRF, H2 production facility and other businesses in the local area. This assessment assumes that in the absence of the ERF, capacity for the production of this electricity would otherwise be met by a gas-fired power station. This is in line with the Guide which states	https://infrastructure.planninginspectora te.gov.uk/projects/yorkshire-and-the- humber/north-lincolnshire-green- energy- park/?ipcsection=docs&stage=app&filte r1=Environmental+Statement
<ul> <li>"A gas fired power station (Combined Cycle Gas Turbine CCGT) is a reasonable comparator as this is the most likely technology if you wanted to build a new power station today".</li> <li>5.3.3.9 As the UK completes the phasing out of producing electricity from coal, CCGT will continue to be a significant contributor to the UK grid electricity fuel mix. Construction of the ERF will not impact decisions relating to the development of renewables such as solar and wind, given the GHG emission reduction targets which have been set by the UK. Given the intermittency of solar and wind power, alternative generation methods which can respond to demand, such as CCGT and ERFs, are likely to be required for some time yet.</li> </ul>	https://infrastructure.planninginspectora te.gov.uk/wp- content/ipc/uploads/projects/EN010116/ EN010116-000404-6.2.6%20- %20ES%20-%20Chapter%206%20- %20Climate.pdf
The Guide = Energy from Waste – A Guide to the debate (DEFRA, 2014) ('the Guide')	
South Humber Bank Energy Centre	PINS Ref: EN010107
19.6.25 The operation of the Proposed Development will generate GHGs (mainly from burning fuel (76.1% from refuse derived fuel usage)) but will also beneficially avoid GHGs from landfill and metals that can be recycled from bottom ash to displace the use of virgin metal sources. The net GHGs during operation are therefore predicted to be 45,297 tCO2e per year, which equates to a carbon intensity of 72 tCO2e per GWh (assuming that the gross electrical output from the Proposed Development is around 76 MW, rather than 95 MW). This is favourable compared to the current grid average carbon intensity (BEIS, 2019) of 173 tCO2e per GWh. As the operational emissions (gross or net) are considerably less than 1% of the UK carbon budget for 2028-2032, the effect is considered to be minor adverse	https://infrastructure.planninginspectora te.gov.uk/projects/yorkshire-and-the- humber/south-humber-bank-energy- centre/?ipcsection=docs&stage=app&fil ter1=Environmental+Statement https://infrastructure.planninginspectora te.gov.uk/wp- content/ipc/uploads/projects/EN010107/ EN010107-000179- SHBEC%20DCO%20- %206.2.19%20ES%20Vol%20I%20Cha pter%2019%20Sustainability%20and% 20Climate%20Change.pdf



# Appendix D Sensitivity Analysis Scenario Outputs

## Waste Compositon Variation

ES Case: Current Residual Waste (for Scenarios: 1, 7, 8, and 14-23)

#### (WRAP survey, 2017: as per 'Current (Core Case)' in Table 14C.1 of Appendix 14C (Volume 6.4) [APP-088])

Municipal Residual Waste: Commercial and Mousehold (% by weight)         Software (% by weight)         Biogenic Carbon (% by weight)         Non-Biogenic Carbo							
Commercial and bloacehold (bit by weight)         Non-Biogeni Carbon (bit by weight)         Non-Biogeni Carbon (bit by weight)         Non-Biogeni Carbon (bit by weight)         Non-Biogeni Carbon (bit by weight)           12/7 (bit by weight)         Sign         312/7 (bit by weight)							Biogenic Carbon
Kiyueghi     Kiyueghi     Kiyueghi     Kiyueghi     Kiyueghi     Kiyueghi       6 Kiyueghi     Sig     Sig     Sig     Sig     Sig     Sig       6 Kiyueghi     Sig     Sig     Sig     Sig     Sig     Sig       6 Kiyueghi     Sig     Sig     Sig     Sig     Sig     Sig       7 Kiyueghi     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig     Sig     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig     Sig     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig     Sig     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig     Sig     Sig     Sig     Sig     Sig     Sig     Sig       8 Sig	rbon 1	Total C	Non-Biogenic Carbon	iogenic Carbon	Net Calorific	Non-Biogenic Carbon	
59%         31.27%         10.749         1.8%           63%         31.27%         10.749         1.9%           88%         28.69%         9.735         2.55%           7.8%         28.69%         9.735         2.55%           8.8%         28.69%         9.735         2.55%           9.3%         24.69%         10.749         1.9%           9.3%         28.69%         9.735         2.55%           9.3%         19.93%         14.812         2.20%         1.0%           9.3%         23.69%         15.79%         14.612         2.20%         1.47%           0.3%         2.94%         4.05%         2.573         0.01%         0.15%           2.6%         0.33%         2.94%         4.05%         2.573         0.01%           2.6%         0.33%         1.141         0.01%         0.01%           2.6%         13.46%         1.414         0.33%         1.11%           2.7%         17.17%         4.210         0.33%         1.11%           2.3%         17.17%         4.210         0.33%         1.11%           2.3%         17.17%         5.81%         7.060         0.17% </th <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>							
6.5%     32.2%     10.749     1.97%       8.6%     97.35     2.5%     4.27%       7.6%     24.642     3.95%       7.5%     10.93%     19.93%     14.327       7.6%     2.6%     4.61%     2.2%       7.6%     2.4%     4.27%       7.6%     2.4%     4.27%       7.6%     2.4%     4.317       7.6%     2.6%     1.0%       7.6%     2.2%     1.4%       7.6%     2.2%     4.0%       7.6%     2.2%     4.0%       7.6%     2.9%     4.05%       7.6%     2.9%     4.05%       7.6%     0.01%     0.01%       7.6%     13.4%     2.2%       7.7%     3.63%     1.1%       7.7%     2.10     0.3%       7.1%     4.210     0.3%       7.1%     4.210     0.3%       7.1%     4.210     0.3%       7.1%     4.210     0.3%       7.1%     4.210     0.3%       7.1%     4.210     0.3%       7.1%     5.5%     0.0%       7.1%     5.5%     0.0%       7.5%     7.6%     0.0%       7.5%     0.00%     0.0%	1.84%	(/2 0)					
8 8 %     28 69%     9.735     2.55%       8 8 %     48 11%     21.279     3.95%       8 8 %     19.93%     14.327     1.10%     1.10%       9 9 8 %     19.93%     14.327     1.10%     1.10%       9 9 8 %     15.79%     14.612     2.20%     1.47%       9 8 %     2.59%     1.57%     16.612     2.00%     1.47%       0 3 6 %     2.29%     4.05%     2.572     0.01%     0.01%       2.66     0.31%     2.44%     4.05%     2.572     0.01%     0.01%       2.66     0.31%     0.31%     0.44%     0.01%     0.01%       2.66     0.31%     0.31%     0.44%     0.01%     0.01%       2.66     0.31%     0.31%     0.01%     0.01%       2.66     0.31%     0.31%     0.01%     0.01%       2.66     0.31%     0.36%     0.01%     0.01%       2.66     0.31%     0.36%     0.01%     0.01%       2.66     0.31%     0.36%     0.01%     0.01%       2.76     1.34%     0.000     0.03%     0.01%       2.76     0.11%     0.13%     0.00%     0.01%       2.86     0.17.7%     0.137%     0.00% <td< td=""><td>1.97%</td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	1.97%						
7 8%         54.7%         24.62         4.2%           8 2%         19.93%         21.27%         3.9%           5 5%         19.93%         19.93%         14.32         1.10%           3 5%         2.94%         4.05%         2.20%         1.10%           3 6%         2.94%         4.05%         2.23%         0.11%         0.15%           3 6%         2.94%         4.05%         2.573         0.11%         0.15%           3 6%         0.31%         1.444         0.01%         0.15%           2 6%         0.31%         1.444         0.01%         0.15%           2 6%         1.144         0.01%         0.15%         0.01%         0.15%           2 6%         17.17%         4.210         0.39%         0.15%         0.15%         0.03%         0.15%           2 70%         17.17%         4.210         0.39%         0.15%         0.17%         0.01%         0.15%           2 2 3%         17.17%         15.81%         7.060         0.07%         0.10%           2 3%         0.51%         10.76%         0.00%         0.05%         0.05%         0.05%         0.05%         0.05%         0.05%         0.05	2.55%						
8.8% 5.5% 5.5% 5.5% 5.5% 5.5% 5.5% 5.5%	4.27%	7%		2.55%			20.0570
55%         1993%         193%         1427         1.0%         1.0%           93%         26%         15.7%         14612         2.20%         1.0%           36%         29%         4.05%         2.23%         1.1%         0.15%           03%         29%         4.05%         2.573         0.11%         0.01%           26%         0.31%         0.34%         0.01%         0.01%           26%         0.31%         1.444         0.01%           26%         0.31%         1.444         0.01%           26%         0.31%         3.460         3.63%           72.0%         11.44%         0.01%         4.20           27.0%         12.77%         4.210         0.39%           2.3%         17.17%         4.210         0.39%           2.3%         17.17%         4.210         0.39%           2.3%         12.77%         4.210         0.39%           1.3%         13.75%         3.07%         0.00%         0.17%           0.5%         13.75%         3.478         0.30%         0.00%	3.95%						
9.3%     23.6%     13.7%     14.612     2.20%     1.47%       3.6%     2.3%     4.05%     2.57     0.11%     0.15%       0.3%     2.3%     4.05%     2.57     0.01%     0.01%       2.6%     0.31%     0.31%     0.01%     0.01%       2.4%     4.05%     2.47     0.01%     0.01%       2.4%     0.31%     0.11%     0.01%     0.01%       2.4%     1.1%     3.460     3.63%     0.01%       2.7%     13.46%     3.420     0.35%       2.3%     12.71%     4.10     0.35%       2.3%     12.71%     4.10     0.35%       1.1%     12.58.1%     7.660     0.17%       0.5%     0.58%     0.00%     0.00%       2.2%     13.75%     0.00     0.00%	2.19%			1 10%			10.03%
3.6%     2.9%     4.0%     2.573     0.11%     0.15%       0.3%     2.9%     4.0%     2.573     0.01%     0.01%       2.6%     0.31%     0.5%     0.01%     0.01%       2.4%     0.31%     0.31%     0.01%     0.01%       1.1%	3.67%						
0.3%         2.3%         4.05%         2.573         0.01%         0.01%           2.6%         .1.14         0.01%         .1.14         0.01%           2.6%         .1.14         0.01%         .1.14         0.01%           1.15%         .1.14         0.01%         .1.16         .1.16           2.7%         .1.16%         .3.460         3.63%         .1.16           2.8%         .1.27%         .4.210         0.3%         .1.16           2.8%         .1.27%         .4.210         0.3%         .1.16           1.15%         .1.17%         .4.210         0.3%         .1.16           0.5%         .0.51%         .1.9.76%         0.0.0%         .0.17%           0.5%         .0.51%         .1.9.76%         .0.00%         .0.0%	0.25%						
2.6%         0.31%         1.414         0.03%           2.4%         -         -         -           1.1%         -         -         -         -           2.70%         13.46%         3.460         3.63%         -           2.7%         17.17%         4.210         0.39%         -           2.3%         17.17%         4.220         0.39%         -           2.3%         17.17%         4.210         0.39%         -           1.1%         -         15.81%         7.66         0.17%           0.5%         0.61%         19.76%         0.00%         0.00%           2.3%         -         3.57%         3.00         0.00%         0.00%	0.02%						
2.4% 1.1% 2.7% 2.7% 13.46% 3.460 3.63% 2.7% 17.17% 4.210 0.46% 2.3% 17.17% 4.210 0.3% 17.17% 4.210 0.3% 17.17% 4.210 0.3% 17.17% 4.210 0.3% 0.51% 10.7% 0.51% 10.7% 0.00% 0.10%	0.01%	170					
11%         3.460         3.63%           270%         13.46%         3.460         3.63%           27%         17.17%         4.210         0.46%           23%         17.17%         4.220         0.39%           23%         17.17%         4.220         0.39%           11%         2.30%         0.39%         0.07%           0.5%         0.61%         19.76%         0.00%         0.10%           2.2%         13.75%         3.479         0.30%         0.00%	0.01%			0.01%	1.414		0.31%
13.45%         3.60         3.63%           17.17%         4.210         0.46%           17.17%         4.210         0.39%           17.17%         4.210         0.39%           17.17%         4.210         0.39%           17.17%         4.210         0.39%           15.81%         7.060         0.17%           0.61%         19.76%         0.00%         0.10%           3.75%         3.479         0.30%         0.00%							
2.7%         17.17%         4.210         0.46%           2.5%         17.17%         4.210         0.39%           2.2%         17.17%         4.210         0.39%           1.11%         4.210         0.39%         0.05%           0.51%         7.060         0.17%           0.51%         7.060         0.00%         0.10%           2.2%         13.75%         3.479         0.30%         0.00%	3.63%			2.0204	2.400		12.40%
2.5%         17.17%         4.210         0.39%           2.3%         17.17%         4.210         0.39%           1.1%         15.81%         7.060         0.17%           0.5%         0.51%         19.76%         0.00%         0.10%           2.2%         13.75%         3.479         0.30%         0.00%	0.46%						
2.3%         17.17%         4.210         0.39%           1.1%         15.81%         7.060         0.17%           0.5%         0.61%         19.76%         0.00%         0.10%           2.2%         13.75%         3.479         0.30%         0.00%	0.46%						
11%         1581%         7.060         0.17%           0.5%         0.61%         19.76%         0.000         0.00%         0.10%           2.2%         13.75%         3.479         0.30%         0.00%	0.39%						
0.5% 0.61% 19.76% 0.000 0.00% 0.10% 2.2% 13.75% 3.479 0.30% 0.00%	0.17%	70/		0.39%			17.17%
<u>2.2%</u> <u>13.75%</u> <u>3.479</u> <u>0.30%</u> <u>0.00%</u>	0.17%			0.000/			0.000
	0.10%						
					3.479		13.75%
100.0%	26.2%						
57.20% 42.80%		0%	42.80%	57.20%			
ided by MVV) Note: 100% design point with 55 MVe net power output and waste throughput below 625,600 tpa							

Net Calorific Value (MJ/kg) Total waste input (tonnes/yr) EfW Facility operations (hrs/yr) EfW Facility electricity generation (MWe)

ES Case: with Reduced Recyclables (for Scenarios: 2 and 9) (by 2035, with 44.5% already recycled in 2019: as per 'Reduced Recyclables' in Table 14C.1 of Appendix 14C (Volume 6.4) [APP-088])

		Future Waste: 20% reduction in paper, card, food, plastics, glass,									
	Current Residual Waste:	metals, garden and			Biogenic Carbon						
	Commercial and Household	wood in residual		Waste:	(% of waste				Non-Biogenic Carbon	Total Carbon	Total NCV
Waste Stream	(% by weight)	waste	residual waste (tonnes)		stream)	(% of waste stream)		(% by weight)	(% by weight)	(% by weight)	(MJ/kg)
Recyclable Paper	5.9%		0.047	5.5%	31.27%		10.749	1.72%		1.729	
Card	6.3%	20.0%	0.050	5.9%	31.27%		10.749	1.84%		1.849	
Non-recyclable Paper	8.9%		0.089	10.4%	28.69%		9.735	2.98%		2.989	
Dense Plastic	7.8%		0.062	7.3%		54.76%	24.682		3.99%		
Plastic film	8.2%	20.0%	0.066	7.7%		48.11%	21.279		3.69%		
Textiles	5.5%		0.044	5.1%	19.93%	19.93%	14.327	1.02%			
Misc. Combustible	9.3%		0.093	10.9%	23.69%	15.79%	14.612	2.57%			
Misc. Non-Combustible	3.6%		0.036	4.2%	2.94%	4.05%	2.573	0.12%			
Other Wastes	0.3%		0.003	0.4%	2.94%	4.05%	2.573	0.01%			
Glass	2.6%		0.021	2.4%	0.31%		1.414	0.008%		0.0089	% 0.0
Ferrous Metals	2.4%		0.019	2.2%							
Non-Ferrous Metals	1.1%	20.0%	0.009	1.0%							
Food Waste	27.0%		0.216	25.2%	13.46%		3.460	3.39%		3.399	
Garden Waste	2.7%		0.022		17.17%		4.210	0.43%		0.439	
Other Organic	2.3%		0.023	2.7%	17.17%		4.210	0.46%		0.469	
Wood	2.3%		0.018	2.1%	17.17%		4.210	0.37%		0.379	
WEEE	1.1%		0.011	1.3%		15.81%	7.060		0.20%	0.209	% 0.0
Hazardous	0.5%		0.005	0.6%	0.61%	19.76%	0.000	0.00%			
Fines	2.2%		0.022		13.75%		3.479	0.35%	0.00%		
Total	100.0%		0.856	100%				15.3%	10.9%	26.29	% 9.
								58.35%	41.65%		

615,66 8,00

<u>EfW CHP Facility Operating Parameters for</u> Net Calorific Value (MJ/kg) Total waste input (tonnes/yr) EfW Facility operations (hrs/yr) EfW Facility electricity generation (MWe) Note: 100% design point with 55 MWe net power output and waste throughput below 625,600 tpa

#### ES Case: with 90% less food and plastics (for Scenarios: 3 and 10) (90% reduction in food and plastics, in addition to 20% reduction in other recyclables: as per 'Reduced Food & Plastic' in Table 14C.1 of Appendix 14C (Volume 6.4) [APP-088])

		Future Waste: 90% reduction in plastics and food									
	Current Residual Waste:	and 19.5% reduction		Future Residual	Biogenic Carbon						
	Commercial and Household			Waste:	(% of waste				Non-Biogenic Carbon	Total Carbon	Total NCV
Waste Stream	(% by weight)	in residual waste	residual waste (tonnes)	(% by weight)	stream)	(% of waste stream)	Value (MJ/kg)		(% by weight)	(% by weight)	(MJ/kg)
Recyclable Paper	5.9%	20.0%	0.047	8.5%	31.27%		10.749	2.66%		2.66%	
Card	6.3%	20.0%	0.050	9.1%	31.27%		10.749	2.84%		2.849	
Non-recyclable Paper	8.9%		0.089	16.0%	28.69%		9.735	4.60%		4.60%	
Dense Plastic	7.8%	90.0%	0.008	1.4%		54.76%	24.682		0.77%	0.77%	
Plastic film	8.2%	90.0%	0.008	1.5%		48.11%	21.279		0.71%	0.719	
Textiles	5.5%	20.0%	0.044	7.9%	19.93%	19.93%	14.327	1.58%	1.58%		
Misc. Combustible	9.3%		0.093	16.7%	23.69%	15.79%	14.612	3.97%	2.64%		
Misc. Non-Combustible	3.6%		0.036	6.5%	2.94%	4.05%	2.573	0.19%	0.26%		
Other Wastes	0.3%		0.003	0.5%	2.94%	4.05%	2.573	0.02%	0.02%	0.04%	
Glass	2.6%	20.0%	0.021	3.7%	0.31%		1.414	0.012%		0.0129	6 0.05
Ferrous Metals	2.4%	20.0%	0.019	3.5%							
Non-Ferrous Metals	1.1%	20.0%	0.009	1.6%							
Food Waste	27.0%	90.0%	0.027	4.9%	13.46%		3.460	0.65%		0.65%	
Garden Waste	2.7%	20.0%	0.022	3.9%	17.17%		4.210	0.67%		0.67%	
Other Organic	2.3%		0.023	4.1%	17.17%		4.210	0.71%		0.719	
Wood	2.3%	20.0%	0.018	3.3%	17.17%		4.210	0.57%		0.57%	
WEEE	1.1%		0.011	2.0%		15.81%	7.060		0.31%	0.319	
Hazardous	0.5%		0.005	0.9%	0.61%	19.76%	0.000	0.01%	0.18%		
Fines	2.2%		0.022	4.0%	13.75%		3.479	0.54%	0.00%		
Total	100.0%		0.555	100%				19.0%	6.5%	25.5%	8.85
EfW CHP Facility Operating Parameters for NCV (p								74.58%	25.42%		

Net Calorit Value (MJ/kg) Total waste input (tonnes/yr) EfW Facility operations (hrs/yr) EfW Facility electricity generation (MWe) nical throughput of 40.8 tph each line and MWe output plus reduced operation hours not to exceed maximum waste throughput of 625,600 tpa

## CCC current residual waste [provided by CCC in Deadline 4 Submission - Cover letter and Appendices [REP4-028]] (for Scenarios: 4 and 11)

Waste Stream	CCC Current Residual Waste 2021 (% by weight)
Paper & Card	12.37%
Plastics	13.17%
Textiles	3.88%
Misc. Combustible	14.10%
Misc. Non-Combustible	5.82%
Other Wastes	0.0%
Glass & Metals	4.96%
Organic Waste	41.42%
Wood	1.04%
WEEE	3.25%
Total	100.0%

(% of waste	Non-Biogenic Carbon	Net Calorific	Biogenic Carbon	Non-Biogenic Carbon	Total Carbon	Tota
stream)	(% of waste stream)	Value (MJ/kg)	(% by weight)	(% by weight)	(% by weight)	(MJ
31.27%		10.749	3.87%		3.87%	
	54.76%	24.682		7.21%	7.21%	
19.93%	19.93%	14.327	0.77%	0.77%	1.55%	
23.69%	15.79%	14.612	3.34%	2.23%	5.57%	
2.94%	4.05%	2.573	0.17%	0.24%	0.41%	
2.94%	4.05%	2.573	0.00%	0.00%	0.00%	
13.46%		3.460	5.58%		5.58%	
17.17%		4.210	0.18%		0.18%	
	15.81%	7.060	0.00%	0.51%	0.51%	
			13.9%	11.0%	24.87%	
			55.92%	44.08%		

EfW CHP Facility Operating Parameters for NCV (provided by MVV)
Net Calorific Value (NU/kg)
Note: 100% design point with 55 MWe net power output, but reduced operation hours not to exceed max
Total wate input (tonnes/r)
EfW Facility electricity generation (MVWe)
EfW Facility electricity generation (MVWe)

CCC current residual waste: with 50% less plastic (for Scenarios: 5 and 12)

		1	Biogenic Carbon			1			
	CCC 50% less plastic		(% of waste	Non-Biogenic Carbon	Net Calorific	Biogenic Carbon	Non-Biogenic Carbon	Total Carbon	Total
	(% by weight)	s	stream)	(% of waste stream)	Value (MJ/kg)	(% by weight)	(% by weight)	(% by weight)	(MJ/
	23.10%		31.27%		10.749	7.22%		7.22	:%
	8.00%			54.76%	24.682		4.38%	4.38	:%
	6.00%		19.93%	19.93%	14.327	1.20%	1.20%	2.39	196
	10.20%		23.69%	15.79%	14.612	2.42%	1.61%	4.03	:%
	3.90%		2.94%	4.05%	2.573	0.11%	0.16%	0.27	'%
	0.9%		2.94%	4.05%	2.573	0.03%	0.04%	0.06	196
	6.70%								
	35.00%		13.46%		3.460	4.71%		4.71	.%
	2.50%		17.17%		4.210	0.43%		0.43	:%
	3.60%			15.81%	7.060	0.00%	0.57%	0.57	'%
-	99.9%					16.1%	8.0%	24.07	%
		-				66.96%	33.04%		
ting Parameters for NCV (pro									
	Note: Reduced boiler load through maximum n	nechanical throughput of 40.8 tph each line and MWe output plus re	educed operation	hours not to exceed max	imum waste throu	ighput of 625,600 t	pa		

CCC current residual waste: with 50% less organics (provided by CCC in Deadline 4 Submission - Cover letter and Appendices (REP4-028)) (for Scenarios: 6 and 13)

		1	<b>Biogenic Carbon</b>			1			
	CCC 50% less organics		(% of waste	Non-Biogenic Carbon	Net Calorific	<b>Biogenic Carbon</b>	Non-Biogenic Carbon	Total Carbon	Total NCV
(% by	weight)		stream)	(% of waste stream)	Value (MJ/kg)	(% by weight)	(% by weight)	(% by weight)	(MJ/kg)
	26.10%		31.27%		10.749	8.16%		8.16%	2.
	19.80%			54.76%	24.682		10.84%	10.84%	4.
	6.80%		19.93%	19.93%	14.327	1.36%	1.36%	2.71%	0.
	11.50%		23.69%	15.79%	14.612	2.72%	1.82%	4.54%	1.
	4.40%		2.94%	4.05%	2.573	0.13%	0.18%	0.31%	0.
	1.0%		2.94%	4.05%	2.573	0.03%	0.04%	0.07%	0
	7.50%								
	16.00%		13.46%		3.460	2.15%		2.15%	0.5
	2.80%		17.17%		4.210	0.48%		0.48%	0.
	4.10%			15.81%	7.060	0.00%	0.65%	0.65%	0.
	100.0%					15.0%	14.9%	29.91%	11.4
						50.26%	49.74%		
ers for NCV (pro	vided by MVV)								
	Note: 100% design point with 55 MWe net pow	ver output and waste throughput below 625,600 tpa							11
									503
									8,

EfW Facility electricity generation (MWe)

## Net Emisssions Summary Link back to index table

				Facility	from Proposed Development	to LFG
Analysis Category	Item	Description	(ktCO2e)	(ktCO2e)	(ktCO2e)	
ES Case	Sc 1	ES Case	10,611	8,040	-2,572	-24.2%
	Sc 2	ES Case with reduced recyclables (65% target)	10,868	7,808	-3,060	-28.2%
	Sc 3	ES Case with 90% less food and plastics	13,688	4,055	-9,632	-70.4%
Waste Composition (WC)	Sc 4	CCC: current residual waste	10,048	8,109	-1,940	-19.3%
	Sc 5	CCC: 50% reduced plastics	11,625	5,509	-6,116	-52.6%
	Sc 6	CCC: 50% reduced organics	8,765	8,940	175	2.0%
	Sc 7	Gas-fired power stations (CCGT)	9,791	4,696	-5,095	-52.0%
	Sc 8	UK grid decarbonisation – for ES Case	11,330	10,970	-361	-3.2%
	Sc 9	UK grid decarbonisation – with reduced recyclables (65% target)	11,604	10,738	-866	-7.5%
Electricity Generation Offset (EGO)	Sc 10	UK grid decarbonisation – with 90% less food and plastics	14,618	6,816	-7,801	-53.4%
	Sc 11	UK grid decarbonisation – CCC: current residual waste	10,729	10,934	205	1.9%
	Sc 12	UK grid decarbonisation – CCC: 50% reduced plastics	12,414	8,161	-4,253	-34.3%
	Sc 13	UK grid decarbonisation – CCC: 50% reduced organics	9,357	11,870	2,512	26.8%
Combined Heat and Power (CHP)	Sc 14	CHP, export of steam from the EfW CHP facility	10,542	5,139	-5,404	-51.3%
combined near and Fower (cnr)	Sc 15	CHP, export of steam from the EfW CHP facility – including grid decarbonisation	11,330	10,583	-747	-6.6%
	Sc 16	52% LFG capture rate	16,431	8,040	-8,391	-51.1%
Landfill Gas capture rate (LFG)	Sc 17	52% LFG capture rate – including grid decarbonisation	16,980	10,970	-6,011	-35.4%
calidini das captule late (Li G)	Sc 18	85% LFG capture rate	4,428	8,040	3,611	81.5%
	Sc 19	85% LFG capture rate – including grid decarbonisation	5,327	10,970	5,642	105.9%
	Sc 20	2030 adoption of CCS by the EfW CHP facility	10,611	1,185	-9,427	-88.8%
Carbon Capture and Storage (CCS)	Sc 21	2030 adoption of CCS by the EfW CHP facility – including grid decarbonisation	11,330	3,397	-7,933	-70.0%
carbon captare and storage (ees)	Sc 22	2040 adoption of CCS by the EfW CHP facility	10,611	3,100	-7,511	-70.8%
	Sc 23	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation	11,330	5,496	-5,834	-51.5%
	Sc 24	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and reduced recyclables (65% target)	11,604	5,392	-6,212	-53.5%
	Sc 25	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and 90% less food and plastics	14,618	3,625	-10,992	-75.2%
	Sc 26	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CCC: current residual waste	10,729	5,478	-5,251	-48.9%
Decarbonisation and CCS combined (D&CCS)	Sc 27	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CCC: 50% reduced plastics	12,414	4,226	-8,187	-66.0%
becarbonisation and ces combined (baces)	Sc 28	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CCC: 50% reduced organics	9,357	5,897	-3,460	-37.0%
	Sc 29	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CHP, export of steam from the EfW CHP facility	11,330	5,110	-6,221	-54.9%
	Sc 30	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation at 52% LFG capture rate	16,980	5,496	-11,484	-67.6%
	Sc 31	2041 adoption of CCS by the EfW CHP facility – including grid decarbonisation at 85% LFG capture rate	5,327	5,496	169	3.2%

LFG

EfW CHP Lifetime Net change % difference

#### Gross Emisssions Summary Link back to index table

				Facility	from Proposed Development	to LFG
Analysis Category	Item	Description	(ktCO2e)	(ktCO2e)	(ktCO2e)	
ES Case	Sc 1	ES Case	11,397	11,243	-155	-1.4%
	Sc 2	ES Case with reduced recyclables (65% target)	11,673	11,011	-662	-5.7%
	Sc 3	ES Case with 90% less food and plastics	14,704	7,074	-7,631	-51.9%
Waste Composition (WC)	Sc 4	CCC: current residual waste	10,792	11,197	405	3.8%
	Sc 5	CCC: 50% reduced plastics	12,487	8,409	-4,079	-32.7%
	Sc 6	CCC: 50% reduced organics	9,413	12,143	2,730	29.0%
	Sc 7	Gas-fired power stations (CCGT)	11,397	11,243	-155	-1.4%
	Sc 8	UK grid decarbonisation – for ES Case	11,397	11,243	-155	-1.4%
	Sc 9	UK grid decarbonisation – with reduced recyclables (65% target)	11,673	11,011	-662	-5.7%
Electricity Generation Offset (EGO)	Sc 10	UK grid decarbonisation – with 90% less food and plastics	14,704	7,074	-7,631	-51.9%
	Sc 11	UK grid decarbonisation – CCC: current residual waste	10,792	11,197	405	3.8%
	Sc 12	UK grid decarbonisation – CCC: 50% reduced plastics	12,487	8,409	-4,079	-32.7%
	Sc 13	UK grid decarbonisation – CCC: 50% reduced organics	9,413	12,143	2,730	29.0%
Combined Heat and Power (CHP)	Sc 14	CHP, export of steam from the EfW CHP facility	11,397	11,243	-155	-1.4%
combined near and Power (cnP)	Sc 15	CHP, export of steam from the EfW CHP facility – including grid decarbonisation	11,397	11,243	-155	-1.4%
	Sc 16	52% LFG capture rate	17,032	11,243	-5,789	-34.0%
Landfill Gas capture rate (LFG)	Sc 17	52% LFG capture rate – including grid decarbonisation	17,032	11,243	-5,789	-34.0%
Landini Gas capture rate (El G)	Sc 18	85% LFG capture rate	5,411	11,243	5,832	107.8%
	Sc 19	85% LFG capture rate – including grid decarbonisation	5,411	11,243	5,832	107.8%
	Sc 20	2030 adoption of CCS by the EfW CHP facility	11,397	11,285	-113	-1.0%
Carbon Capture and Storage (CCS)	Sc 21	2030 adoption of CCS by the EfW CHP facility – including grid decarbonisation	11,397	11,285	-113	-1.0%
carbon capture and storage (ecs)	Sc 22	2040 adoption of CCS by the EfW CHP facility	11,397	11,285	-113	-1.0%
	Sc 23	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation	11,397	11,285	-113	-1.0%
	Sc 24	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and reduced recyclables (65% target)	11,673	11,053	-620	-5.3%
	Sc 25	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and 90% less food and plastics	14,704	7,116	-7,589	-51.6%
	Sc 26	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CCC: current residual waste	10,792	11,239	447	4.1%
Decarbonisation and CCS combined (D&CCS)	Sc 27	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CCC: 50% reduced plastics	12,487	8,451	-4,037	-32.3%
becarbonisation and cc3 combined (baccs)	Sc 28	2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation and CCC: 50% reduced organics	9,413	12,185	2,772	29.5%
	Sc 29	2040 adoption of CCS by the EfW CHP facility - including grid decarbonisation and CHP, export of steam from the EfW CHP facility	11,397	11,285	-113	-1.0%
	Sc 30	2040 adoption of CCS by the EfW CHP facility - including grid decarbonisation at 52% LFG capture rate	17,032	11,285	-5,747	-33.7%
	Sc 31	2041 adoption of CCS by the EfW CHP facility - including grid decarbonisation at 85% LFG capture rate	5,411	11,285	5,874	108.6%

LFG

EfW CHP Lifetime Net change % difference

#### Scenario 1 ES Case

#### Link back to

Headline assumptions for ES Case (additional to the general assumptions) 1a Waste composition based on WRAP 2017 profile for England 1b EW CHP facility operating parameters for NCV of 9.53 MI/Mg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55) 2 Electricity generation offset for 40 wars based on emissions factor in ES for UK grid average 2020/21 = 182 g/XWh 3 Electricity export only for the EW CHP facility, no steam export 4 LFG capture rate for modern, large UK landfill = 68% 5 No CCS

Reference See worksheet: 'Waste composition variation' See worksheet: 'Waste composition variation' BEIS (2021). Fuel Mix Disclosure Data Table 2020-2021

19,650

262,062

N/A DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

 
 Step 1) Residual Waste Composition

 Waste Stream

 Recycluble Paper

 Card

 Non-recycluble Paper

 Dense Plastic

 Plastic film

 Textiles

 Misc. Conconductible

 Misc. Conconductible

 Other Wastes

 Glass

 Ferrous Metals

 Food Waste

 Gowlet House

 Grader Waste

 Grader Waste

 Gwell Waste

 Gwell Waste

 Gwell Waste

 Gwell Waste

 Garder Waste

 Gwell Waste

 Gwell Waste

 Gwell Waste

 Gwell Waste

 Gwell Waste

 Gwell Waste
 Scenario 1 5.9% 6.3% 8.9% 7.8% 8.2% 5.5% 9.3% 0.3% 2.6% 2.4% 1.1% 2.7% 2.3% 1.1% 0.5% 2.2% Other Organic Wood WEE Haardous Fines Net Calorific Value (MJ/kg) Total waste input (tonnes/yr) Total waste input (tonnes/yr) Total carbon (% of total Carbon) Non-Biogenic Carbon (% of Total Carbon) Their begins cannot five review darkany Parameter Total works input flowner/vi Total works input flowner/vi Non-Biogenic Carbon (K sid Total Carbon) Mass of fosal carbon in residual works (formes carbon) Fosal derived CO2 emissions (ICO2) NO2 emissions functional works (combustion (tonnes) Equivalent CO2 emissions (ICO2) CH4 emissions for residual works (combustion (tonnes) Equivalent CO2 emissions (ICO2) 613,573 26.20% 42.80% 68,793 252,242 23 6,197 175 4,911 745,424 CH4 emissions from residual waste combustion (tonne Equivalent CO2 emissions (tCO2e) Auxilliary Burners - Fuel: Gas Oli (litres) Auxilliary Burners - emissions for use of fuel (tCO2e) EfW Gross emissions (tCO2e/yr) 4,815 268,165 EW Facility electricity generation (MWe) EW Facility operations (Inrv/y) Electricity generated by EW Facility (NWh) CO2 emissions factor for energy generation (g/kWh) EW Equivalent CO2 offset for electricity generation by Facility (tCO2e/vr) EW Equivalent CO2 offset for electricity 440,000 80,080 EfW Net emissions (tCO2e/yr) 188,085 Sten 3) Carbon emissions from Step 3) Carbon emissions from landfilling residual waste Parameter Mass of biogenic carbon in residual waste (fromes carbon) Total carbon converted to LFG (formes carbon) Methane in LFG released from residual waster (CH4) Uncaptured LFG oxidied or LO2 in landfill cap (CH4) Uncaptured LFG oxidend to LO2 in landfill cap (CH4) Uncaptured LFG oxidend to LO2 in landfill cap (CH4) 91,933 45,966 34,935 23,755 1,118 Uncaptured LFG released to atmosphere as methane (tCH4) LFG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr) 10,061 281,712 23,755 21,594 388,687 107,969

## Methane in LFG captured for use in gas engines (ICH4) Methane used in gas engines (ICH4) Fuel input to UFG engines (GI) Power generated by UFG engines (INWh) UFG (EQUENDING factor for electricity generation (g/kWh) UFG Equivalent CO2 offset for electricity generation from combustion (ICO2e/yr) LFG Net emissions (tCO2e/yr) Step 4) Carbon emissions from operation s over 40 years Parameter EfW forses operational emissions (ktCO2e) EfW Equivalent CO2 offset for electricity generation by Facility (ktCO2e)

Parameter	Scenario 1
EfW Gross operational emissions (ktCO2e)	10,727
EfW Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	3,203
EfW Net operational emissions (ktCO2e)	7,523
LFG Gross operational emissions (ktCO2e)	11,268
LFG Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	786
LFG Net operational emissions (ktCO2e)	10,482

### 5) Lifetime ca

Project Lifecycles	Scenario 1)	Scenario 1) ES Case	
	LFG	EfW CHP Facility	
	(ktCO2e)	(ktCO2e)	
Construction			
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55	
A5 – Construction process stage		4.90	
A4 – Construction Transport		7.93	
Operation			
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91	
B6 – Operational energy	25.04	10,726.58	
B7 – Operational water		0.24	
B8 – Other operational processes: Landfill	11,268.48		
88 – Other operational processes: Operational transport	103.85	271.68	
88 – Other operational processes: IBA and APCr		142.60	
Decommissioning			
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.38	
General			
D – Avoided emissions	-786.01	-3,203.20	
TOTAL	10,611.36	8,039.57	

-

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

#### Scenario 2

ES Case with reduced recyclables (65% target) Link back to index table

 Headline assumptions for Scenario (red type indicates variation with respect to the ES Case)

 1a Waste composition based on: target 65% of municipal waste is recycled by 2035, with 44.5% already recycled in 2019

 1b EVM CHP facility operating parameters adjusted for NCV (waste - 61.568 U/yr)

 2 Electricity generation offset of or 0 years based on emission factor in ES for UK grid average 2020/21 = 182 g/KWh

 2 Electricity expend only for the EVM CHP facility, no steam export

 4 LFG capture rate for modern, large UK landlill = 68%

 5 No CCS

Reference See worksheet: Waste composition voriation' See worksheet: Waste composition voriation' BI'S (2021). Fuel Mix Disclosure Data Table 2020-2021 N/A DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

 
 Step 1] Residual Waste Composition

 Waste Stream
 Recycliable Paper

 Card
 Carde

 Dense Plantic
 Paper

 Dense Plantic
 Paper

 Mice Combustible
 Paper

 Mice Combustible
 Paper

 Other Wastes
 Paper

 Glass
 Ferrous Metals

 Non-Ferrous Metals
 Paper

 Good Waste
 Paper

 Other Waste
 Paper

 Garden Waste
 Paper

 Wood
 WEEE

 Haardoous
 Paper
 Hazardous Fines Net Calorific Value (MJ/kg) Total waste input (tonnes/yr) Total Carbon (% of Yotal Carbon) Biogenic Carbon (% of Total Carbon) Non-Biogenic Carbon (% of Total Carbon) 2.6% Step 21 Carbon emissions from residual waste combustio Parameter Total waste inout (tonnes/yr) Total carbon (% by weight) Non-Biogenic Carbon (% of Total Carbon) Mass of fossil carbon in residual waste (tonnes carbon) Fossil derived CO2 emission (tCO2) NO2 emission form esidual waste combustion (tonnes) waste combustion in EfW CHP Facility 15.668 26.21% 41.65% 67,213 246,449 Equivalent CO2 emissions (tCO2e) CH4 emissions from residual waste combustion (tonnes) 6,201 176 Equivalent Co2 emissions (CO2e) Auxilliary Burners - Fuel: Gas Oil (litres) Auxilliary Burners - emissions for use of fuel (tCO2e) EfW Gross emissions (tCO2e/yr) 4,914 1,745,424 <u>4,815</u> **262,379** EfW Facility electricity generation (MWe) EfW Facility operations (hrv/yr) Electricity generated by EfW Facility (MWh) CO2 emission factor for energy generation (g/kWh) EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr) 80,080 EfW Net emissions (tCO2e/yr) 182,299 Ent the compared (code yr)
Eggs 3) Carbon emissions from Indilling residual waste and LFG combus
Parameter
Mass of biogenic carbon in residual waste (tonnes carbon)
Todi carbon converted to LFG (tonnes carbon)
Methane in LFG released from residual waste (CH4)
Methane in LFG released to from period a sonplex (CH4)
Uncaptured LFG addresd to danoptere an methane (CH4)
LFG Equivalent CO2 of post anison released to immosphere (tCO2e/yr)
LFG Equivalent (CD2 effective and the son of the sont of the s 94,182 47,091 35,789 24,337 1,145 10,307 288,604 Methane in LFG captured for use in gas engines (ICH4) Methane used in gas engines (ICH4) Fuel input to IC engines (IGI) Power generated by LFG engines (IMWh) UK grid CO2 emission Starfor of executivity generation (g/LWh) LFG Equivalent CO2 offset for electricity generation from combustion (ICC2e/yr) 24,337 22,122 398,197 110.610 20,131 LFG Net emissions (tCO2e/yr) 268,473 
 Step 4) Carbon emissions from operational processes over 40 years

 Parameter

 EW Gross operational emissions (kCO2e)

 EW Ruywalen C20 field refeating systemation by Facility (kCO2e)

 EW Net operational emissions (kCO2e)
 10,495 3,203 7,292 LFG Gross operational emissions (ktCO2e) LFG Equivalent CO2 offset for electricity generation by Facility (ktCO2e) LFG Net operational emissions (ktCO2e) 805 10,739

Step 5) Lifetime carbon emissions				
Project Lifecycles		Scenario 2) ES Case with reduced recyclables (65% target)		
	LFG	EfW CHP Facility		
	(ktCO2e)	(ktCO2e)		
Construction				
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.		
A5 – Construction process stage		4.5		
A4 – Construction Transport		7.		
Operation				
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.		
B6 – Operational energy	25.04	10,495.		
B7 – Operational water		0.3		
B8 – Other operational processes: Landfill	11,544.17			
88 – Other operational processes: Operational transport	103.85	271.		
88 – Other operational processes: IBA and APCr		142.		
Decommissioning				
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.		
General				
D – Avoided emissions	-805.24	-3,203.3		
TOTAL	10,867.82	7,808.3		

4
265
30
28
1,939,360
90%
0.2731
2.75857
50
50%
57%
68%
10%
91%
36%

Scenario 3 ES Case with 90% less food and plastics Link back to index ta

 Headline assumptions for Scenario (red type indicates variation with respect to the ES Case)

 1a
 Waste composition based on: 50% reduction in food and plattice, in addition to 20% reduction in other recyclables

 1b
 EW CHP facility operating parameters adjusted for MCV (waste = 625,800 t/yr; hours = 7.667 per yr; MVe = 54.08)

 2
 Electricity execution offset of 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh

 2
 ECCTOR parameters adjusted for facility, no steam export

 4
 EFG capture rate for modern, large UK landfill = 68%

 5
 No CCS

Reference See worksheet: Waste composition voriation' See worksheet: Waste composition voriation' BI'S (2021). Fuel Mix Disclosure Data Table 2020-2021 N/A DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

Step 1) Residual Waste Composition
Wate Stream
Recyclude Paper
Recyclude Paper
Pense Plastic
Non-recyclude Paper
Pense Plastic
Pense Plastic
Non-Scrubustble
Misc. Non-Combustble
Other Waste
Glass
Ferrous Metals
Forol Metals
Ford Waste
Garden Waste
Gard nario 3 8.5% 9.1% 16.0% 1.5% 7.9% 16.7% 6.5% 0.5% 3.5% 3.5% 3.5% 3.5% 4.9% 3.9% 4.1% 3.3% 2.0% 0.9% Hazardous Fines Net Calorific Value (MJ/kg) Total waste input (tonnes/yr) Total Carbon (% by weight) Biogenic Carbon (% of Total Carbon) Non-Biogenic Carbon (% of Total Carbon) .0% Step 21 Carbon emissions from residual waste combustio Parameter Total waste input (tonnes/yr) Total Carbon (% by weight) Non Biogenic Carbon (% of Total carbon) Mass of forsil carbon in residual waste (tonnes carbon) Fossil derived CO2 emissions (tCO2) NO2 emissions from residual waste combustion (tonnes) waste combustion in EfW CHP Facility 625.600 25.49% 25.42% 40,528 148,603 Equivalent CO2 emissions (tCO2e) CH4 emissions from residual waste combustion (tonnes) 5,868 166 Equivalent Co2 emissions (CO2e) Auxilliary Burners - Fuel: Gas Oil (litres) Auxilliary Burners - emissions for use of fuel (tCO2e) EfW Gross emissions (tCO2e/yr) 4,650 1,745,424 <u>4,815</u> **163,935** EfW Facility electricity generation (MWe) EfW Facility operations (hrv/yr) Electricity generated by EfW Facility (MWh) CO2 emission factor for energy generation (g/kWh) EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr) 414,613 75,460 EfW Net emissions (tCO2e/yr) 88,475 TW test Eliminature Local Pri

Step 3) Carbon emissions from landfilling residual waste and LFG combust
Parameter

Mass of bion converted to LFG formes carbon)

Mass of bion converted to LFG formes carbon)

Methane in LFG captured for use in gas engines (ICM4)

Methane in LFG captured for use in gas engines (ICM4)

Uncaptured LFG related for a straidal wate (ICM4)

Lincaptured LFG related for to antidual lice (ICM4)

Lincaptured LFG related for straidal motioner (ICM4)

Lincaptured LFG related for straidal motioner (ICM4)

LFG Equivalent CO2 Gross emissions released to atmosphere (ICO2e/yr1) 59,456 45,187 30,727 1,446 13,014 364,386 Methane in LFG captured for use in gas engines (ICH4) Methane used in gas engines (ICH4) Fuel input to LFG engines (IGI) Power resentated by LFG engines (MWh) UK grid CO2 emissions factor for electricity generation (g/kWh) LFG Equivalent CO2 offset for electricity generation from combustion (ICO2e/yr) 30,727 27,931 502,755 139.654 25,417 \*\*8,969 LFG Net emissions (tCO2e/yr) Step 4) Car Alego 47 Calibon emission i form operational processes over 40 years Parameter ETW Gross operational emissions (ktCO2e) ETW Tequivalent CO2 offest for electricity generation by Facility (ktCO2e) ETW Net operational emissions (ktCO2e) 6,557 3,018 3,539 LFG Gross operational emissions (ktCO2e) LFG Equivalent CO2 offset for electricity generation by Facility (ktCO2e) LFG Net operational emissions (ktCO2e) 14,575 1,017 13,559

Step 5) Lifetime carbon emissions		
Project Lifecycles	Scenario 3) ES Case with 90	% less food and plastic
	LFG	EfW CHP Facility
	(ktCO2e)	(ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.5
A5 – Construction process stage		4.9
A4 – Construction Transport		7.9
Operation		
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.
B6 – Operational energy	25.04	6,557.4
87 – Operational water		0.3
88 – Other operational processes: Landfill	14,575.42	
88 – Other operational processes: Operational transport	103.85	271.
88 – Other operational processes: IBA and APCr		142.0
Decommissioning		
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.3
General		
D – Avoided emissions	-1,016.68	-3,018.
TOTAL	13,687.63	4,055.3

EW Parameters: N20 Emissions Factor 4 kpN0/11 (IPCC) N20 Global Warming Potential (IgCC2e / kpN20) CH4 Emissions Factor 4 kgCH4/T1 (IPCC) CH4 Global Warming Potential (IgCC2e / kgCH4) Tacid Gas 00 (Igeo) Consumption (International Auxillaro burners - % of annual Gas 01 Consumption Fuel (Gas 00) emissions factor (IgCC2e/Ntm) Fuel (Gas 00) emissions factor (IgCC2e/Ittre) 4 265 30 28 1,939,360 90% 0.2731 2.75857 UFG Parameters: Calorific value of methane (MI//kg) Biogenic carbon in resdual waste converted to landfill gas (LFG) Proportion of UFG recovered from resdual waste Ovidation of LFG released from resdual waste to CO2 in landfill cap Proportion of LFG released from resdual waste to CO2 in landfill cap Proportion of UFG used in gas engines LFG engine efficiency: 36% 50 50% 57% 68% 10% 91% 36%

## Scenario 4

CCC: current residual waste

Headline assumptions for Scenario (rnd type indicates variation with respect to the ES Case) 1a Waste composition based on: Cambridgeshire Current Residual Waste Composition 1b EMC (rbl facility operating parameters adjusted for NCV (waste = 625,600 (fyr; hours = 7,713 per yr) 2 Electricity generation offset of 40 years based on ensistons factor in ES for UK grid average 2020/21 = 182 g/kWh 3 Electricity export only for the EMV CHP facility, no steam export 4 LFG capture rate for modern, large UK landfill = 68% 5 No CCS

Reference See worksheet: 'Waste composition variation' See worksheet: 'Waste composition variation' BEIS (2021). Fuel Mix Disclosure Data Table 2020-2021 BEIS (2021). Fuel Mix Disclosure Data Table 2020-2021 N/A DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

See 11 Residual Waste Composition
Waste Stream
Paper & Cord
Parts
Paper & Cord
Parts
Parts
Textiles
Miss: Concombustible
Other Wastes
Glass & Metals
Food Waste
Wood
WEEE Scenario 4 12.4% 13.2% 3.9% 14.1% 5.8% 0.0% 5.0% 41.4% 1.0% 3.3% Net Calorific Value (MJ/kg) Total waste input (tonnes/yr) Total Carbon (% by weight) Biogenic Carbon (% of Total Carbon) Non-Biogenic Carbon (% of Total Carbon) Non-Biogenic Carbon (% of Total Carbon)

Step 21 Carbon emissions from residual waste combustion in EfW CHP Facility
Parameter

Total waste input (tonnes/yr)
Total carbon (% by weight)
Non-Biogenic Carbon (% of Total Carbon)
Mass of fossil carbon in residual waste (none carbon)
Fossil derived CO2 emissions (ECO2P)
NO2 emissions (ECO2P)
CM emissions form residual waste combustion (tonnes)
Eguivalent CO2 emissions (ECO2P)
CM emissions for carbon (% of Total Carbon)
Audillary Burners - sel: Gas Ol Iltee)
Audillary Burners - sel: Gas Ol Iltee)
EfW for emissions for use of fuel (tCO2P)
EfW for emissions fuel to carbon (% of the formediate to carbon)
Fossil derived CO2 emissions for use of fuel (tCO2P)
EfW formers - emissions for use of fuel (tCO2P) 625,600 24.87% 44.08% 68,576 251,445 23 6,003 170 4,757 1,745,424 4,815 267,020 EW Facility electricity generation (MWe) EW Facility operation (hrv(ry)) Electricity generated by EW Facility (MWh) C22 emission factor for energy generation (g/Wh) EW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr) 424,215 77,207 EfW Net emissions (tCO2e/yr) 189,813 Step 3) Carbon emissions from I ind LEG combi Step 3) Carbon emissions from landfilling residual waste : Parameter Mass of biogenic carbon in residual waste (tonnes carbon) Total carbon converted to LFG (tonnes carbon) Methane in LFG released from residual waste (tCH4) 86,996 43,498 33,058

Methane in LPG released from residual waste (LCH4)	33,058
Methane in LFG captured for use in gas engines (tCH4)	22,480
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	1,058
Uncaptured LFG released to atmosphere as methane (tCH4)	9,521
LFG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr)	266,583
Methane in LFG captured for use in gas engines (tCH4)	22,480
Methane used in gas engines (tCH4)	20,434
Fuel input to LFG engines (GJ)	367,812
Power generated by LFG engines (MWh)	102,170
UK grid CO2 emissions factor for electricity generation (g/kWh)	182
LFG Equivalent CO2 offset for electricity generation from combustion (tCO2e/yr)	18,595
LFG Net emissions (tCO2e/yr)	247,988
Step 4) Carbon emissions from operational processes over 40 years	
Parameter	Scenario 4
EfW Gross operational emissions (ktCO2e)	10,681
EfW Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	3,088
EfW Net operational emissions (ktCO2e)	7,593

LFG Gross operational emissions (ktCO2e)	10,663
LFG Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	744
LFG Net operational emissions (ktCO2e)	9,920

Project Lifecycles	Scenario 4) CCC: curre	Scenario 4) CCC: current residual waste	
	LFG	EfW CHP Facility	
	(ktCO2e)	(ktCO2e)	
Construction			
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55	
A5 – Construction process stage		4.90	
A4 – Construction Transport		7.9	
Operation			
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91	
B6 – Operational energy	25.04	10,680.81	
B7 – Operational water		0.24	
B8 – Other operational processes: Landfill	10,663.30		
B8 – Other operational processes: Operational transport	103.85	271.68	
88 – Other operational processes: IBA and APCr		142.60	
Decommissioning			
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.38	
General			
D – Avoided emissions	-743.80	-3,088.29	
TOTAL	10,048.39	8,108.71	

EfW Parameters: N2O Emiccions Factor 4 kgN2O/TJ (IPCC)

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

## Scenario 5 CCC: 50% reduced plastics

## Link back to index table

Headline assumptions for Scenario (ned type indicates variation with respect to the ES Case) 1a Wate composition based on: Cambridgeshire current residual wate with plastics reduced 50% iets than baseline 1b MC 01<sup>6</sup> Rolity operating parameters adjusted for NCV wate = 02,3500 (Yr, Nuor = 7.667 per yr, NWe = 51.94) 2 Electricity generation offset for 40 years based on emissions factor in ES for UK grid average 2020/21 = 182 g/kWh 3 Electricity expendion ofly for the EVC off calibr, no tasem export 4 LFG capture rate for modern, Large UK landfill = 68%

Reference See worksheet: Waste composition voriation' See worksheet: Waste composition voriation' BE'S (2021). Fuel Mix Disclosure Data Table 2020-2021 NA DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling NA

25.04

2,358.39 103.85

-862.04 11,625.25

educed plastics EfW CHP Facility (ktCO2e)

35.55 4.90 7.93 4.91

0.24

271.68 142.60

48.38

-2,899.19 5,509.35

6,115.90

Scenario 5) CCC: 54 LFG (ktCO2e)

Step 1) Residual Waste Composition	
Waste Stream	Scenario 5
Paper & Card	23.1%
Plastics	8.0%
Textiles	6.0%
Misc. Combustible	10.2%
Misc. Non-Combustible	3.9%
Other Wastes	0.9%
Glass & Metals	6.7%
Food Waste	35.0%
Wood	2.5%
WEEE	3.6%
Net Calorific Value (MJ/kg)	8.50
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	24.07%
Biogenic Carbon (% of Total Carbon)	66.96%
Non-Biogenic Carbon (% of Total Carbon)	33.04%
Step 2) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 5
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	24.07%
Non-Biogenic Carbon (% of Total Carbon)	33.04%
Mass of fossil carbon in residual waste (tonnes carbon)	49,742
Fossil derived CO2 emissions (tCO2)	182,389
N2O emissions from residual waste combustion (tonnes)	21
Equivalent CO2 emissions (tCO2e)	5,638
CH4 emissions from residual waste combustion (tonnes)	160
Equivalent CO2 emissions (tCO2e)	4,468
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424
Auxilliary Burners - emissions for use of fuel (tCO2e)	4,815
EfW Gross emissions (tCO2e/yr)	197,309
EfW Facility electricity generation (MWe)	52
EfW Facility operations (hrs/yr)	7,667
Electricity generated by EfW Facility (MWh)	398,241
CO2 emissions factor for energy generation (g/kWh)	182
EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr)	72.480
	12,400
EfW Net emissions (tCO2e/yr)	124,829
Step 3) Carbon emissions from landfilling residual waste and LFG combustion	
Parameter	Scenario 5
Mass of biogenic carbon in residual waste (tonnes carbon)	100,825
Total carbon converted to LFG (tonnes carbon)	50,412
Methane in LFG released from residual waste (tCH4)	38,313
Methane in LFG captured for use in gas engines (tCH4)	26,053
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	1,226
Uncaptured LFG released to atmosphere as methane (tCH4)	
LFG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr)	308,960
Methane in LFG captured for use in gas engines (tCH4)	26.053
Methane used in gas engines (tCH4)	23,682
Fuel input to LFG engines (GI)	426.282
Power generated by LFG engines (MWh)	118,412
UK grid CO2 emissions factor for electricity generation (g/kWh)	118,412
LFG Equivalent CO2 offset for electricity generation (gr/win)	21,551
E o clamacin coco on activity Beneration non-comparian (cocc) (i)	21,331
LFG Net emissions (tCO2e/yr)	287,409
Step 4) Carbon emissions from operational processes over 40 years	
Parameter	Scenario 5
EfW Gross operational emissions (ktCO2e)	7,892
EfW Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	2,899
EfW Net operational emissions (ktCO2e)	
Erw wet operational emissions (ktcoze)	4,993
LFG Gross operational emissions (ktCO2e)	12,358

Construction

A - A2 - A3 - Rew materials supply, transport and manufacture
A - Construction process stage
A - Construction Prosport

C - Construction Prosport

2 - B5 - Maintenance, reply, replacement and refurbishment

3 - Operational energy

3 - Operational energy

3 - Operational processes: Is constained transport

3 - Other operational processes: Is and APErr

Decommissioning

C - -2, -2, -2, -2, -2, -1, of of fle, including deconstruction, transport, waste processing for recovery and disposal

Central

Central

Construction

Constructi Net change in GHG emissions resulting from the Proposed Development (ktCO2e)

Step 5) Lifetime carbon emissions Project Lifecycles

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

## Scenario 6 CCC: 50% reduced organics

#### Link back to

Headline assumptions for Scenario (red type indicates variation with respect to the ES Case)

 1a
 Waste composition based on: Cambridgeshire current residual waste with organics reduced 50% less than baseline

 1b
 EW Crift Boilty operating parameters adjusted for NCV (waste = 503,00 t/yr)

 2
 Externity expension offset for dyvers based on ensitions factor in ES for UK grid average 2020/21 = 182 g/kWh

 2
 Externity expension offset for dyvers based on ensitions factor in ES for UK grid average 2020/21 = 182 g/kWh

 3
 Externity expension offset for dyvers based on ensities for UK grid average 2020/21 = 182 g/kWh

 4
 LFG capture rate for modern, large UK landfill = 68%

 5
 No CCS

Reference See worksheet: Waste composition variation' See worksheet: Waste composition variation' BES (2021): Fuel Mix Disclosure Data Table 2020-2021 NGFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

Waste Stream	Scenario 6
Paper & Card	26.1
Plastics	19.8
Textiles	6.8
Misc Combustible	11.5
Misc. Non-Combustible	4.4
Other Wastes	1.0
Glass & Metals	7.5
Food Waste	16.0
Wood	2.8
WEEE	4.1
Net Calorific Value (MJ/kg)	11.4
Total waste input (tonnes/yr)	503,80
Total Carbon (% by weight)	29.91
Biogenic Carbon (% of Total Carbon)	50.26
Non-Biogenic Carbon (% of Total Carbon)	49.74
Step 2) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 6
Total waste input (tonnes/yr)	503,80
Total Carbon (% by weight)	29.91
Non-Biogenic Carbon (% of Total Carbon)	49.74
Mass of fossil carbon in residual waste (tonnes carbon)	74,97
Fossil derived CO2 emissions (tCO2)	274,89
N2O emissions from residual waste combustion (tonnes)	2
Equivalent CO2 emissions (tCO2e)	6,11
CH4 emissions from residual waste combustion (tonnes)	17
Equivalent CO2 emissions (tCO2e)	4,84
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,42
Auxilliary Burners - emissions for use of fuel (tCO2e)	4,81
EfW Gross emissions (tCO2e/yr)	290,66
EfW Facility electricity generation (MWe)	
	8,00
EfW Facility operations (hrs/yr)	
	440,00
Electricity generated by EfW Facility (MWh)	
Electricity generated by EfW Facility (MWh) CO2 emissions factor for energy generation (g/kWh)	18
ENV Facility operations (Instyl) Electricity generated by ENV Facility (MWN) CO2 emissions Each for energy generation (g/Wh) ENV Equivalent CO2 offset for electricity generation by Facility (ICO2e/yr)	440,00 18 80,08

Parameter	Scenario 6
Mass of biogenic carbon in residual waste (tonnes carbon)	75,740
Total carbon converted to LFG (tonnes carbon)	37,870
Methane in LFG released from residual waste (tCH4)	28,781
Methane in LFG captured for use in gas engines (tCH4)	19,571
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	921
Uncaptured LFG released to atmosphere as methane (tCH4)	8,289
LFG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr)	232,093
Methane in LFG captured for use in gas engines (tCH4)	19,571
Methane used in gas engines (tCH4)	17,790
Fuel input to LFG engines (GJ)	320,226
Power generated by LFG engines (MWh)	88,952
UK grid CO2 emissions factor for electricity generation (g/kWh)	182
LFG Equivalent CO2 offset for electricity generation from combustion (tCO2e/yr)	16,189
LFG Net emissions (tCO2e/yr)	215,904
Step 4) Carbon emissions from operational processes over 40 years	
Parameter	Scenario 6
EfW Gross operational emissions (ktCO2e)	11,627
EfW Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	3,203
EfW Net operational emissions (ktCO2e)	8,423

LFG Gross operational emissions (ktCO2e)	9,28
LFG Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	64
LFG Net operational emissions (ktCO2e)	8,63

## p 5) Lifetime carbon e

Project Lifecycles	Scenario 6) CCC: 50%	reduced organics
	LFG	EfW CHP Facility
	(ktCO2e)	(ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55
A5 – Construction process stage		4.90
A4 – Construction Transport		7.93
Operation		
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91
B6 – Operational energy	25.04	11,626.60
B7 – Operational water		0.24
88 – Other operational processes: Landfill	9,283.72	
B8 – Other operational processes: Operational transport	103.85	271.68
88 – Other operational processes: IBA and APCr		142.60
Decommissioning		
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.38
General		
D – Avoided emissions	-647.57	-3,203.20
TOTAL	8,765.05	8,939.59

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

# Scenario 7 Gas-fired power stations (CCGT) Link back to index table

 Neadline assumptions for Scenario (red type indicates variation with respect to the ES Case)

 La Waste composition based on WINP 20.17 profile for England

 La Ura Status (red to Placitity operating parameters for KV-07 53.3 MJ/kg (waste 613,573 L/yr; hours = 8,000 per yr; MWe = 55)

 2 Electricity peration using natura gas, offect for 40 years, based on latest UK emissions factor 2021/22 = 372 g/kWh

 2 Electricity perator only for the EW CHP facility, no steam export

 4 LFG capture rate for modern, large UK landfill = 68%

 5 No CCS

Reference See worksheet: 'Woste composition variation' See worksheet: 'Woste composition variation' DESVZ (2023). Fuel Mix Disclosure Data Table 2021-2022 N/A DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

Waste Stream	Sconario 7
Recyclable Paper	5.99
Card	5.97
Non-recyclable Paper	6.37
Dense Plastic	7.89
Plastic film	8.29
Textiles	5.59
Misc. Combustible	9.39
Misc. Non-Combustible	3.69
Other Wastes	0.39
Glass	2.69
Ferrous Metals	2.49
Non-Ferrous Metals	1.19
Food Waste	27.09
Garden Waste	2.79
Other Organic	2.39
Wood	2.39
WDdd	
	1.15
Hazardous	0.55
Fines	2.25
Net Calorific Value (MJ/kg)	9.5
Total waste input (tonnes/yr)	613,57
Total Carbon (% by weight)	26.209
Biogenic Carbon (% of Total Carbon)	57.209
Non-Biogenic Carbon (% of Total Carbon)	42.809
·	
Step 2) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 7
Total waste input (tonnes/yr)	613,57
Total Carbon (% by weight)	26.205
	42.805
Non-Biogenic Carbon (% of Total Carbon)	
Mass of fossil carbon in residual waste (tonnes carbon)	68,79
Fossil derived CO2 emissions (tCO2)	252,24
N2O emissions from residual waste combustion (tonnes)	2
Equivalent CO2 emissions (tCO2e)	6,19
CH4 emissions from residual waste combustion (tonnes)	17
Equivalent CO2 emissions (tCO2e)	4,91
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424
Auxilliary Burners - emissions for use of fuel (tCO2e)	4,815
EfW Gross emissions (tCO2e/yr)	268,165
	200,10
	5
EfW Facility electricity generation (MWe)	
EfW Facility operations (hrs/yr)	8,00
Electricity generated by EfW Facility (MWh)	440,00
CO2 emissions factor for energy generation (g/kWh)	37
EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr)	163,68
EfW Net emissions (tCO2e/yr)	
	104,48
	104,48
	104,48
Step 3) Carbon emissions from landfilling residual waste and LFG combustion	104,48 Scenario 7
Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter	Scenario 7
Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter Mass of biogenic carbon in residual waste (tonnes carbon)	Scenario 7 91,93
Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter Mass of biogenic carbon in residual waste (tonnes carbon) Total carbon comverts do Lof Connes-carbon)	Scenario 7 91,93 45,96
Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter Mass of blogenic carbon in residual waste (tonnes carbon) Total carbon converted to LFG formes carbon) Methane in LFG released from residual waste (LTH4)	Scenario 7 91,93 45,96 34,93
Step 3] Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of biogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LFG (tonnes carbon)           Total carbon converted to LFG (tonnes carbon)         Total carbon converted to LFG (tonnes carbon)           Methane In LFG calcussed from residual waste ((TotA)         Methane In LFG calcussed from regional waste ((TotA)	Scenario 7 91,93 45,96 34,93 23,75
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)         Methane in LFG released from residual waste (LTH4)           Methane in LFG captured for use in gas engines (LTH4)         Methane in LFG captured for use in gas engines (LTH4)	Scenario 7 91,93 45,96 34,93 23,75 1,11
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Total carbon in residual waste (tonnes carbon)         Total carbon in residual waste (tonnes carbon)           Total carbon converted to LFG (tonnes carbon)         Methane In LFG carbons carbon in selful waste (tot4)           Methane In LFG carbons for unit gas regimes (LO14)         Methane In LFG carbons for unit gas regimes (LO14)           Uncaptured LFG existed to atmosphere as methane (tO14)         Methane LFG carbons are smethane (LO14)	Scenario 7 91,93 45,96 34,93 23,75 1,11 10,06
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Total carbon in residual waste (tonnes carbon)         Total carbon in residual waste (tonnes carbon)           Total carbon converted to LFG (tonnes carbon)         Methane In LFG carbons carbon in selful waste (tot4)           Methane In LFG carbons for unit gas regimes (LO14)         Methane In LFG carbons for unit gas regimes (LO14)           Uncaptured LFG existed to atmosphere as methane (tO14)         Methane LFG carbons are smethane (LO14)	Scenario 7 91,93 45,96 34,93 23,75 1,11 10,06
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LFG formes carbon)           Total carbon converted to LFG formes carbon)         Methane in LFG released from residual waste (tCH4)           Wethane in LFG captured for use in gas engines (CH4)         Uncaptured LFG released to atmosphere as methane (CH4)           Uncaptured LFG released to atmosphere as methane (CH4)         LFG Equivalent CO2 Gross emissions released to atmosphere (LC02e/yr)	Scenario 7 45,95 34,93 23,75 1,11 10,06 281,71
Step 3) Carbon emissions from landfilling residual waste and LFG combustion           Parameter           Total carbon converted to LFG (connes carbon)           Total carbon converted to LFG (connes carbon)           Methane in LFG released from residual waste (COLH)           Methane in LFG captured for use inge sengines (CH4)           Uncaptured LFG existed to tarbon (age sengines (CH4)           Uncaptured LFG existed to tarbon (age sengines (CH4)           Uncaptured LFG existed to tarbon (age as methane (CH4)           UFE Equivalent CO2 Gross emissions released to atmosphere (ICO2e/yr)	Scenario 7 45,95 34,93 23,75 1,11 10,06 281,71
Step 3J Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blognet: carbon in residual waste (tones carbon)         Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)         Methane in LFG residues from residual waste (tot4)           Methane in LFG captured for use in gas engines (tot4)         Uncaptured LFG calibest to CO2 in landfill cap (tot4)           Uncaptured LFG calibest to CO2 in landfill cap (tot4)         Uncaptured LFG calibest to CO2 in landfill cap (tot4)           Uncaptured LFG calibest to CO2 in landfill cap (tot4)         Uncaptured LFG calibest to CO2 in landfill cap (tot4)           Uncaptured LFG calibest to CO2 in landfill cap (tot4)         Uncaptured LFG calibest to CO2 in landfill cap (tot4)           Methane in LFG captured for use in gas engines (tCH4)         Uncaptured LFG calibert to CO2 in landfill cap (tot4)	Scenario 7 91,93 45,96 34,93 23,775 1,11 10,066 281,71 23,75
Step 3) Carbon emissions from landfilling residual waste and LPG combustion         Parameter           Mass of biogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LPG formes carbon)           Total carbon converted to LPG formes carbon)         Masse biogenic carbon in residual waste (total carbon)           Webman RL FO reduced from residual waste (totAl carbon)         Masse biogenic carbon in setting and total carbon in the set (totAl carbon)           Unscapative LPG reduced from residual waste (totAl carbon)         Masses biogenic carbon in the set (totAl carbon)           Unscapative LPG reduced to atmosphere in (totAl)         Masses biogenic carbon in the set (totAl carbon)           USE Equivalent CO2 Gross emissions released to atmosphere (LCO24/vr)         Methane used in ages prions: (totAl carbon)           Wethane use LPG captured for use ingense (totAl)         Methane used in ages prions: (totAl carbon)	Scenario 7 91,93 45,96 34,99 23,75 1,11 10,06 23,75 21,57
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blogenic carbon in residual waste (tones carbon)         Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)         Methane in LFG released from residual waste (ICH4)           Methane in LFG captured for use in gas engines (ICH4)         Uncaptured LFG carbon converted to LFG fournes carbon in the carbon converted to LFG carbon	Scenario 7 91,33 45,96 34,39 23,75 1,11 0,06 <b>281,71</b> 23,75 21,59 388,66
Step 3) Carbon emissions from landfilling residual waste and LPG combustion         Parameter           Wass of biogenic carbon in residual waste (tonnes carbon)         Total carbon in residual waste (tonnes carbon)           Webma in LFG explored for user galance state (total)         Webma in LFG explored for user galance state (total)           Webma in LFG explored for user galance (total)         Webma in LFG explored for user galance state (total)           Webma in LFG explored for user galance (total)         Webma in LFG explored for user galance state (total)           Webma in LFG explored for user galance state (total)         Webma in LFG explored for user galance state (total)           User galance data state stat	Scenario 7 5(2)
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blognic carbon in residual waste (tones carbon)         Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)         Methane in LFG respective for use in gas engines (TOt4)           Uncaptured IFG orabide to CO2 in landfillic age (tCH4)         Uncaptured IFG orabide to CO2 in landfillic age (tCH4)           Uncaptured IFG orabide to CO2 in landfillic age (tCH4)         Uncaptured IFG orabide to CO2 in landfillic age (tCH4)           Uncaptured IFG orabide to CO2 in landfillic age (tCH4)         Uncaptured IFG orabide to CO2 in landfillic age (tCH4)           Wethane ILFG captured for use in gas engines (ICH4)         Uncapture IFG orabide to CO2 in landfillic age (tCH4)           Wethane used in gas engines (ICH4)         Parameter IFG captured for use in gas engines (ICH4)           Wethane used in gas engines (ICH4)         Parameter IFG captured for USE (to US	Scentrio 7  Scentr
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blognic carbon in residual waste (tones carbon)         Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)         Methane in LFG respective for use in gas engines (TOt4)           Uncaptured IFG orabide to CO2 in landfillic age (tCH4)         Uncaptured IFG orabide to CO2 in landfillic age (tCH4)           Uncaptured IFG orabide to CO2 in landfillic age (tCH4)         Uncaptured IFG orabide to CO2 in landfillic age (tCH4)           Uncaptured IFG orabide to CO2 in landfillic age (tCH4)         Uncaptured IFG orabide to CO2 in landfillic age (tCH4)           Wethane ILFG captured for use in gas engines (ICH4)         Uncapture IFG orabide to CO2 in landfillic age (tCH4)           Wethane used in gas engines (ICH4)         Parameter IFG captured for use in gas engines (ICH4)           Wethane used in gas engines (ICH4)         Parameter IFG captured for USE (to US	Scentrio 7  Scentr
Step 3) Carbon emissions from landfilling residual waste and LFG combustion           Parameter           Mass of blogenic carbon in residual waste (tones carbon)           Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)           Methane ILFG regulated from residual waste (ICH4)           Uncaptured IFG oxited to CO2 In landfillica (ICH4)           Uncaptured IFG oxited to CO2 In landfillica (ICH4)           Uncaptured IFG oxited to CO2 In landfillica (ICH4)           Uncaptured IFG oxited for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane landfillica (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane landfillica (ICH4)<	Scenario 7  Scenar
Step 3) Carbon emissions from landfilling residual waste and LFG combustion           Parameter           Mass of blogenic carbon in residual waste (tones carbon)           Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)           Methane ILFG regulated from residual waste (ICH4)           Uncaptured IFG oxited to CO2 In landfillica (ICH4)           Uncaptured IFG oxited to CO2 In landfillica (ICH4)           Uncaptured IFG oxited to CO2 In landfillica (ICH4)           Uncaptured IFG oxited for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane landfillica (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane landfillica (ICH4)<	Scenario 7  Scenar
Step 3) Carbon emissions from landfilling residual waste and LFG combustion           Parameter           Wass of blogenic carbon in residual waste (tones carbon)           Total carbon converted to LFG fournes carbon)           Total carbon converted to LFG fournes carbon)           Methane ILFG regulated from residual waste (ICH4)           Uncaptured IFG orables of LOX 2016 and IGL (ICH4)           Uncaptured IFG orables of LOX 2016 and IGL (ICH4)           Uncaptured IFG orables of LOX 2016 and IGL (ICH4)           Uncaptured IFG orables of LOX 2016 and IGL (ICH4)           Uncaptured IFG orables of LOX 2016 and IGL (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG captured for use in gas engines (ICH4)           Wethane ILFG ILFG USE (ICH4)           Wethane ILFG Captured for use in gas engines (ICH4)           Unard ILFG USE INSTANCE (ICH4)           Wethane ILFG Captured for use in gas engines (ICH4)           UFG USE Causions Instant for electricity generation from combustion (ICO2e/yr)           UFG Net emisions (ICO2e/yr)	Scenario 7  Scenar
Step 3) Carbon emissions from landfilling residual waste and LPG combustion           Parameter           Mass of biogenic carbon in residual waste (tones carbon)           Total carbon converted to LPG formes carbon)           Mass of biogenic carbon in residual waste (tones carbon)           Methane is LPG explored for use in gas engines (ICH4)           Uncapture LPG order for use in gas engines (ICH4)           Uncapture LPG orders for use in gas engines (ICH4)           Use Gaulawine CO2 consemissions reseased to atmosphere # (CO2e/yr)           Methane is LPG explored for use in gas engines (ICH4)           Description LPG explored for use in gas engines (ICH4)           Use Gaulawine CO2 consemissions reseased to atmosphere # (CO2e/yr)           Methane is LPG engines (ICM4)           Use gaines (ICM5)           Power powerated by LPG engines (ICM4)           Use gaines (ICM2)           Use gaines (ICM2) <t< td=""><td>Scenario 7           91.93         45.96           34.93         34.93           32,75         1.11           1006         281.71           27,75         21.59           383.68         68.019.99           37         40.16           241.54         241.54</td></t<>	Scenario 7           91.93         45.96           34.93         34.93           32,75         1.11           1006         281.71           27,75         21.59           383.68         68.019.99           37         40.16           241.54         241.54
Step 3] Carbon emissions from landfilling residual waste and LPG combustion         Parameter         Wins of biogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LPG formes carbon)         Total carbon converted to LPG formes carbon)         Methane in LPG explored for use in gas engines (CH4)         Uncaptured LPG oxide to CO2 in landfillica (CH4)         Uncaptured LPG released to atmosphere as methane (ICH4)         UPE Gauvelent CO2 fores emissions feaseed to atmosphere (toC2e/yr)         Methane in LPG captured for use in gas engines (ICH4)         Uncapture LPG released to atmosphere as methane (LCH4)         UPE Gauvelent CO2 fores emissions fease engines (ICH4)         Wethane used in gas engines (ICH4)         Uniquiput to LFG engines (G1)         Power generated by LFG engines (ICH4)         Use of CO2 emissions facts for electricity generation (g/Whh)         LFG Equivalent CO2 offset for electricity generation (g/Whh)         LFG Equivalent CO2 offset for electricity generation from combustion (ICO2e/yr)         LFG Het emissions (ICO2e/yr)         Step 4] CEAnon emissions from operational processes over 40 years         Parameter	Scenario 7  Scenario 7  Scenario 7  Scenario 7  Scenario 7  Scenario 7
Step 3) Carbon emissions from landfilling residual waste and LPG combustion           Parameter           Wask of biogenic carbon in residual waste (tones carbon)           Total carbon converted to LPG formes carbon)           Wethane is LPG explored for use in gas engines (CH4)           Uncaptured IFG outions carbon in the state (total)           Detabulant CD2 Gross emissions restate to antrosphere as methane (Ct04)           Uncaptured IFG outions carbon in the state to antrosphere it (Ct04)           Uncaptured IFG outions carbon in the state to antrosphere it (Ct04)           Uncaptured IFG outions of the state to antrosphere it (Ct04)           Uncaptured IFG outions in the state to antrosphere it (Ct04)           Deta Baukent CCD for semissions restate to antrosphere it (Ct04)           Methane in LFG explores (Tt04)           Prever paremeted to UFG explores (Tt04)           Uncaptured IFG outions forted for electricity generation (n2/Wh)           UFG explores (Ct02 offest for electricity generation (n2/Wh)           UFG explores (Tt02 offest for electricity generation (n2/Wh)	Scenario 7 9.93 45,56 34,93 32,75 1,11 10,00 28,17 21,75 21,
Step 3) Carbon emissions from landfilling residual waste and LPG combustion           Parameter           Wask of biogenic carbon in residual waste (tones carbon)           Total carbon converted to LPG formes carbon)           Wethane is LPG explored for use in gas engines (CH4)           Uncaptured IFG outions carbon in the state (total)           Detabulant CD2 Gross emissions restate to antrosphere as methane (Ct04)           Uncaptured IFG outions carbon in the state to antrosphere it (Ct04)           Uncaptured IFG outions carbon in the state to antrosphere it (Ct04)           Uncaptured IFG outions of the state to antrosphere it (Ct04)           Uncaptured IFG outions in the state to antrosphere it (Ct04)           Deta Baukent CCD for semissions restate to antrosphere it (Ct04)           Methane in LFG explores (Tt04)           Prever paremeted to UFG explores (Tt04)           Uncaptured IFG outions forted for electricity generation (n2/Wh)           UFG explores (Ct02 offest for electricity generation (n2/Wh)           UFG explores (Tt02 offest for electricity generation (n2/Wh)	Scenario 7  1027 1027
Step 3) Carbon emissions from landfilling residual waste and LFG combustion         Parameter           Mass of blogenic carbon in residual waste (tones carbon)         Total carbon converted to LFG (tones carbon)           Total carbon converted to LFG (tones carbon)         Total carbon converted to LFG (tones carbon)           Methane n LFG carboned for engines (tones carbon)         Total carbon converted to LFG (tones carbon)           Methane n LFG carboned for engines (tores)         Total carbon converted for LFG (total)           Uncapture UFG released to annosphere as methane (Tot4)         Uncapture UFG released to annosphere as methane (Tot4)	Scenario 7 9193 4596 3493 32757 1111 1006 28171 277 2159 3856 079 0 24154
Step 3) Carbon emissions from landfilling residual waste and LFG combustion           Parameter           Mass of bagenic carbon in residual waste (tonnes carbon)           Total carbon converted to LFG formes carbon)           Total carbon converted to LFG formes carbon)           Methane ILFG regulated form residual waste ([CH4])           Uncaptured LFG oxides of toox Tool indicitie (ap (CH4)           Uncaptured LFG oxides to 0.20 in indific (ap (CH4)           Uncaptured LFG oxides to 0.20 in indific (ap (CH4)           Uncaptured LFG oxides to 0.20 in indific (ap (CH4)           VEG Eduvalent CC2 forse smioston services to antonsphere (toC22/yr)           Methane ILFG captured for use in gas engines (ICH4)           User and LFG captured for use in gas engines (ICH4)           Wethane such in gas engines (ICH4)           User and LFG captured for use in gas engines (ICH4)           Wethane such in gas engines (ICH4)           User and USE for electricity generation (g/Wh)           UFG devident CC2 offset for electricity generation from combustion (tCO2e/yr)           UFG Net emissions (tCO2e/yr)           Step 4) Chrone missions from sporetional processes over 40 years           Parameter           EW Gross operational emissions (ICC22e)           EW Gross operational emissions (Text prevention by Facility (ktCO2e)	Scenario 7  Scenario 8  Scenar
Step 3) Carbon emissions from landfilling residual waste and LPG combustion         Parameter         Was of biogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LPG formes carbon)         Wethane in LPG explored for use lique waste (totAl)         Wethane in LPG explored for use lique waste (totAl)         Uncarptured ISG wasted form esclaub waste (totAl)         Uncarpture ISG wasted to annotations released to atmosphere (LCO2e/vr)         Methane In LPG explored for use ingue explores (ICH4)         Methane use IG explores for use ingue explores (ICH4)         Methane use IG explores for use ingue explores (ICH4)         Methane use IG explores for exercitivity generation form combustion (ICO2e/vr)         UK gait/carbon emissions factor for electricity generation form combustion (ICO2e/vr)         UK gait/carbon emissions factor for electricity generation form combustion (ICO2e/vr)         UK explored for Carbon emissions (ICO2e/Vr)         EVM ensisted at emissions (ICO2e)         EVM explored to Carbon emissions (IRCO2e)	Scenario 7  Scenar
Step 3) Carbon emissions from landfilling residual waste and LFG combustion           Parameter           Miss of blogenic carbon in residual waste (tones carbon)           Total carbon converted to LFG formes carbon)           Total carbon converted to LFG formes carbon)           Methane is LFG elevated for use in gas engines (CH4)           Uncaptured IFG oxides to CO2 in Indiffici cap (CH4)           Uncaptured IFG oxides to CO2 in Indiffici cap (CH4)           Uncaptured IFG oxides to CO2 in Indiffici cap (CH4)           Uncaptured IFG oxides to CO2 in Indiffici cap (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use in gas engines (CH4)           Wethane in LFG captured for use indictive gameration (g/Wh)           Use of Cortex indictive gameration form cambustion (tCC2e/yr)           LFG Rest envisions (fcCO2e/yr)           LFG Rest envisions from operational proceses over 40 years           Parameter <td>Scenario 7 9,53 4,56 3,43 3,57 1,11 1000 281,71 23,75 21,59 385,68 20,75 21,59 23,75 21,59 23,75 21,59 24,545 24,545 24,545 24,545 24,545 24,</td>	Scenario 7 9,53 4,56 3,43 3,57 1,11 1000 281,71 23,75 21,59 385,68 20,75 21,59 23,75 21,59 23,75 21,59 24,545 24,545 24,545 24,545 24,545 24,
Step 3) Carbon emissions from landfilling residual waste and LPG combustion         Branneter         Mass of biogenic carbon in residual waste (tonnes carbon)         Total carbon converted to LFG formes carbon)         Mass of biogenic carbon in residual waste (tonnes carbon)         Methane in LFC explored for use in jase engines (CH4)         Methane in LFC explored for use in gase engines (CH4)         Usergarved LFG endered 1 as anotyphere in emithane (ICH4)         USE for Querter for use in gase engines (CH4)         Wethane in LFC explored for use inguine engines (CH4)         Use gravited LFG engines (GL)         Power perivated by USE engines (CH4)         UK grid Coll carbon engines (CH4)         UK grid Societ for electricity generation form combustion (toC2e/yr)         UK device (CCC Coll field for electricity generation form combustion (toC2e/yr)         UK device (CCC Coll field for electricity generation form combustion (toC2e/yr)         UK device (CCC Coll field for electricity generation form combustion (toC2e/yr)         UK device (CCC Coll field for electric	Scenario 7  Scenar

Step 5) Lifetime carbon emissions		
Project Lifecycles	Scenario 7) Gas-fired po	wer stations (CCGT)
	LFG	EfW CHP Facility
	(ktCO2e)	(ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.
A5 – Construction process stage		4.9
A4 – Construction Transport		7.
Operation		
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.
B6 – Operational energy	25.04	10,726.
B7 – Operational water		0.3
B8 – Other operational processes: Landfill	11,268.48	
B8 – Other operational processes: Operational transport	103.85	271.
88 – Other operational processes: IBA and APCr		142.
Decommissioning		
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.
General		
D – Avoided emissions	-1,606.57	-6,547.3
TOTAL	9,790.80	4,695.

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

 Server I

 Bit Control - La Control - L

Nieg 2) Besidual Wate Competition Wiste Mater	Transfe #	
	5.95	
Card Nor-would be faser	6.3N 8.7N	
Dence Placitic	7.8%	
Place film Institut	8.2N	
Max Panel-Allin	5.05	
Miss. Non-Combustiliae Other Woldes	1.6N 0.3N	
Glass	2.6%	
Persons Metals Non-Person Metals	24N 13N	
Food Wedge	27.0%	
Garden Watte Other Organic	2.7%	
wood	2.85	
VEE	118	
Kaladoul Films	63N 2.2%	
Net Georfe take (Miller)	231	
Solal water specifications (v) Solal Cardon (N. Isy wealth)	611.171	
Bagenic Carbon (K of Total Carbon)	17.205	
Non-Reamon Carbon (% of Total Carbon)	42.875	
Neg 2) Carbon entocions from residual moste conduction in UNI CHP Paillity Pasameter		
Parameter Total walde input (Jonney/yr)	lossaria I	
Social waitle input (Sonner)/yr) Social radios (N. burwes)//	623,373	
Total Carloon (% by weight) Non-Bugenic Carbon (% of Total Carbon)	42.80%	
Macc of faccil carbon in residual waste (tannes carbon)	48,793	
Possi deniced CCZ encours (ICCZ) N2D encourse from recidual water conduction (connect)	1	
Equivalent CO2 emissions (ICO24) CHE emissions (ICO24) autor sandwidten (Ionnes)	6,187	
	4/01	
Austiliary Burrett - Fuel Cali CH (Drive) Austiliary Burrett - encoders for use of fuel (ISCOR)	1,781,424	
Auxiliary Barters - encoders for use of faet (ECO)et 10V Gross emologies (ECO)e/or1	200.00	
the facility electricity generation (Miler) the facility constances (Neu/er)	55	
Disclose an ended by DW Tacity (MMI)	440,000	
CCD environment factor for energy generation (g/VMA) TWV Inscitations CCD offset for electricity generation to Facility (ICCDs/v)	See cells \$38.AR38	_
	and carry and states	-
The Ant emission (CD2e-Vel	80	
Nep 2 Calon entroises from landfilling residual walts and IPG conduction		
	Normatio I 91,911	
Moccol Bagenic Carbon In Hodual watte (somer Carbon) Total Carbon converted tochti(somer Carbon)	6,90	
	34,935	
Michane in 196 captured far use in goc engines (10x4) Uncaptured IPG and sed to 002 in Sandhill cap(10x4)	23,755	
	10.091	
120 Exclusived CO2 Gross emissions entraced to atmosphere (CO2+/w)	281,712	
Michane in 170 castured far use in ask entities. (1040)	23,733	
Methane used in gaceegines (ICHI)	21,394	
Fuel input to LPG engines (51) Forwargenesized by LPG engines (500h)	100,487	Tes
UK gent CCD emissions ( batter far vierbrindty generation (g/VM) UKD Basiloalent CCD officet far vierbrindty convertion from conduction (ICCDz-Av)	See cells ETE ARTE	
JPD Exclusion CO2 official for electricity amendian from control loss (CO2e/or)	See cells 178.0679	
LPG Net enclusions (ICO2e/pr)	<b>A</b> (A	
Step 4) Carbon enicities from operational processes cover 42 years Proceeder	Research #	
IfW Good operational encoders/(KICD24)	10,727	
tife Equivalent CC2 officit for electricity generation by Facility (RCCDe) tife text-specialization electricity (RCCDe)	271	
URD Book convoltional invescions/INCC224		
URG GROCCOperational environme.(MCD204) URG Inquivalent CC22 offset for electricity generation by Facility (MCC204)	11,268	
Uto tel conceltanos emosiones (SECCOP)	11,201	
Ying X] Lifetime carbon entrators.		
Project Likegeles	Second State and Second	whether a factly from
reges uniques	LPS (NCC2H)	BTW CHP Audity
	(6003+)	(KICCOH)
Construction N2 - N2 - N3 - Naw materials caudio. Statuto Land manufacture		8.33
AS – AS – AS – Saw materials copply, tamport and manufacture AS – Candination process cape		4.90
M - Cand Subset Transport Operation		2.93
		4.95
BS - Operational energy B7 - Operational water	25.04	10,126.1M
BI - Other operational processes Landfill	11,268.68	
88 - Other operational processes: Operational biansport	205.85	275.48
III - Other operational processes IIIA and APCA		10.61
C1-C2-C3-C4-Ind of Me, including deconstruction, transport, watte processing for recovery and disposal		0.10
Greenal		
2014	11.00.0	22.969.52
Net change in ONE environmentating from the Proposed Development (MCD2e)		
Effer Parameters: N2D Emissions Pactor & kgN2D/11 (PCC)		
	4	
N30 Bisbak Warning Patiential (kgC03e / kgN20)	295	

N20 Bisbal Warning Putertial (kgC02e / kgN20)	295
CHE Environment Partier & kg/OH(/T) (IPCC)	30
CHE Glubal Warning Patential (kgCDar / kgCHE)	28
Total Sac Oli (desel) cansumption (libre)	1,939,360
Auxiliary Jumers - N of annual Gas Oil consumption	90%
Puel (Gas Cil) emissions factor (IgCCDP/KM1)	0.2793
Puel (Gas Chi) emissions factor (IgCCDe/Iliste)	2.75857
UG Parameters	
Calorfic value of methane (MI/kg)	50
Engenic carbon in readult watte converted to landfill got (241)	32%
Propilian of methane in 245	105
Proportion of UPD recovered from recidual water	955
Oxidation of IPG released from recidual worke to CD2 in landfill cop	20%
Proparties of UPDuced in gat engines	95N
LPG engine efficiency: 38%	305

## 

#### Scenario 9 UK grid decarbonisation – with reduced recyclables (65% target) UK lacks index bits

Headline accumulance for Economic (red type indicates variation with respect to the ES Case)	Reference
<ul> <li>Where composition based on target BTK of managed wateric recorded to 2020, with 64.95 already recorded in 2029</li> </ul>	he worksheet. Washr composite
b) the contraction concentration adjusted for NCV (wade + 623,6811/vf)	he worksheet. Washr composite
885 forward emissions factors for UK and electricity generation over 42 wast (for the central 25% to 25%)	MITA (2020). Trimaquery Green Book -
<ol> <li>Electricity expansionly for the EfWCHP facility, na clean expansion</li> </ol>	n(a
4. LPG capture rate for modern, large UK landfill + 68%	DEPAA (2016). DEPAA Review of La
5 No CCS	n(A
Nep 1) Recidual Warls Composition Waste Meson	Scenario T
Wala Intern Recalable Faster	Longe Lan
Recyclater Paper	5.55
Card Non-moulable Pager	22.05
Non-recyclable Paper	25.0%
Electro Faces	1.2%
Patat tim	124
interest in the second se	22.8%
Mer Non-Conducting	42%
Pharman Andrew State (1997)	9.65
Rind .	2.0%
Persons Mirials	125
Net Persons Mirals	10%
Tool Wells	23.25
Gardes Waste	2.3%
Other Organic	2.7%
Wood	2.1%
VALUE	1.05

WEE	1.0%	
Hazardous	0.an	
Pars	24%	
ter Groefic volve (Milya)	1.12	
Total wate most formes/with	673.668	
Social Cardion (K By weight)	26.225	
Biogenic Cardon Hs of Total Cardoni	38.875	
Non-Wastern Cadeon (% of Total Cadeon)	£1.6%1	
Steg 2) Carbon enicities.from reddual waste cambuilion in 1792 CHP Padility Finameter		
Total wate insuf (Jonnes/w)	623.668	
Total water input (Sonney/yr) Total Carbon (% by weight)	411,468	
Non-Blazenic Caldon (N. of Total Caldon)	6.65	
Hard Hanggmin, Campan ( Inter Campan) Macc of faccol carbon in recidual wards (tannes carbon)	67.213	
Naci de fue d'Ozerna de la companya de Esta de la companya de	10,000	
N22 enrozons from modual wade conduction tormed	28	
Raz Herobali (Han Hotala Bala Bendolari (Bene) Razvateri CC2 enistanci (CC2e)		
CHE encodore fram modual wade canbuction (tonnec)	120	
Republic CD2 emissions (ICD24)	4814	
Auxiliary Burters - Nel Gal Of (10%)	120-00	
Auxiliary Burners - encodors for use of fuel (1003e)	483	
EfW Gross embodiess (ICC3e/yr)	262.379	
the facility electricity generation (MMV)		
the facility operations (hs/w)		
Electricity generated by IBW facility (MMI)	660,200	
CCD emissions factor for energy generation (a/WM)	See cells \$39,0009	
If W Soubalient CO2 offset for electricity assertation by Facility (SCO2e/w)	See cells 180,4560	
		-
EW Net emissions (ICC2p/wil	NA	
Step 3) Carbon entrotions from Landfilling residual waste and IPG combustion		
Faaneter	Scenario T	
Miss of biagenic carbon in residual waste (tonnes carbon)	94,182	
Total Carbon converted to CPE(tannet Carbon)	47,091	
Michane in DRI released from residual walte (ICHII)	\$3,799	
Michane in 1PG captured far use in gac engines (IDH4)	24,887	
Unceptured LPG exclused to CD2 in fandfill cop (ICH4)	1,145	
Uncastured UPD released to atmosphere as methane (10HD)	22.807	
URG Equivalent CO2 Gross-emissions released to atmosphere (ICO2+/y)	288,404	
Michane in 1PG captured far use in gac engines (IDH4)	24,887	
Methane used in gal engine (3040)	22,522	
Puel input to LPG engines (G3)	398,397	
Pawer generated by IPG engines(MRIh)	120,822	
UK and CCD envisions fador for electricity peneration (all/Wh)	See colic 178 AKTE	
UPD taxholinet CO2 offset far electricity generation from candigation (ICO3e/w)	3re-cells (29,8579	
UPD Text emploies (ICD2a/w)	N/A	
The d Cales emission from operational encement over 12 years		
Parameter If W Dock searchised enviropen (MCD24)	22,011	
the back operational energies (ec.cov)	273	
If W Net operational emissions (NECCOP)	27.8	
URD Strock exercitional environment/MCCOVI	11.544	
UPD Equivalent CCD offset for electricity generation by Facility (HCCOJe)	11,000	
UPD Net operational emissions (NECC2E)	11.675	
	ites.	
The A Statement of the second s		
	Scenario Mittle and decarios	heading - with reduced
Point Uleades	mandables it	EN Largerth
	176	If NOP NOIRY
	(6(502y)	(10032)
Construction		
AS = A2 = A3 - Kaw materials copply, transport and manufacture		8.55
Ab - Candination pracess stage		4.90

EW Parameters	
N2D Benesions Patter & IgN2D/T3 (IPCC)	
N20 Slubal Warring Patential (kgC02e / kgN20)	265
CHE Britisbers Faller & IgONE/T3 (IPCC)	30
CHE Blubal Warning Patential (kgCD2e / kgCHE)	28
Total Gac Cil (diesel) cansumption (libre)	1,839,860
Auxiliary Jumers - N of annual Gas Oil consumption	82%
Fuel (Gas Cil) emissions factor (sgCCDe/KMI)	0.2781
Fuel (Gas Chi) envicouss factor (NgCC2#, fister)	2.75857
DG Reserves	
Calorfic value of methane (M/Ng)	50
Engress carbon in resoluti waste converted to landfill gas (DS)	32%
Poptianal metane in 20	875
Properties of URD resourced/new resolution water	975
Declation of IPG wiresed from recidual worke to CD2 in landfull cap	12%
Properties of URGusted in gas engines	82%
D'G engine officiency 38%	30%

Scenario 10 UK grid decarbonisation – with 50% less food and plastics Unit tack to refer table	
Headline accumulation for Tamaria (and two indicates constant with recent to the EL Case) Water composition based on 10% reduction in field and plastics, in addition to 20% reduction in other wrystables	Reference See worksheet. Youth compaction variation'
the core facility operating parameters adjusted for NCV (wade = 625,602 U/y), hours = 7,607 per y), MMH = 56,08	tee worktheet. Wate compaction sociation'
BET forecast evaluation factors for UK and electricity generation over 42 years (for the period 2028 to 2000) Electroty export only for the ERWCHP facility, no steam export	MITS (2020). Treasury Green Bask – Data Tables 5-18. supporting the taolist and the guidance (updated 17 April 2021, to %s formation N/A
understeller progen einer für medenn, lange utt landhilt + 60%	DEPA (2010). DEPA Review of Londfill Methane Emissions Modelling
No CCI	ηία
Step 2] Recidual Weste Composition	
Wale Mean	Burnario 30
Cali	125
Non-recyclable Paper	3625
Dense Plattic Biotra file	1.05
Pada ton Sector	136
Mo. Canbullity	26.7%
Misi. Non-Cambuchlin	6.0%
Other Waltes Dies	0.1%
Period Mitals	8.3%
Non-Person Metals	14%
Nod Walls	69% 28%
Garden Welde Other Organic	42%
Wood	125
WEE	10
Helandous	0 m
Foreis Net Colordis volve (MI/W)	10
2004 waite most (3onnes/vr)	423.400
Sidal Cardion (K By weight)	7.00
Buzenic Carbon IN of Total Carbon) Non-Buzenic Carbon (N.of. Total Carbon)	
Neg 2) Carbon enócions from recidual waste conduction in 1910 CMP Padility	
Facameter 100al wadte input (tonnes <sup>t</sup> yr)	Surrante 22
Total Carbon (%, by weight)	21.0%
Non-Biagenic Carbon (16 of Total Carbon)	7.4%
Mixes of facoli carbon in recidual wadle (barnes carbon) Notal derived CO2 emissions (ICO2)	40,538
Passi denived CO2 emissioni (ECO2) NYS anishted from actificial estre methodistica Property	100,005
Tourvolent CC2 emissions (ICC24)	1.00
CHE enrozans from excitual eade contexton (tonnec) Naziolett CD2 enrozans (1002e)	266
Barvaterit CC2 emissions (ICC2e) Auxiliary Bumeri - Fuel Gas Col (ICCHS)	1205-020
Auxiliary Burnets - emotions for use of fael (2002e)	483
EffW Gross emissions (ICCOP/yr)	140,00
the racity electricity generation (MWe)	14
tfW Pacifity operations (htt/w)	7,667 Nor2 Nor2 Nor3 Nor6 1
tiectnoty generated by the facility (MMA) CD2 emissions factor fair energy americans (a/WMA)	434,433 2028 2027 2028 2029 2030 2031
CC2 environment failler für einerste generation solvWeit Hite Basinaliset CC2 officet für einschnütte generation be Paulitie (ECD2e/veit	3re of 1 10 2010 10 10 10 10 10 10 10 10 10 10 10 10
EfW Net enclation (ICO2e/y)	sçis.
Step 2) Carbon entroconc.from Landfilling recidual water and IPG conduction Facameter	Screats 20
Misc of biogenic carbon in recidual waste (tonnes carbon)	13(91)
Total carbon converted to CPD (tannes carbon) Michane in LPD minaced from residual works (12ND)	10,004
Methane in IPG captured far size in gas engines (IDNI)	80,727
Uncaptured LPG acidited to CD2 in landfill cap (ICHE)	1,655
Uncastured UPD released to atmosphere as methane (ICHE) UPD Equivalent CO2 Gross emissions released to atmosphere (ICO2#/y)	16014
on spears to out record a second start a second record (r)	
Methane in DRI captured for use in gac engines (IDNI)	80,727
Mechane-used in gaterogines (32HI) Fuel insul to LPD ensures (32H	27,012 102,725 Nov2 Nov2 Nov2 Nov2 Nov2 Nov2 Nov2
Fuel input to DPG engines (SE) Fourie generated by UPG engines (SMBB)	502,755 Nov 1 Hear 2 Hear 3 Hear 4 Hear 3 Nov 6 H 139,656 200 2007 2008 2009 2010 2011
UK and CCD environm factor for electricity generation (alfVMI)	100 001/2003
US Exchained CO2 offset for electricity generation from controllers (ICO2e/el	3ee of LTP ACR 12.500 9.507 8.320 6.841 6.246 5.857
UPD Text evolutions (1002): Vel	N/L
	-
Neg () Calon enistient fram operational processes over 62 pean. Featureler	Name of T
EW Gross powrational environme.(NCC2w)	6,337
	717
tifw tiquivalent CC2 ulfiset for electricity generation by Facility (HCC20e)	
MM Bywalevit CCD alfiart for electricity generation by Facility (RCCDe) MM Net operational emonions (RCCDe)	4,800
the Equivalent CCO afflus for electricity generations by Pacifity (ECCOP) the Net Operational emissions (ECCOP) (TO Encompetitude if emissions (ECCOP)	4.00

## 

Step 1) Efetine cabon encodors		
	Scenario 35 UK grid decarbonis	ation -with 92% in
Project Lifecycles	food and place	
	LPG	If NOP NOIRY
	(krcopy)	(80020)
Construction		
AL = AI = AI = Raw materials supply, transport and manufacture		n
A3 - Candhudton pracess dage		4
M + Candhudton Transport		
Operation		
82 - 85 - Mantenance, repair, replacement and refurboliment		
85 - Operational energy	25.06	6,332
87 - Operational water		0
RB - Other operational processes Landfill	14,175.42	
EB - Other operational processes Operational transport	201.85	271
BI+ Other operational processes IBA and MCr		10.
Deconvertisationing		
C1+C2+C2+C4+End of life, including dependentialian, transport, waste processing for recovery and disposal		a.
D - Avoided energoos	-8.7	-20
D - Annibit exception 79754	-46.75 1447.39	
	-88.75 34.457.39	
D - Annibit exception 79754	48.73 1442.98	
no - parale de canación 2010 Nel chango as sent enclandes de activos (fans. B.o. Royaced Executivosed (USERDO)	AL YI LAATAN	
D - Audulta Fenerators Strat		
12-robust for announce of a second se	4	
	4 285	
	4	
	4 265 30	
A productional	4 285 30 28 20 28 20 28	
	4 203 203 203 203 203 203 203 203 203 203	
A protocolomit      Station      A protocolomit      A protoc	4 285 30 28 20 28 20 28	-22 1.138 0.038
A protocolomit      Station      A protocolomit      A protoc	4 285 39 39 39 39 30 30 30 30 30 30 30 30 30 30 30 30 30	
A monocolumna      A monoco	4 285 39 39 39 39 30 30 30 30 30 30 30 30 30 30 30 30 30	
	4 285 39 39 39 39 30 30 30 30 30 30 30 30 30 30 30 30 30	
	4 20 30 30 30 30 30 30 30 30 30 30 30 30 30	
	5 38 38 1880 80 8 977 1, 2, 2017 2, 30 20 20	
A - Excellence of the second se	4 28 33 482,00 9,00 1,00 1,00 1,00 1,00 1,00 1,00 1	
A meta- a meta- set of the second s	4 38 38 38 486 3.285 3.285 3.285 3.285 3.285 3.285 3.285 3.285 3.285 3.285 3.285 3.295 3.2	
	3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

Sense 1 If and a sense of the sense of the

Step 2 Recidual Warts Composition		
Walds Konam Paper & Card	Idenate 11 12.4%	
Faper & Card Fladas	11.4%	
Textiles.	125	
Mo. Canbullity	14.1N	
Mis: Non-Canduzzilia Other Woldes	5.8% 6.0%	
Cher Waltes	EON 1/0	
NodWada	61.65	
wood	1.0%	
WEE	1.1N	
Net Cristific table (Milwi	20	
. Still water result (tornes/w)	621.602	
Stall Carlos (S. Byweight) Biogenic Carlos (N. of Noal Carlos)	24.87%	
Baseria Carbon R. d. 1650 Carboni New Baseria Carbon R. d. 1651 Carboni	11.075	
Step 2) Calcon enlocioes from reddual waste conduction in SFM CHP Padility		
	Scenario 11	
Solal-waidle ingul (Jonney/yr) Solal-Carlon (% by weight)	625,600	
Total Carbon (% by weight) Non-Wagenic Carbon (% of Total Carbon)	21.0% 61.0%	
Misso of facol carbon in recidual waste (tannes carbon)	60,376	
	251,665	
100 enozoni fran modual wate iambuction (tornel)	23	
Bauvalent CC2 emissions (ICC2e) CM emissions from micdual water conduction former()	6.001	
balvalert CO2 emission (1002v)	4757	
Auxiliary Bumers - Nel Gas OI (IDH)	1,78,424	
Auxiliary Burners - encodors for use of fuel (1002e)	6401	
BTW Gress evenuess (bC03e/je)	367,000	
the facility electricity procession (MWP)		
BW Pacifity speciations. (http://wil		
tiects of y generated by the facility (MMA)	424,233	
CO2 encoders factor for energy anteration (s/Wh)	See cells the ARXe	
the business CO2 offset for electricity enseration by Facility (ICO2e/w)	See cels 882 AR80	
EfW Net emission (ICO2e/y)	NA	
Step 1) Calum entrodoes from landfilling recidual worke and UPC combustion		
	Remarks 11	
Parameter Mexical bagencicarbon in residual waste (tonnes carbon)	Romania 11 BAJPAN	
Paratetiv Mess of langenic carbon in residual wastle (sames carbon) Total carbon carbon/tild toc/triguenes carbon)	Nonato 33 86,996 43,098 11,098	
Parameter Monor II langens carles in modual watel (somes carles) Mala carles converted to 04(somes carles) Mediane no 10 minuted from modul watel (1011) Mediane no 10 minuted from modul watel (1011)	43,098 83,098 22,680	
Parameter Maccord Daugence Carbos veri nechaal wasche (Sonnee Carbos) Tastis Landers einzerheit Schotzligunzen Carbos) Mechanen zur Stansend Sonneen Bauk wasce (Strol) Mechanen zur Schotzlief Eric einz bezi regilnen (Strol) Mechanen zur Schotzlief Eric einz bezi regilnen (Strol)	43,498 83,098 22,480 3,098	
Parameter Maccord Daugence Carbos veri nechaal wasche (Sonnee Carbos) Tastis Landers einzerheit Schotzligunzen Carbos) Mechanen zur Stansend Sonneen Bauk wasce (Strol) Mechanen zur Schotzlief Eric einz bezi regilnen (Strol) Mechanen zur Schotzlief Eric einz bezi regilnen (Strol)	41,098 81,098 22,080 1,098 8321	
Parameter Monor II langens carles in modual watel (somes carles) Mala carles converted to 04(somes carles) Mediane no 10 minuted from modul watel (1011) Mediane no 10 minuted from modul watel (1011)	43,058 33,058 22,080 3,058	
Parameter Maccord Daugence Carbos veri nechaal wasche (Sonnee Carbos) Tastis Landers einzerheit Schotzligunzen Carbos) Mechanen zur Stansend Sonneen Bauk wasce (Strol) Mechanen zur Schotzlief Eric einz bezi regilnen (Strol) Mechanen zur Schotzlief Eric einz bezi regilnen (Strol)	41,098 81,098 22,080 1,098 8321	
An and approximate and a start by the second and th	41,498 31,098 32,480 1,098 8122 286,381 226,381 226,081 226,081	
An and Angenetic States in Hole and Denne States States and States and States States and States States and States States and States and States States and States States and States and States States and and States States and States States and States States and States States and States Sta	22,000 31,000 3,000 3,000 32,000 22,000 22,000 20,044 30,702	
The analysis of the second sec	41,498 31,098 32,480 1,098 8122 286,381 226,381 226,081 226,081	
The difference of the second s	22,000 31,000 3,000 3,000 32,000 22,000 22,000 20,044 30,702	
Manual Segmentation A material and a province inter- Manual Segment and A material A materiad A mat	44,488 84,058 92,480 9,525 9,525 9,525 9,526 20,684 847,925 847,925 100,684 847,925 100,684 101,225 102,485 102,485	I
The difference of the second s	44,488 84,058 92,480 9,525 9,525 9,525 9,526 20,684 847,925 847,925 100,684 847,925 100,684 101,225 102,485 102,485	ļ
Man Alaman and Alaman A	44,488 84,058 92,480 9,525 9,525 9,525 9,526 20,684 847,925 847,925 100,684 847,925 100,684 101,225 102,485 102,485	ļ
Name Alignment and Annotae Ann	44,488 84,058 92,480 9,525 9,525 9,525 9,526 20,684 847,925 847,925 100,684 847,925 100,684 101,225 102,485 102,485	ļ
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Man Angele and a solution and a solu	ELON ELON 22,000 33,000 33,000 23,000 23,000 30,0000 30,0000 30,0000 30,0000 30,0000 30,0000 30,0000 30,00000000	
Manufacture ranke and particular Varian Care and Annual Care	4,000 8,000 2,000 8,000 8,000 20,0000 20,0000 20,0000 20,0000 20,0000 20,0000 20,0000 20,00000000	ļ
Man Angeward a ranker and particular design of the second	4,648 4,648 12,64 337 344,441 24,6424,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,6424,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64 24,64624,646 24,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,646 24,64624,646 24,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,64624,646 24,646 24,646 24,64624,646 24,64624,646 24,646 24,646 24,646624,646 24,646624,6466 24,646624,6466 24,64666666666666666666666666666	ļ
Man Angele and a solution and a solu	ELON ELON 22,000 33,000 33,000 23,000 23,000 30,0000 30,0000 30,0000 30,0000 30,0000 30,0000 30,0000 30,00000000	ļ
Manufactor a radia and a particular Water and a particular and a particul	4,6,6,6 4,6,6,6 2,2,6,9 4,9,7,7 4,9,7,7 4,9,7,7 4,9,7,7,7 4,9,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,	ļ
Manufacture and a material protection Manufacture and an advection of the second second second Manufacture and advection of the second secon	4,6,6,6 4,6,6,6 2,2,6,9 4,9,7,7 4,9,7,7 4,9,7,7 4,9,7,7,7 4,9,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,	ļ
Manufactor south and a particular Varian Andream Andr	4.646 4.667 4.66 4.66 4.66 4.67 4.66 4.67 4.67	
Manufacture and a material protection Manufacture and an advection of the second second second Manufacture and advection of the second secon	4,6,6,6 4,6,6,6 2,2,6,9 4,9,7,7 4,9,7,7 4,9,7,7 4,9,7,7,7 4,9,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,7,	
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Manual Andream Series S	man man man man man man man man man man	1947 CHP FACED IN COP FACED IN 19 1947 CHP FACED 1947 1947 1947 1947 1947 1947 1947 1947
Manufactoria o calabia ana pana bandi Vestaria ana ana fana ana ana ana ana ana ana a	Ause Barrier Ause Ause Ause Ause Ause Ause Ause Ause	eader Bhar Core Facality (NECOR) 8,555 4,950 7,931 4,950 50,060,881 6,321
Manufacture and a random and parters into Westers and and a random and parters into Westers and and a random and a rando	Ause Barrier Ause Ause Ause Ause Ause Ause Ause Ause	1947 CHP FACED IN COP FACED IN 19 1947 CHP FACED 1947 1947 1947 1947 1947 1947 1947 1947
Maximum of a value analysis of the set of th	Ause Barrier Ause Ause Ause Ause Ause Ause Ause Ause	ender Ihn CoP Ruckly (NEO24) 8.35 4.95 7.93 4.95 7.94 8.45 4.95 4.95 4.95 4.95 4.95 4.95 4.95 4
Manufactoria o calabia ana pana bandi Vestaria ana ana fana ana ana ana ana ana ana a	Ause Barrier Ause Ause Ause Ause Ause Ause Ause Ause	104 CVP FACIES 104 CVP FACIES

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#### Scenario 12 UK grid decarbonisation – CCC: 50% reduced plastics task lack to index table

	Meadline accumptions for Remarks (red type indicates variation with respect to the ES Case)	Reference
		See worksheet. 'Mister compaction' workship'
		See worksheet: 'Maste consocition vorusian'
		HETS (2021). Treasury dreen Book - Data Tables 1-DB supporting the toolist and the guidance (updated 17 April 2023, to fix formatting errors)
1	Electricity expansionly far the EFW CHP facility, na stram expans	n/A
		0876A (2024). OBFAA Review of Landfill Mechane Emissions Modeling
5	No CCN	n/A

Ney 1) Residual Waste Composition Viside Uman		
Wale Unean Paper & Canl	21.1%	
Paper & Carel	825	
Textiles.	62%	
Mic. Canbullitie Mic. Non-Canbullitie	30.2% 3.8%	
Cher Wales	0.00	
Glass & My Lak		
Nucl Walk	83.2%	
Wood VIII	23%	
	LIK.	
Net Calertis value (Miluri	4.50	
Total wade input (tornes/w)	623.600	
Sutal Cardian (% By weight)	24.076	
Non-Baarna Carbon (% of 106a) Carbon)	11.00	
Neg 2) Calum entrolous from reddial waste candiadion in UNI CHP Failing		
Parameter Total walde input (Sanney/pr)	Network 12 523.600	
	24.07%	
Non-Wagevic Cadeon (N of Total Cadeon)	33.02%	
Maccol faccil carbon in recidual wards (tannes carbon) Notal defined C02 enroques (1002)	49,762 302,999	
Pass denied CCI envisions (ICCI) NIC envisions from modulal wade conduction fiomes)	20,80	
Bauvolent CC2 emissions (1002H)	1.00	
CHE enrosons from residual watte conduction (tonnes)	30	
	4,68	
Auxiliary Burners - Fuel GascOl (ISTIN) Auxiliary Burners - encodors for use of fuel (ISCO2e)	4.63	
EfW Gross emissions (ECC2+/yr)	287,829	
the racity electricity generation (MWe)	10	
the reality operations (Inc/y) tectnotygenerated by the facility (MMB)	7,607	
CD2 encodions factor for energy generation (a/VWh)	100 (PTS 100 0000	
the bushalest CO2 offset for electricity annexation by Facility (1002e/w)	Tee cells this arris	
ETW Net enclosions ()CD2e,/y/	NA	
the second (control of		
The 2 Carbon entrotions from landfilling residual water and IPS combustion		
Facameter Moccarl bagenic carbon in recidual watte (tonnes carbon)	Nevaria 12 20.825	
Total Carbon converted to 075 (tannes carbon)	10.422	
Michane in URLinieated from republic words (10HD)	86.823	
Uncaptured UPG existend to CD2 in fandfill cap (ICH4)	1,336	
Conceptured UPD referenced to attractablese as methane (COM). UPD Topolatient CO2 Gross emissions referend to attraceptive (CO2#/p)	11.040 308,960	
Methane in IPE captured for use in gas engines (IDM)	26,000	
Michane used in gas engines (ICHE) Fuel mout to LPG engines (ISI	23,882	
Report department for 1970 engineer (NMRA)	104,302	
UK and CO2 emissions factor far electricity enversion (a WWN)	See cells 170 ANTE	
UPD Excitations CO2 offices for electricity generation from conduction (CO2e/or)	See cells 176.4079	
PG Net emissions (http://w)	8/8	
Step 4) Carbon enticcions from operational processes over 40 years		
Facametar INV Gooscoperational encodenci(NCC20v)	Nervero 12 7,812	
	207	
tfW Net operational emotions (RECC3e)	7,465	
UPD Disco coertificatii entocons/3000241		
LPG Brock operational emocians.(ktCC2w) LPG Bigwadent CC2 offset for electricity generation by Facility (ktCC2e)	12,808	
ura sigenation coo antas na renancia grenancia y raciny (accord) Ura Net operational emocioni (ki202e)	11,305	
They TJ Effetime Carbon embodices		
	Sonato 32) UK gid decaloritatio	H - CCC: 58%
Project Lifecycles	reduced plastics	CHERKIN.
	1/G 1/M	OIP Facility
Construction	1000	and the
A1 - A2 - A3 - Raw materials copply, the que Land manufacture		8.92
N - Candination pracess stage	1 1	410
M - Candidation Transport		7.01
Specifice 12 - 15 - Manderiance, repair, replacement and refutionment		6.91
N - Operational every	25.00	7,812,81
17 - Operational water		0.24
III - Other operational processes Landfill III - Other operational processes: Operational transport	22,858.29	271.68
IB - Other operational processes: Operational transport IB - Other operational ordicesses: IBA and APCr	20185	271.48
Decommissioning		66.10
Decommissioning		
Decommissioning		
Decommissioning	-784	
Deservations Control Control of Management of the second second second second second for resource and Assess Control Control of Control of Cont	-711	
Decomplicationing Classification of the control of	-7846 12468.73	4,203.03
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An examination of the control of the	4 30 12	
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An examination of the control of the	4 30 12	

# Image: Section 2016 Image: Section 2016

#### Scenario 13 UK grid decarbonisation – CCC: 50% reduced organics UK tacks budy bar

Meadline accumutions for Scenario (red type indicate contation with respect to the ES (case)	Reference
White composition based as: Cambridgecher current residual water with organics induced 10% less than baseline	See worksheet: Mastecomposition variation"
 a the OPE facility operating parameters adjusted for NCV (wade = 101,001 (/y))	See worksheet: Mastecomposition variation"
	MIS (2021). Treasury Green Back - Data Tables 1-19: supporting the loafskit and the guidance (updated 17 April 2023, to fix forma
If includy expected by factor facing, on strain expect	nja
4 DNL capture rate for modern, large UK landfill + 68%	DIPAA (2014) - DIPAA Review of Landhill Methane Benozions Madelling
s No CCS	njh

	Susanda 12	
Web Stein Paper & Card	26.15	
Piedas	19.8%	
Textiles Mici, Canduzāle	6.8%	
ilio, Canbulles Mo, Non Canbulles	1.5%	
Zher Walles	105	
East WEAK	7.05	
ood Walle	26.0%	
Nod	2.8%	
451	4.15	
et caluelle table Market	110	
NGRI walte mout Donnes/vr) NGRI Carton (% by weight)	101.00	
ofair Cardion (N by weight) Isazenic Cardion (N of Total Cardion)	26.826	
Service Carbon Hit of Total Carbon) Ser-Biogreek Carbon Hit of Total Carbon)	80.05	
	H.as	
leg 2) Calcon entoconc.from reddual watte combuillon in IfW CHP Padiloy		
	Specific 11	
ofal wade input (some \v/yr)	50,80	
	28.825	
ton-Bagenic Cadvan (16 of Total Carbon)	49.765	
Moccal Facol Carbon In Hechical Waldle (Sames Carbon) Nacial derived CCI2 environes (SCCI2)	76,815 276,898	
ana amin'ny Casimana (Acas) 20 enisoan fran modual wade ionductian (Jonnei)	23	
autoleti CO2 emissioni (ICO2e)	6.115	
HE enrosons fram residual watte cambustian (tonnes)	175	
	4,855	
unifiary Burners - Fuel das OI (ISSH)	1,70,435	
unifiary Burners - encodors for use of fuel (1003e)	600	
fW Gross emissions (ICO3e/js)	210,645	
fM Pacifity electricity generation (MMV) fM Pacifity speciations (Mix/yr)		
NV Pacifity operations (Invyly) lectricity generated by thV facility (MMA)	440,000	
D2 emissions, factor for energy anteraction (a/WMI)	See origination	
W Isocialized CO2 offset for electricity generation by Facility (ICO2e/v)	See prix teo Anio	
NV Net emissions (ICD2e/y)	N/A	
By 3) Carbon encounce from Londfilling recidual works and IPG combustion.	Support 18	
danced bagenic carbon in recidual waste (tonnec carbon)	75.302	
and an angenic careful in resonant water parties careful) (20) carbon converted to 270/tannes carbon)	17,742	
Acthane in LFG released from residual works (ICHS) Acthane in LFG captured for use in gas engines (ICHS)	28,575	
Inceptured LPG excidened to CO2 in Lendrid cap (1014)	925	
Acastured URL released to atmosphere as methane (10HD)	1.20	
PG Equivalent CO2 Gross emissions released to atmosphere ()CO2#/y)	212,046	
Bethane in 196 captured far use in gas engines (1046)	29.375	
Arthone used in gas.explored (3DHD)	17,790	
Achane used in gaceogines (ICHI) uel injut la LPG engines (ICI	820,226	
Arthano statu gasengano (2016) artingata tarta engano (2016) anno generata da puta engano (2016)	17,790 130,226 80,922 bet cells 172,437	
Andhane searching pack-regione (1004) winner (panckangeless) (21) waner generationale fay to die negaters (2004) et als CO2 envirouses (2004)	820,226	
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htte son der generation (Seine Seine	102,28 2010 104 pill 104 pill 104 pill 104 pill	
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	10.25 85 25 84 2016 17.847 84 2016 17.847 84 2016 17.847 84 2016 17.847 1.847 1.847 1.847 1.848 1.847 2.75 1.848 2.75 1.847 2.75 1.95 1.95 1.847 1.847 1.95 1.95 1.95 1.95 1.95 1.95 1.95 1.95	
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	10.2.20 Rep Rep 117447 242.017447 142.07447 14.07 14.07 10	
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	20.23 99.9 99.9 99.9 90.9 90.9 90.9 90.9 90.	Sandustan - CCC 30
	10.2.20 Rep Rep 117447 242.017447 142.07447 14.07 14.07 10	Sandurdas - CCC. 187 gandas EN COMPACIENTAS EN COMPACIENTAS
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Mark and segment (Mark an	20.23 99.9 99.9 99.9 90.9 90.9 90.9 90.9 90.	(MECODA)
Marking Angelerization         Second Se	20.23 99.9 99.9 99.9 90.9 90.9 90.9 90.9 90.	(MCOD#)
Marking Angelerization         Second Se	20.23 99.9 99.9 99.9 90.9 90.9 90.9 90.9 90.	(MCOD#)
	20.02 99.0 99.0 90.0 10.0 10.0 10.0 10.0 10.0	(MCG2v)
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Mar and particular and an and an and an and an	A BLD A BLD A BLD	(MCOP) 2 11,65 27 27 27 21
		(MCON) 11 4 4 11 11 11 11 11 11 11 11 11 11 11
Mar and particular and an and an and an and an	A BLD A BLD A BLD	(MCON) 11 4 4 11 11 11 11 11 11 11 11 11 11 11

NDD Invisions Factor 4 kgRdD/11 (PCC)	4	
ND Blabal Warming Patential (kgCDar / kgN2D)	265	
CHE Environment Failler & legONE/T1 (PCC)	30	
CHE Blubal Warning Patential (kgCD2e / kgCHE)	28	
Total Gac Cil (diesel) cansumption (libre)	1,889,880	
Auxiliary Jumers - N of annual Gas Oil consumption	825	
Fuel (Gas Cil) emissions factor (sgCCDe/KMI)	0.2735	
Fuel (Gas Chil) emocians factor (sgCODe/liste)	2.75857	
UG Reamsteric		
Calorfic value of methane (MI/kg)	10	
Eugenic carbon in resoluti watte converted to landfill gas (191)	52%	
Poptianal methane in 20	375	
Proparties of URG resourced from residual walke	485.	
Ourdation of IPD released from recidual worke to CD2 in landfill cap	10%	
Proportion of LPD used in gat engines.	92%	
D'G engine officiency 38%	365	

## 

Scenario 14 CHP, export of steam from the EfW CHP facility UK

 Headline assumptions for Scenario (red type indicates variation with respect to the ES Case)

 1a Waste composition based on WRAP 2017 profile for Englind

 1b W1C9 Fickling poenting parameters for NCV of 533 MV/kg (waste 613,573 L/yr, hours = 8,000 per yr, HWe = 48.8)

 2a Electricity generation offset of 40 years based on latest UK grid average emissions factor 2021/22 = 20.87 g/kWh

 2a Electricity generation offset of 40 years based on latest 10K grid average emissions factor 2021/22 = 20.87 g/kWh

 3 CHE VH Vichity exports 48.8MWe of electricity (blowing for 5MWe parasitic load) and 23.6MWth of steam

 4 UFG capture rate for modern, large UK landfill = 68%

 5 No CCS

Reference See worksheet: 'Woste composition variation' See worksheet: 'Woste composition variation' DESW (2023). Fuel Min Dickoure Data Table 2021-2022 UK Government (2023). Greenhouse gas reporting: conversion factors 2023 MVW deign nilo. DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

 
 Step 1] Residual Waste Composition

 Waste Stream

 Recycluble Paper

 Card

 Dense Plant;

 Plant;

 Plant;

 Mic: Combustible

 Mic: Combustible

 Other Wastes

 Gass

 Ferrous Metals

 Non-Ferrous Metals

 Food Waste

 Garden Waste

 Other Waste

 West

 West

 Mics Combustible

 Other Waste

 Garden Waste

 Mics

 West

 Mics Combustible

 Mics Combustible

 Mont Avaste

 Mics Other Waste

 Fines

 Mics Combustible

 Fines

 Fines

 Fines

 Food Waste Input (conners/ry)

 Total carbon (S vol Total carbon)

 Biogenic Carbon (S vol Total Carbon)

 Roseria Carbon (S vol Total Carbon)

 Step 2] Ourbon emissions from residual waster
 Scenario 14 5.9% 6.3% 8.9% 7.8% 8.2% 9.3% 9.3% 0.3% 0.3% 0.3% 0.4% 1.4% 2.7% 2.3% 1.5% 0.3% 1.5% 0.3% Step 2) Carbon emissions from residual waste combustion in EIW CHP Facility
 Parameter
 Total work in part (tonnes/yr)
 Total Carbon (5k by weight)
 Non Biogene Carbon (5k of Total Carbon)
 Mass of fosal carbon in residual waste (tonnes carbon)
 Fould diriked O20
 Residual carbon residual waste combustion (tonnes) 4 613,573 26.20% 42.80% 68,793 252,242 23 Equivalent CO2 emissions (tCO2e) CH4 emissions from residual waste com Equivalent CO2 emissions (tCO2e) Auxilliary Burners - Fuel: Gas Oil (litres) 6,197 175 4,911 745,424 Auxiliary Burners - Puer Gas OII (IIITPS) Auxilliary Burners - emissions for use of fuel (tCO2e) EfW Gross emissions (tCO2e/yr) <u>4.815</u> 268,165 390,400 7,299 8,000 188,800 <u>38,264</u> 115,564 EfW Net emissions (tCO2e/yr) 152,601 Step 3) Carbon emissions from landfilling residual waste and LFG comb Parameter 

Mass of biogenic carbon in residual waste (tonnes carbon)	91.933
Total carbon converted to LFG (tonnes carbon)	45,966
Methane in LFG released from residual waste (tCH4)	34,935
Methane in LFG captured for use in gas engines (tCH4)	23,755
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	1,118
Uncaptured LFG released to atmosphere as methane (tCH4)	10,061
LFG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr)	281,712
Methane in LFG captured for use in gas engines (tCH4)	23,755
Methane used in gas engines (tCH4)	21,594
Fuel input to LFG engines (GJ)	388,687
Power generated by LFG engines (MWh)	107,969
UK grid CO2 emissions factor for electricity generation (g/kWh)	198
LFG Equivalent CO2 offset for electricity generation from combustion (tCO2e/yr)	21,378
LFG Net emissions (tCO2e/vr)	260.334

Step 4) Carbon emissions from operational processes over 40 years	
Parameter	Scenario 14
EfW Gross operational emissions (ktCO2e)	10,727
EfW Equivalent CO2 offset for electricity and heat energy generation by Facility (ktCO2e)	6,104
EfW Net operational emissions (ktCO2e)	4,623
LFG Gross operational emissions (ktCO2e)	11,268
LFG Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	855
LFG Net operational emissions (ktCO2e)	10,413

Step 5) Lifetime carbon emissions			
Project Lifecycles		Scenario 14) CHP, export of steam from the EfW CHP facility UK	
	LFG	EfW CHP Facility	
	(ktCO2e)	(ktCO2e)	
Construction			
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55	
A5 – Construction process stage		4.90	
A4 – Construction Transport		7.93	
Operation			
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91	
B6 – Operational energy	25.04	10,726.58	
B7 – Operational water		0.24	
B8 – Other operational processes: Landfill	11,268.48		
B8 – Other operational processes: Operational transport	103.85	271.68	
B8 – Other operational processes: IBA and APCr		142.60	
Decommissioning			
C1 - C2 - C3 - C4 - End of life, including deconstruction, transport, waste processing for recovery and disposal		48.38	
General			
D – Avoided emissions	-855.11	-6,104.04	
TOTAL	10,542.26	5,138.73	

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines.	91%
LFG engine efficiency: 36%	36%

Net change in GHG emissions resulting from the Proposed De

#### Scenario 15 OIP, export of steam from the EfW CHP facility – including grid decarbonisation

Headlese accumptions for Scenario (red type indicates variation with respect to the ES Coor) Waste composition based on WHOP 2017 profile for togland	Reference See worksheet. 'Waste connection variation'	
If W CMF facility operating parameters for NCV of N33MQ/kg (wade 603,1571 k/w), hows = 0,500per yr), MVM = 05.0 IEEE forecast evenuous factors for UK gnd electrolity prevaidon over 40 years (for the period 2020 to 2000)	See worksheet. Waste consocition sociation'	
	MIS (2021). Treasury Green Book – Data Tables 1-29. supporting the taolist UK Government (2021). Greenhouse gas reporting: carvecton factors 2021	and the guidance (updated 17 April 2021, to fin formating errors) (BITI (2021), "Resoury Green Book - Data Tables 5-18, supporting the taolist and the guidance (updated 17 April 2021, to fin formative
Neel for heating officer to 2000. Exection function rational gas convocants facture 2022/22 – 2023. AP given in Neel for heating officer after 2223 based on BEER forecast envasions factures for UK generations.		
New Service and the	MYY design info DEPEA (3004). DEPEA Neview of Landfill Methane Emissions Modelling N/A	
Sing 2) Residual Warlie Comparition Warle Kina an	Normatio 13	
Recyclable Paper Card	1.00	
Cali San Mayer Mayer Mana Calina San San San San San San San San San S		
Place film Instites	8.25	
Mic. Candudhia Mic. Non-Candudhia	5.05	
OtherWaltes	0.81	
sans Period tertais	2.01	
Tennuc, Michiel Michiel Michiel Nauf Mazie Mache Walter	1.0% 27.0%	
	2.5%	
Kantugan Wada WAR Karadoo	2.85	
	0.3N 1.2N	
Net Calorfu value (MN/M) NEA wate input (Somer/yr)	813.771	
Total Carbon (N By weight) Reservic Carbon (N of Total Carbon)	26.225	
Non-Boarrow Carbon His of Total Carboni	0 125	
Neg 2) Carbon entrocons/vom re-dduat waste conduction in 1700 CNP Facility Factories	Security 10	
Sotal waite input (bonney)(v) Sotal Carbon (% by weight)	423,375 26,275	
Non-Blagenic Cadoon (Holf Total Cadoon) Miscolf Spozi carbon in residual wadte (tannes catbon)	0.85	
Maccal derived CCI encoders (ICCI) Nasial derived CCI encoders (ICCI) NCI encoders (Inci )	68,781 203,262	
ND recoord han modul wate contuction (conver) handeer CC2 encours (http://www.contuction	6.07	
Bauvalent CO2 emissions (1000x)	175 4,803	
Auxiliary Burness - Fuel Gas Col (Innes) Auxiliary Burness - encodors (Scruss of Fuel (SCCDe)	1,78,65	
Eff& Gross emissions (ICO2e/yr)	20,105	
NW Nachty electricity precision (MWe) NW Nachty operations (Net/y)	48.8 8,000 Tear 2 Tear 2	Nex'l
tiectscoygenerated by thW tacitby (MMA) CD2 environs.factor for energy generation (g/WM)	K.020 Pear 2 Year 2     WO,020     Sec.020     Se	No.1         No.4         No.4 <th< td=""></th<>
after Resoluted CO2 offices for electricity amenation inv Pacific (ICCDIn/w) Infor Pacificy head generation (MMIN)	544 Calls 201 ANIO 21.4	
Mit halfs ender songer sonder songer Mit halfs ender songer sonder songer songe	8,000 Hear 2 Hear 2 289,800 200 200 200	Nex'l
CC2 environs. Factor for text percention (g/inth) - gas to 2018, god electafter 2218 BYR Deutopert CC2 officief in fear anexylatin by Facility (CCDA)	See Gels BRCARE, 200 ar 200 a See Gels BRCARE, 20, 20 ar 200 a	
the backalent CO2 offset for electricity and best energy generation by Facility (CO2e/w)		
EfW Net enricitions (1002e/w)	80	
Neg X Carbon entrotions from Landfilling residual wiscle and IPG combustion Distances	New York The Control of Control o	
Moccel bagenc carbon in resolutil wate (some carbon) Nati carbon soverted tooPhiltemes carbon	5,80	
Michane In 245 released from resolution worke (2014)	36.80	
Nachane in 176 Laphanel far see in gat eagines (1014) Unsightead UN andread as 000 in Snahlf aug/10140 Unsightead UN related ta amounteer as methane (1014)	21,755	
Unclaitand Discrimpted is atmosphere at methods (ICHE) UPD Rauhalent COZ Gross embodies: elevand to atmosphere RCORe/el	21.52	
Methane in DB captured far sce in gat engines (IDH)	21,705	
Michaeuselin gaceogues()DH) Fuel input Is I/D engine()DI Fuel input Is I/D engine()DB)	21,004 388,687 Tear 2 Year 2 327,969 2020 202	700r3 70ar4 70ar3 70ar8 70ar3 70ar3 70ar3 70ar3 70ar33 70ar3
UK and CC2 emission. Fader for electricity enversion (all/Wh)	See cells SBS AND DO 1	7 18 07 05 18 10 21 27 18 28 17
US taxhabet CO2 offset for electricity procession from conduction (ECO2+Art)	See cels ER ARE	8 6282 5280 4388 6328 1289 2385 2281 1861 1861 1385 12
UPG Net entations ()CD2e/yr)	n(h.	
Stop & Cabon enlocion: fram operational processes over 42 years Parameter	Remarks 13	
MW Glocc agenzalowik energicani (NCC224) MW Bijurvalevit CC2 affart for electricity and heat energy generation by Nacility (ICCC24)	10,707	
IfW Net operational emotions (ISCODe)	20.337	
UPG Biolocapierational environmec(biotodol) UPG Biolocaberiet COL alfans fune electricating generations by Pacifity (BECCOLe) UPD for departamental environme (ECCOLe)	11,388 67 11 W1	
LPG Net operational emotions (BCCDE)		
The A Lifetime and an emissions	Scenario 111 CHP, export of down from the IDM CHP	
Pagest Likopies	Twitty - including pild decademication UPS ETWOP Facility	
Construction	(AED24) (AED24)	
A2 – A2 – A2 – Kiw materials capply, tampart and manufacture A5 – Candination process capp	8.33 490 2.98	
Al-Card value Tanget Operatie		
82 - 85 - Mandecance, repair, replacement and refudedment 86 - Operational energy	25.04 10,726.58	
	6.30 31,288.68	
D - Operation Rate (Construct Land) B - Other operational processes Clarify (Construct Stategort B - Other operational processes Operational Stategort B - Other operational Rate operational Stategort B - Other operational Rate op	100.00 100.00 102.00	
Decompositioning C1=C1=C1=C1=C1=D1 of Me, including descent reation, transport, words processing for reasively, and disposal General General		
De-Anoded weekaars	17.0 4044	
notria. Net change is GMS enoscions.retailing from the Proposed Development (ISI2029)	113020 103010	
Net change is EHS encoded-net-alting from the Proposed Development (ISCO3e)	-765.28	
NAD BINISAINE FACINE & KINTON (1) (PCC) NAD BINISAINE FACINE & KINTON ( ANTONIO (		
CHE Breacens Patter & kgON(71 (PCC)	-	
the The Annual Academic Section (1992)     10 The Annual Academic S	28 1,899,880	
Auxillary Sumers - N of annual das Ol consumption Puel (das Ol (emocoass factar (agC02e/KMN)	4 20 20 1,000,000 0,2701 2,20007	
Fuel (Gas Cill) emocions factor (kgCC2e/litre)	2.75857	
	50 52N 32N	
UP Prevention Caloritoculur of Instane (UN)(g) Illigenic calora is invaluit acute convected to lastific gas (US) Priophane (in exclanes in US) Priophane (Instanese) (Instanese)	171	

## Scenario 16 52% LFG capture rate

Link back to index table

Charles (1) Devidently Marche Comm

Headline assumptions for Scenario (red type indicates variation with respect to the ES Case)
Vaste composition based on WRAP 2017 profile for England
Vaste composition based on WRAP 2017 profile for England
Le EW CHP facility operating aprameters for NCV of 9.53 MJ/kg (waste 613,573 Uyr; hours = 8,000 per yr; MWe = 55)
El techtricity generation offset for 40 years based on ensistonis factor in ES for UK grid average 2020/21 = 182 g/Wh
El UFG capture rate for older operational UK landfill (Type 3 MeIMOD) = 52%
S No CCS

Reference See worksheet: 'Woste composition variation' See worksheet: 'Waste composition variation' BEIS (2021). Fuel Mix Disclosure Data Table 2020-2021 N/A DEFRA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

Waste Stream	Scenario 16
Recyclable Paper	5.9%
Card	6.3%
Non-recyclable Paper	8.9%
Dense Plastic	7.8%
Plastic film	8 7%
Textiles	5.5%
Misc. Combustible	9.3%
Misc. Non-Combustible	3.6%
Other Wastes	0.3%
Glass	2.6%
Ferrous Metals	2.4%
Non-Ferrous Metals	1.1%
Food Waste	27.0%
Garden Waste	2.7%
Other Organic	2.3%
Wood	2.3%
WEEE	1.1%
Hazardous	0.5%
Fines	2.2%
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	613,573
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Step 2) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 16
Total waste input (tonnes/yr)	613.573
Total Carbon (% by weight)	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	68 793
Fossil derived CO2 emissions (ICO2)	252.242
N2O emissions from residual waste combustion (tonnes)	23
Equivalent CO2 emissions (tCO2e)	6,197
CH4 emissions from residual waste combustion (tonnes)	175
Equivalent CO2 emissions (tCO2e)	4,911
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424
Auxiliary Burners - emissions for use of fuel (tCO2e)	4,815
EfW Gross emissions (tCO2e/yr)	268,165
EfW Facility electricity generation (MWe)	55
EfW Facility operations (hrs/yr)	8.000
Electricity generated by EfW Facility (MWh)	440.000
CO2 emissions factor for energy generation (g/kWh)	182
EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr)	
	80,080
	80,080
EfW Net emissions (tCO2e/yr)	
EfW Net emissions (ICO2e/yr)	80,080
EfW Net emissions (RCO2e/yr) Step 3) Carbon emissions from Landfilling residual waste and LFG combustion	80,080
EfW Net emissions (ICO2e/yr) Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter Parameter	80,080
EHV Net emissions (ECO2e/yr) Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter Mass of biogenetic carbon in residual waste (tonnes carbon)	80,080 188,085 Scenario 16 91,933
EfW Net emissions (ItC02e/yr) Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter Mass of logenic carbon in residual waste (tonnes carbon) Total carbon converted to LFG (tonnes carbon)	80,080 188,085 Scenario 16 91,933 45,966
EfW Net emissions (RCO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion  Parameter  Mass of biogenic carbon in residual waste (tionnes carbon) Total carbon converted to LFG (tonnes carbon) Methanie nLFG Telesed from residual waste (tift)	80,080 188,085 Scenario 16 91,933
EfW Net emissions (bCD2e/vr) Step 3) Carbone emissions from landfilling residual waste and LFG combustion Parameter Tabla carbon converted to LFG (nones carbon) Tabla carbon converted to LFG (nones carbon) Methane in LFG released from residual waste (ICM4) Methane in LFG released from residual waste (ICM4)	80,080 188,085 Scenario 16 91,933 45,966 34,933 18,166
EfW Net emissions (RCO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter  Mass of biogenic carbon in residual waste (tiones carbon) Total carbon converted to LFG (tones carbon) Wethane in LFG captured for ouse in pas engines (CIC4) Wethane in LFG captured for ouse in pas engines (CIC4) Methane in LFG captured for use in pas engines (CIC4)	80,080 188,085 Scenario 16 91,933 45,966 34,935 18,166 1,677
EW Net emissions (tCO2e/vr)  Step 3) Carbon emissions from landfilling residual waste and LFG combustion  Parameter  Total carbon converted to LFG (nones carbon) Total carbon converted to LFG (nones carbon) Methane in LFG released from residual waste (tCN4) Methane in LFG released from residual waste (tCN4) Uncapture LFG released to Amosphere as methane (tCH4) Uncapture LFG released to Amosphere as methane (tCH4)	80,080 188,085 Scenario 16 91,933 45,966 34,935 18,166 1,677 15,092
EfW Net emissions (RCO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter  Mass of biogenic carbon in residual waste (tiones carbon) Total carbon converted to LFG (tones carbon) Wethane in LFG captured for ouse in pas engines (CIC4) Wethane in LFG captured for ouse in pas engines (CIC4) Methane in LFG captured for use in pas engines (CIC4)	80,080 188,085 Scenario 16 91,933 45,966 34,935 18,166 1,677
ENV Net emissions (ECO2e/yr)  Step 3) Carbon emissions from landfilling residual waste and LFG combustion  Parameter  Total action converted for the carbon carbon)  Total action converted for the carbon carbon  Mehane in LCG activated for usen lags engines (ECN4)  Mehane in LCG activated for usen lags engines (ECN4)  Uncaptured LFG endesed to atmosphere as methane (ECH4)  LFG Equivalent CO2 Gross emissions released to atmosphere (ECO2e/yr)	80,080 188,085 5cenario 15 9,1,933 45,966 34,935 18,166 1,677 15,092 422,558
EfW Net emissions (RCO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter  Mass of biogenic carbon in residual waste (tonnes carbon) Total carbon converted to LFG (tonnes carbon) Methane in LFG captured for use in pas engines (CH4) Methane in LFG captured for use in pas engines (CH4) Uncapture LFG released to atmosphere as methane (CH4) Uncapture LFG released to atmosphere as methane (CH4) Wethane in LFG captured for use in pas engines (CH4) Methane in LFG captured for use in pas engines (CH4) Methane in LFG captured for use in pas engines (CH4) Methane in LFG captured for use in pas engines (CH4) Methane in LFG captured for use in pas engines (CH4) Methane in LFG captured for use in pas engines (CH4)	80,080 188,085 Scenario 16 91,933 43,965 34,935 18,166 1,677 15,092 42,2588 42,2588 18,166 18,166
EfW Net emissions (ECO2e/yr)  Step 3) Carbon emissions from landfilling residual waste and LFG combustion  Parameter  Total action converted to LFG (connes carbon) Total action converted to LFG (connes carbon) Total action converted to LFG (connes carbon) Uncaptured LFG existence for usin gas particles (LFG4) Uncaptured LFG existence to carbon any engines (CH4) Uncaptured LFG existence to carbon any engines (CH4) UFG Equivalent CO2 in andfill cap (CH4) UFG Equivalent CO2 engines (CH4) UFG Equivalent for usin gas engines (CH4) Wethan en LFG captured for use in gas engines (CH4) Wethan en LFG captured for use in gas engines (CH4) Wethan en LFG captured for use in gas engines (CH4) Wethan end use in gas engines (CH4)	80,080 188.085 Scenario 16 91,933 45,966 34,935 18,166 1,577 15,092 42,568 18,166 16,573
EfW Net emissions (ItO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter  Mass of biogenic carbon in residual waste (tonnes carbon) Total actobn converted to LFG (tonnes carbon) Wethane in LFG captured for use in pas engines (CH4) Uncapture LFG realesed from ancidaul waste (tot4) Uncapture LFG realesed from ancidaul waste (tot4) Uncapture LFG realesed from ancidaul waste (tot4) Uncapture LFG realesed to atmosphere as methane (tot4) Uncapture LFG realesed to atmosphere (tot2e/yr) Wethane in LFG captured for use in pas engines (tOt4) Uncapture LFG realesed to atmosphere (tot2e/yr) Methane in LFG captured for use in pas engines (tOt4) Uncapture LFG realesed to atmosphere (tot2e/yr) Methane in LFG captured for use in pas engines (tOt4) Uncapture LFG realesed for statesed to atmosphere (tot2e/yr)	80,080 188,085 Scenario 16 91,933 45,966 34,935 18,166 1,677 1,509 422,568 18,166 16,513 297,231
EfV Net emissions (ECO2e/yr)  Step 3) Carbon emissions from Landfilling residual waste and LFG combustion Parameter  Asso of Diagenc carbon in residual waste (connes carbon) Total carbon converted to LFG (connes carbon) Methane in LFG residual waste (conne) Methane in LFG residual waste (conne) LFG Equivalent Core Service as methane in LFG (contex) LFG Equivalent Core Service in gas engines (CH4) Methane in LFG captured for our sein gas engines (CH4) LFG Equivalent Core Service in gas engines (CH4) Methane in LFG captured for use in gas engines (CH4) Methane in LFG captured for use in gas engines (CH4) Methane in LFG captured for use in gas engines (CH4) Fed Equivalent COre Service in LFG (contex) Methane in LFG captured for UFG engines (CH4) Fed Engine UFG (contex) Fed Equivalent CORE (CH4) Fed Engine (CH4) Fed Engine (LFG (contex)) Fed Engines (CH4) Fed Engines	80,080 188,085 5cenario 16 9,193 3,495 6,34,935 18,166 16,77 15,092 422,568 18,166 16,513 297,231 8,2564
EfW Net emissions (ItO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter  Mass of biogenic carbon in residual waste (tonnes carbon) Total carbon converted to LFG (tonnes carbon) Wethanie n LFG captured for use in pas engines (tOt4) Uncapture LFG released to atmosphere as methanie (tOt4) Uncapture LFG released to atmosphere as methanie (tOt4) Uncapture LFG released to atmosphere as methanie (tOt4) Uncapture LFG released to atmosphere (tC02e/yr) Wethanie nused in gas engines (tOt4) Uncapture LFG released to atmosphere (tC02e/yr)  Methanie nused in gas engines (tOt4) Uncapture LFG released to atmosphere (tC02e/yr) Power generated by LFG engines (MW) Wethanie nused in gas engines (tOt4) UFG (gavenues factor of released to atmosphere (tC02e/yr)	80,680 188,085 5cenario 16 91,933 45,966 34,935 16,977 15,092 425,666 16,513 297,231 82,564 182,7231 28,564 182,7231 28,564 182,7231 28,564 182,7231 28,564 182,7231 28,564 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 183,725 183,755 1
EfV Net emissions (ECO2e/yr)  Step 3) Carbon emissions from Landfilling residual waste and LFG combustion Parameter  Asso of Diagenc carbon in residual waste (connes carbon) Total carbon converted to LFG (connes carbon) Methane in LFG residual waste (conne) Methane in LFG residual waste (conne) LFG Equivalent Core Service as methane in LFG (contex) LFG Equivalent Core Service in gas engines (CH4) Methane in LFG captured for our sein gas engines (CH4) LFG Equivalent Core Service in gas engines (CH4) Methane in LFG captured for use in gas engines (CH4) Methane in LFG captured for use in gas engines (CH4) Methane in LFG captured for use in gas engines (CH4) Fed Equivalent COre Service in LFG (contex) Methane in LFG captured for UFG engines (CH4) Fed Engine UFG (contex) Fed Equivalent CORE (CH4) Fed Engine (CH4) Fed Engine (LFG (contex)) Fed Engines (CH4) Fed Engines	80,080 188,085 5cenario 16 9,193 3,495 6,34,935 18,166 16,77 15,092 422,568 18,166 16,513 297,231 8,2564
EfW Net emissions (ItO2e/yr)  Step 3) Carbon emissions from landffiling residual waste and LFG combustion Parameter  Mass of biogenic carbon in residual waste (tonnes carbon) Total carbon converted to LFG (tonnes carbon) Wethanie n LFG captured for use in pas engines (tOt4) Uncapture LFG released to atmosphere as methanie (tOt4) Uncapture LFG released to atmosphere as methanie (tOt4) Uncapture LFG released to atmosphere as methanie (tOt4) Uncapture LFG released to atmosphere (tC02e/yr) Wethanie nused in gas engines (tOt4) Uncapture LFG released to atmosphere (tC02e/yr)  Methanie nused in gas engines (tC04) Uncapture LFG released to atmosphere (tC02e/yr) Power generated by LFG engines (MWh) UK grid C02e emissions factor of release(to type emission (g/Wh))	80,680 188,085 5cenario 16 91,933 45,966 34,935 16,977 15,092 425,666 16,513 297,231 82,564 182,7231 28,564 182,7231 28,564 182,7231 28,564 182,7231 28,564 182,7231 28,564 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 182,7231 183,725 183,755 1
EVW Net emissions (ECO2e/vr)  Step 3) Carbon emissions from Landfilling residual waste and LFG combustion Parameter  Nass of biogenic carbon in residual waste (cones carbon) Total carbon convertes to LFG (cones carbon) Methane in LFG carboned waste (Cr64) Uncaptured LFG oreleased from residual models (Cr62) UFG faulwalent CO2 ores emissions released from residual models (Cr64) Fuel Input LFG regines (Cl74) Vef Faulwalent CFG or electricity generation (g/Wh) UF grid CO2 emissions factor for electricity generation (g/Wh) UFG faulwalent CO2 or electricity generation (g/Wh) UFG faulwalent CO2 or electricity generation from combuston (tCO2e/yr) UFG faulwalent CO2 or electricity generation from combuston (tCO2e/yr) UFG faulwalent CO2 or electricity generation from combuston (tCO2e/yr)	80,080 188,085 5cenario 16 91,93 181,66 16,577 15,022 422,568 18,166 16,513 297,231 82,554 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,564 182,565 182,555 182,557
EfW Net emissions (ECO2e/yr)  Step 3) Carbon emissions from Landfilling residual waste and LFG combustion Parameter  Step 3) Carbon emissions from Landfilling residual waste (Link)  Restar of Ling Carbon in residual waste (Link)  Methane in LIC carbon emissions results (Link)  Methane in LIC carbon emissions released to atmosphere (ECO2e/yr)  LFG Equivalent CO2 emissions factor Link)  Methane in LIC carbon emissions from Link)  LTG Equivalent CO2 emissions from Link)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation from combustion (tCO2e/yr)  LTG Equivalent CO2 emissions factor for decrinity generation factor decrinity generation (g/Wh)  LTG Equivalent CO2 emissions factor for decrinity generation (g/Wh)  LTG Equivalent CO2 emissi	80,080 188,085 Scenario 16 9,133 4,596 3,4935 15,022 425,566 18,166 18,166 19,133 29,751 15,027 407,541 Scenario 16
EfW Net emissions (RCO2e/yr)  Step 3) Carbon emissions from Landfilling residual waste and LPG combustion Parameter  Mass of Diagenc carbon in residual waste (connes carbon) Total carbon converted to LPG (connes carbon) Mechanie ni LPG captured for use in gas engines (CO4) Mechanie ni LPG captured for use in gas engines (CO4) Uncapture LPG cold corso emissions released to annopatere (RCO2e/yr)  Mechanie ni LPG captured for use in gas engines (CO4) Uncapture LPG corso emissions released to annopatere (RCO2e/yr)  Mechanie ni LPG captured for use in gas engines (CO4) Mechanie ni LPG captured for use in gas engines (CO4) Mechanie used (corso emissions released to annopatere (RCO2e/yr)  Mechanie used (corso emissions released to annopatere (RCO2e/yr)  LPG faquivalent CO2 effest for electricity generation (g/Wh) Ut grid CO2 emissions form operational processes over 40 years Parameter EWG Gross persionnal emissions (RCO2e)	80,080
EfV Net emissions ftc02e/vr)  Step 3) Carbon emissions from Landfilling residual waste and LFG Combustion Parameter  Step 3) Carbon converted to LFG Connes carbon Total carbon converted to LFG Connes carbon Uncapture LFG carbon ensistoms released to atmosphere (EC02e/vr)  Wethane in LFG captured for use in gas engines (CH4) Wethane in LFG captured for use in gas engines (CH4) Wethane in LFG captured for use in gas engines (CH4) Wethane in LFG captured for one instant released to atmosphere (EC02e/vr)  Wethane used in gas engines (CH4) Fuel input LFG Fergines (G) Power annexed to Carbon for electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer of electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  LFG Equivalent CO2 of Infer LFG electricity generation for combuston (EC02e/vr)  EFU Gross operational emissions (EC02e)  EFV Gross operational emissions (EC02e)	80,080
EfW Net emissions (RCO2e/yr)  Step 3) Carbon emissions from Landfilling residual waste and LPG combustion Parameter  Mass of Diagenc carbon in residual waste (connes carbon) Total carbon converted to LPG (connes carbon) Mechanie ni LPG captured for use in gas engines (CO4) Mechanie ni LPG captured for use in gas engines (CO4) Uncapture LPG cold corso emissions released to annopatere (RCO2e/yr)  Mechanie ni LPG captured for use in gas engines (CO4) Uncapture LPG corso emissions released to annopatere (RCO2e/yr)  Mechanie ni LPG captured for use in gas engines (CO4) Mechanie ni LPG captured for use in gas engines (CO4) Mechanie used (corso emissions released to annopatere (RCO2e/yr)  Mechanie used (corso emissions released to annopatere (RCO2e/yr)  LPG faquivalent CO2 effest for electricity generation (g/Wh) Ut grid CO2 emissions form operational processes over 40 years Parameter EWG Gross persionnal emissions (RCO2e)	80,080 188,085 Scenario 16 9,933 181,065 181,065 181,065 182,564 182,565 182,555 18
EfV Net emissions ftco2e/v)  Step 3) Carbon emissions from Landfilling residual waste and LFG Combustion Parameter  Mass of biogenetic carbon in residual waste (tonnes carbon) Total atoms converted to LFG (tonnes carbon) Uncapture LFG extended to atmosphere a methane (LCH4) Uncapture LFG extended to atmosphere (tCH4) Uncapture LFG extended to atmosphere (tCH4) Uncapture LFG extended to atmosphere (tCH4) UFG Extended to atmosphere (tCH4) UFG Extended to LFG (LFH4) Tell input LFG engines (LG) Power panetate but CFG extended to (g/Wh1) UF gf CQ2 emissions factor for electricity generation from combustion (tCQ2e/yr) UFG Extended to Offset for electricity generation from combustion (tCQ2e/yr) UFG Retentissions (tCQ2e) EfV Vet operational emissions (tCQ2e) EfV Vet operational emissions (tCQ2e)	80,080 188,085 Scenario 16 9,193 4,5966 3,4935 18,166 16,77 15,022 422,568 18,166 18,166 18,166 18,167 19,7541 5cenario 16 10,777 3,203 7,523
EfW Net emissions (ECO2e/yr)  Step 3) Carbon emissions from LandTilling residual waste and LFG combustion Parameter  Mass of blogenic carbon in residual waste (tornes carbon) Total carbon converted to LFG (tonnes carbon) Methane in LFG captured for use in gas engines (ECH4) Uncapture LFG released Tota metalaud waste (ECH4) Uncapture LFG released Tota metalaud waste (ECH4) Uncapture LFG released Tot metalaud waste (ECH4) LFG faulwalent CO2 released Tot metalaud waste (ECH4) LFG faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation (g/Wh1) LFG E faulwalent CO2 offset for electricity generation form combustion (tCO2e/yr) LFG For electricity generation to faulty (ktCO2e) EFW Foroson perational emissions (ktCO2e) EFW Verto perational emissions (ktCO2e) LFG for descriptional perational perational perational perational perational perational emissions (ktCO2e) LFG for descriptional perational emissions (ktCO2e) LFG for descriptional perational perational emissions (ktCO2e) LFG for descriptional perational emissions (ktCO2e) LFG for descriptional perational emissions (ktCO2e) LFG for descriptional perational emissions (ktCO2e) LFG foreson perational emissions (ktCO2e) LFG foreson perational emissions (ktCO2e	80,080 188,085 Scenario 16 91,933 43,965 34,935 13,965 422,585 422,585 422,585 422,585 422,585 422,585 422,585 422,585 422,585 422,585 422,585 422,585 15,027 407,541 5cenario 16 5cenario 16
EfV Net emissions ftco2e/v)  Step 3) Carbon emissions from Landfilling residual waste and LFG Combustion Parameter  Mass of biogenetic carbon in residual waste (tonnes carbon) Total atoms converted to LFG (tonnes carbon) Uncapture LFG extended to atmosphere a methane (LCH4) Uncapture LFG extended to atmosphere (tCH4) Uncapture LFG extended to atmosphere (tCH4) Uncapture LFG extended to atmosphere (tCH4) UFG Extended to atmosphere (tCH4) UFG Extended to LFG (LFH4) Tell input LFG engines (LG) Power panetate but CFG extended to (g/Wh1) UF gf CQ2 emissions factor for electricity generation from combustion (tCQ2e/yr) UFG Extended to Offset for electricity generation from combustion (tCQ2e/yr) UFG Retentissions (tCQ2e) EfV Vet operational emissions (tCQ2e) EfV Vet operational emissions (tCQ2e)	80,080 3188,085 3cenario 16 9,033 4,5966 3,4935 1,677 1,502 422,568 18,166 16,573 18,166 16,513 297,231 8,2,564 15,13 297,231 10,207 407,541 5cenario 16 10,777 10,775 10,777 10,775 10,77 10,775 10,775 10,775 10,775 10,775 10,775 10,775 10,7
EfW Net emissions (RCO2e/yr) Step 3) Carbon emissions from LandTilling residual waste and LFG combustion Parameter Mass of biogenic carbon in residual waste (ICH4) Methane in LFG captured for use in gas engines (ICH4) Uncapture LFG calcesed from residual waste (ICH4) Uncapture LFG calcesed for a metadual waste (ICH4) Uncapture LFG calcesed for a metadual waste (ICH4) Uncapture LFG calcesed for a metadual trap (ICH4) EFG faulwaller CO2 of first for electricity generation (g/Wh) UF gif CG2 emissions from for electricity generation (g/Wh) UF GF faulwaller CO2 of first for electricity generation (g/Wh) UF GF faulwaller CO2 of first for electricity generation (g/Wh) UF gif CG2 emissions from ceretional processes over 40 years Parameter UFW Gross persion elemissions (ICO2e) EFW Tecupient CO2 of first for electricity generation (g/Wh) UF gif CG calcesed for delectricity generation (g/Wh) UF gif CG calcesed for delectricity generation (g/Wh) UF gif CG calcesed for electricity generation (g/Wh) UF	80,080 188,085 5cenario 16 91,933 43,956 14,956 14,956 14,956 14,956 15,927 422,569 407,541 50,677 407,541 50,677 407,541 50,773 16,777 10,507 10,777 10,50

Project Lifecycles	Scenario 16) 52% LF	G capture rate
	LFG	EfW CHP Facility
	(ktCO2e)	(ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.5
N5 – Construction process stage		4.9
A4 – Construction Transport		7.9
Operation		
32 – B5 – Maintenance, repair, replacement and refurbishment		4.9
36 – Operational energy	25.04	10,726.5
87 – Operational water		0.2
B8 – Other operational processes: Landfill	16,902.72	
38 – Other operational processes: Operational transport	103.85	271.6
88 – Other operational processes: IBA and APCr		142.6
Decommissioning		
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.3
Seneral		
D – Avoided emissions	-601.07	-3,203.2
TOTAL	16,430.55	8,039.5

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	52%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

### Scenario 17 52% LFG capture rate – including grid decarbonisation

	Meadline accumultance for Economic find type indicates variation with respect to the EE Case)	Reference .
-	a Wade composition based on WR0P 2017 profile for tegland	tee worksheet. 'Wate composition variation'
1	B BW OPF facility operating parameters for NCV of 9.3334(kg (waite 423,3781/yr) hours = 8,000 per yr) MNR = 30)	tee workcheet. Wate composition variation'
	8 BBS forecast emissions factors for UK and electricity generation over 40 years (for the period 2028 to 2080)	BETS (2023). Treasury Green Book – Data Tables 3-29: supporting the tosikit and the guidance (updated 37 April 2028), to fix furnating error)
	Ilectricity expected by facility, each an expert	a/a
	E UPG capture rate for older operational UIClandfill (Type 8 MeIMOD) + 52%	DEPKA (2004). DEPKA Neview of Landfill Methane Envisions Modeling
	s No CCS	a/a

Yang 2) Recidual Warte Composition		
	toesado 17	
Recyclable Paper Card	1.95	
Lana Nan-wegelahle Paper	8.05	
Dense Plactic	7.8%	
Plazz fán	8.2%	
Textile:	5.35	
Mo: Canbuttele	5.3N	
Mor. Non-Cambuchtie	LON	
Other Wastes Stats	6.8N 2.6N	
naris Perious Metals	248	
Non-Persous Metals	118	
Garden Waste	2.7%	
Other Organic.	2.8N	
Wood	2.8N	
VEI	11N	
Kelandouk	63N	
Poes Net Colorfic Value (MI/M)	2,2%	
Nal white insul (Seners'vi)		
A A A A A A A A A A A A A A A A A A A	644,074	
States / False Ni of Solid False)	2.1 900	
Non-Biogenic Cadion (K of Notal Carbon)	42.30%	
Nep 2) Carbon entocions from recidual worke combudios in XFW CHP Padility		
	Reasonin VV	
Social wastle input (Sonney/yri)	623,373	
Total Carbon (N by weight) Non-Bugenic Carbon (N of Total Carbon)	26.20%	
Non-Bagenic Carbon (It of Total Carbon) Miscoaf facol carbon in recalual watte (tannec carbon)	42.80% 48.793	
	44,791	
Pala printer, ca transmiri (n.c.a) ND2 enission: fran in-sidual wade cambuction (some c)	21	
Bauvalent CO2 emissions (ICO2e)		
Bauvalent CC2 emissioni (ICC2e) CH5 emissioni fram incidual ealte cambactian (ponnec)	175	
Banyolent CC2 emissions/1022el	6911	
Auxiliary Burners - Fuel das Oil (IDHs)	1,70,424	
Auxiliary Bumers - encoders for use of fuel (3003e)	600	
EfW Gross embodies (ICC2e-Art	268,265	
If W Facility electricity generation (MWe) If W Facility aperations (Ins/w)	55	
INV Facility operations (INCyr) Electricity generated by EW Facility (MRM)	445,000	
CCD emissions failer for energy prevation (a/WM)		
EfW Repubations CO2 offset for electricity generation by Pacifile (ICD3e/yr)	See cells bid AMBD	
the network according to the second	80	
Nep 3) Cales and construction land ling recipied waits and IPS conduction Factories		
Parameter Misscaf bragenic carbon in reodual watte (tonnes carbon)	11 PU	
Mox of Bragenic Carlies in recolual walde (bonnes Carlies) Total Carlies Gorverted Io(250(tannes Carlies)	\$1,965 43,966	
Inclusion and the second from residual water (2010)	16,700	
Methane in DR captured for use in gat engines (IDH)	10.100	
	1877	
	15,083	
UPD Environment CO2 Gross embodies; minuted to atmosphere BCO2+ /wi	422.348	
Michane in DRI captured for use in gas engines (IDHI)	18,166	
Methane used in gac engines (2D46)		
Fuel input to IPG engines (03) Fourier generated by IPG engines (040h)	287,281	
Favor processed by US engine (1988) UK and CC2 emissions faster far electricity emissions (a/VMI)	82,064	
UPG Equivalent CO2 offset far electricity generation from conduction (ICO2e/(v)	has calls FTR AFTR	
UPD Net emissions (1002a/w)	aria.	
Ying & Calum emission from operational processes over 42 years Personner		
Factorian If W Deck complete all emissions (ACC224)	10 727	
BfW Gooss operational encoders.(NCCOH) BfW Bquivalent CC2 offset for electricity generation by Facility (NCCOH)	10,727	
the net constant emission (RECOP)	175	
UPG (Book aperational enorgians (\$100.04)	34,923	
LPG Equivalent CC2 offset for electricity generation by Facility (KCC3e)	53	
UPD Net aperational emotions (NECCOP)	16.851	
Thep T) Lifetime Carbon enricidans		
	bornario 171 125 170 center	a cida o las hadiantes
Project Lifecycles	decarbonia	allow .
	UNS .	star or racing
		(arrow)
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AL - AL - KE- Kew materials copply, tangent and manufacture AL - Candination process copp		
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Act	34,802.72	14,12 27
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12: Franciska sprak program kandiska 	94,802.73 105.83	20,73 21 11
12: Franciska sprak program kandiska 	34,802.72	14, 11 27 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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12: Franciska sprak program kandiska 	94,802.73 105.83	30, 77 37 30 -27 38 W
View of control maps, large for land, data	94,802.73 105.83	30, 77 37 30 -27 38 W
View of control maps, large for land, data	94,802.73 105.83	30, 77 37 30 -27 38 W
View of control maps, large for land, data	94,802.73 105.83	32,72 27 38 - 27 - 27 - 27 - 27 - 27 - 27 - 27 - 27
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View of control maps, large for land, data	94,802.73 105.83	32,72 37 38 - 37 - 37 - 37 - 37 - 37 - 37 - 37 - 37

ToD Black Vesening Proceeding (VpCDar / VpCDa) Cone Black Vesening Proceeding (VpCDar / VpCDa) ToD Black Vesening Proceeding (VpCDar / VpCDa)	265 30 28 1895.360
Auxiliary butters - N of annual day Of concumation	100,000
Fuel (Sax Oil) emissions factor (lqCOP/VMI)	0.2793
Fuel (Gas Dil) emissions factor (sgCD2e/libre)	2.75857
V0 Pagements	
Calorfic value of methane (MI/Ng)	50
Biogenic carbon in realizal wade converted to landfill got (191)	30%
Propition of methane in D15	175
Propartian of SPEcesawered from residual walde	32%
Ondation of IPD released from recidual wade to CO2 in landfill cap	32%
Properties of tPfbused in gas engines.	95N
D'G engine efficiency 38%	MN

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# Scenario 18 85% LFG capture rate

Headline assumptions for Scenario (red type indicates variation with respect to the ES Case)
1a Waste composition based on WRAP 2017 profile for England
1b EW CvP facility operating parameters for KVC v0 9.53 M//kg (waste 613,573 t/yr; hours = 8,000 per yr; MWe = 55)
2 Electricity generation offset for 40 years based on ensists factor in ES for UK grid average 2020/21 = 182 g/kWh
3 Electricity execution visit for 40 years based on ensists factor in ES for UK grid average 2020/21 = 182 g/kWh
3 Electricity execution visits for 40 years based on ensists factor in ES for UK grid average 2020/21 = 182 g/kWh
3 Electricity execution visits for 40 years based on ensists factor in ES for the SM based on experts' opinion
5 No CCS

Reference See worksheet: Waste composition voriation' See worksheet: Waste composition voriation' BES (2011) fuel Nik Oliciosure Data Table 2020-2021 DEFIA (2014). DEFRA Review of Landfill Methane Emissions Modelling N/A

Step 1) Residual Waste Composition	
Waste Stream	Scenario 18
Recyclable Paper	5.9%
Card	6.3%
Non-recyclable Paper	8.9%
Dense Plastic	7.8%
Plastic film	8.2%
Textiles	5.5%
Misc. Combustible	9.3%
Misc. Non-Combustible	3.6%
Other Wastes	0.3%
Glass	2.6%
Ferrous Metals	2.4%
Non-Ferrous Metals	1.1%
Food Waste	27.0%
Garden Waste	2.7%
Other Organic	2.3%
Wood	2.3%
WEEE	1.1%
Hazardous	0.5%
Fines	2.2%
	9.53
Net Calorific Value (MJ/kg)	
Total waste input (tonnes/yr)	613,573
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Step 2) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 18
Total waste input (tonnes/yr)	613,573
Total Carbon (% by weight)	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	68,793
Fossil derived CO2 emissions (tCO2)	252,242
N2O emissions from residual waste combustion (tonnes)	23
Equivalent CO2 emissions (tCO2e)	6,197
CH4 emissions from residual waste combustion (tonnes)	175
Equivalent CO2 emissions (tCO2e)	4,911
Auxilliary Burners - Fuel: Gas Oil (litres)	1.745.424
Auxilliary Burners - emissions for use of fuel (tCO2e)	4,815
EfW Gross emissions (tCO2e/yr)	268,165
EfW Facility electricity generation (MWe)	55
EfW Facility operations (hrs/yr)	8.000
Electricity generated by EfW Facility (MWh)	440.000
CO2 emissions factor for energy generation (g/kWh)	182
EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr)	80,080
Elw Equivalent Co2 offset for electricity generation by Pacinty (ECO2e/yr)	80,080
584 Not emissions (FCO26 /us)	188,085
EfW Net emissions (tCO2e/yr)	188,085
Step 3) Carbon emissions from landfilling residual waste and LFG combustion	
Parameter	Scenario 18
Mass of biogenic carbon in residual waste (tonnes carbon)	91,933
Total carbon converted to LFG (tonnes carbon)	45,966
Methane in LFG released from residual waste (tCH4)	34,935
Methane in LFG captured for use in gas engines (tCH4)	29,694
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	524

Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	524
Uncaptured LFG released to atmosphere as methane (tCH4)	4,716
LFG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr)	132,053
Methane in LFG captured for use in gas engines (tCH4)	29,694
Methane used in gas engines (tCH4)	26,992
Fuel input to LFG engines (GJ)	485,859
Power generated by LFG engines (MWh)	134,961
UK grid CO2 emissions factor for electricity generation (g/kWh)	182
LFG Equivalent CO2 offset for electricity generation from combustion (tCO2e/yr)	24,563
LFG Net emissions (tCO2e/yr)	107,490
LFG Net emissions (tCO2e/yr)	107,490
LFG Net emissions (tCO2e/yr) Step 4) Carbon emissions from operational processes over 40 years	107,490
Step 4) Carbon emissions from operational processes over 40 years	107,490
Step 4) Carbon emissions from operational processes over 40 years Parameter	Scenario 18
Step 4) Carbon emissions from operational processes over 40 years Parameter EfW Gross operational emissions (ktCO2e)	Scenario 18 10,727
Step 4) Carbon emissions from operational processes over 40 years Parameter EW Gross operational emissions (ktCD2e) EW Equivalent CCD offset for electricity generation by Facility (ktCD2e)	Scenario 18 10,727 3,203
Step 4) Carbon emissions from operational processes over 40 years Parameter EW Gross operational emissions (ktCD2e) EW Equivalent CCD offset for electricity generation by Facility (ktCD2e)	Scenario 18 10,727 3,203
Step 4) Carbon emissions from operational processes over 40 years Parameter EW Gross operational emissions (ktCO2e) EW Equivalent CO2 offset for electricity generation by Facility (ktCO2e) EW Net operational emissions (ktCO2e)	Scenario 18 10,727 3,203 7,523

Project Lifecycles	Scenario 18) 85% L	G capture rate
	LFG	EfW CHP Facility
	(ktCO2e)	(ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.5
A5 – Construction process stage		4.9
A4 – Construction Transport		7.9
Operation		
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.9
B6 – Operational energy	25.04	10,726.5
B7 – Operational water		0.2
B8 – Other operational processes: Landfill	5,282.10	
B8 – Other operational processes: Operational transport	103.85	271.6
B8 – Other operational processes: IBA and APCr		142.6
Decommissioning		
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.3
General		
D – Avoided emissions	-982.51	-3,203.2
TOTAL	4,428.48	8,039.5

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgCO2e / kgN2O)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	85%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

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Nep 2) Residual Warts Composition Waste Umean	Scenario 17	
Recyclable Faper	5.9%	
Card	6.3%	
Non-wcyciałle Paper Dense Placis	8.95	
Place from	825	
Textifies.	1.15	
Mol. Canbullable	5.35	
Mor. Non-Cambuchlia Other Wattes	14N 0.3N	
Cline Waltes Slats	2.05	
temes Metals	245	
Non-Persous Metals	11N	
NoodWada	27.0%	
Garden Walde Other Ossans	2.7%	
Cher Organic Wood	2.85	
VEL	115	
Harandous	63N	
2045	2.2%	
Net Calorific Yalue (Mir/M) Solal wade your (Somerily)	931	
Nika kade mad Donorsten Nika Carlon (N by weight)	611371	
	17.225	
Non-Beams Cades (16 of 160) Cades)	62.805	
Ney 2) Carbon entroine from reduced wate conduction in DW CHP Fadility Pacentar		
Financiar Total wade input (Sonnet/yr)	653.373	
Total Carbon (% by weight)	26.225	
Non-Bagenic Caldion (% of Total Cardion)	42.80N	
Maxx of focul carbon in recidual wadte (tannes carbon)	48,793	
Facel derived CO2 emissions (ICO2) N25 emissions from in-class water conduction (Icomes)	253,242	
ND2 enrozons from enclast wade conduction (Connec) Biorisolent CD2 emissions (ICD2H)	6.187	
CH6 emissions from mindual water conduction filonner/l	173	
Revisitent CD2 emissions (1002e)	4,901	
Auxiliary Burners - Fuel Gac OI (IDHK)	1,78,424	
Auxiliary Burness - encoders for use of fuel (2002e) BW Gross encoders (2002e/yr)	2421	
End Grant Automatic (FCON/da)		
the facility electricity generation (MNVe)		
	8,000	
the cloudy generated by the facility (MMB)	440,000	
2022 encoders factor for energy assessment (a/VMA) 2014 Exclusived CO2 offset for electricity assessment for Facility (1002a/v/)	her cell the Arth	
	See cebi 882 ARID	-
RW Set emissions (ICO2e/p)	A(A	
Step 2) Calean emission chann landfilling residual waste and 240 conduction		
	Scenario 18	
Parameter Moccol Engevis: carbon in residual waste (tornes: carbon)	10000010 10 91,911	
Proceedings Procee	43,966	
Parameter Based Engineeratalise in incohait asate (sonese caldon) Stati Lahan caowerta to 091(sonese caldon) Methaan in 051 sintaad Sone nood awat2 (2010) Methaan in 051 sintaad Sone sone (sone (CM))	47,766 54,915 29,654	
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Parameter Monor of langemic carbon in mochaal watche (lannes carbon) Stati carbon ei caronette di scot (glannes carbon) Mochane au tot anisotato fono escala al avaito (DDI) Mochane au tot scaparate for ace al angle acego (DDI) Mochane au tot scaparate for ace and angle (DDI)	2(366 3(393 2(464 324 324	
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An example of the second secon	2(,966 84,975 74,844 134 4,756 133,053 29,854	
Among  Am	20,946 14,970 29484 4770 182,083 294,984 29,985	
An example of the second secon	20,066 34,070 30,484 4,706 342,043 24,043 24,043 24,043 24,043 24,043	
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Reserve and a set of the set	0, 196 1,571 2,893 354 4,575 24,955 24,9	
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Water         State St	0,000 34597, 2984 302 2964 2964 2964 2964 2964 2964 2964 296	<u>_</u>
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Water         Status           Amage: Amag	0, mass 3, 42 PJ 2, 44 PJ 2, 45 PJ 2, 45 PJ 2, 45 PJ 3, 45 P	sation
Water         Second         Second </td <td>0, mass 3, 42 PJ 2, 44 PJ 2, 45 PJ 2, 45 PJ 2, 45 PJ 3, 45 P</td> <td>ETWOP facility</td>	0, mass 3, 42 PJ 2, 44 PJ 2, 45 PJ 2, 45 PJ 2, 45 PJ 3, 45 P	ETWOP facility
Name      Answer of the second	0, mass 3, 42 PJ 2, 44 PJ 2, 45 PJ 2, 45 PJ 2, 45 PJ 3, 45 P	the CHP racitly (IXCOD) B.33 6.90
Name      A Second Seco	0, mass 3, 42 PJ 2, 44 PJ 2, 45 PJ 2, 45 PJ 2, 45 PJ 3, 45 P	the CHP facility (NECON)
Water         Amage: Amage	0, mass 3, 42 PJ 2, 44 PJ 2, 45 PJ 2, 45 PJ 2, 45 PJ 3, 45 P	Bits CHP Facility (AKCOR) (B. 50) 4.90 7.91
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Without works	e, ma High State 197 197 197 197 197 197 197 197	Bits CHP Facility (AKCOR) (B. 50) 4.90 7.91
Without works	Cume Million State Comparison And Annual Comparison Com	salese the Cor Facility (SECON) 8.35 4.30 7.35 30,756 50 0.20 0.21 275.46
Water         Amage: Amage	e cons and the second	salan Bille Cole Facility (NECO) 8,33 4,90 7,91 4,90 4,90 4,90 4,90 4,90 4,90 4,90 4,90
Manuari Marian Maria	e cons and the second	sten Corractiny (NEO21) 8.00021 8.33 4.90 7.91 14.92 14.93 1
Water         Amage: Amage	e cons and the second	salese the Cor Facility (SECON) 8.35 4.30 7.35 30,756 50 0.20 0.21 275.46
Manuari Marian Maria	e cons and the second	stan cor success (92002) (92002) 8350 8450 7450 8450 8450 8450 8450 8450 8450 8450 8

EW Parameters	
NDD Benacions Patter & kgN3D/11 (IPCC)	4
N20 blubal Warning Patential (kgC02e / kgN20)	265
CHE Emissions Padler & AgONE/T3 (IPCC)	10
CH6 Glubal Warning Patential (kgC03+ / kgCH6)	28
Total das Oil (diesel) cansumption (litres)	1,999,360
Auxiliary burners - % of annual das OI consumption	90%
Fuel (Sas Dil) emissions factor (spCDP/WH)	0.2793
Fuel (Gas Cit) emissions factor (kgCCDe/litive)	2.79837
US Relatedons	
Calorfic value of methane (MI/kg)	50
Biagenic carbon in residual watte converted to landfill gas (195)	325
Propition of methane in 195	175
Proportion of DPD resourced from residual waste	RN RN
Oundation of IPD released from recidual worke to CD2 in landfill cap	22%
Proportion of DPD used in gate engines	10N

 
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# Scenario 20 2030 adoption of CCS by the EfW CHP facility Link back to index table

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Step 1) Residual Waste Composition	
Waste Stream	Scenario 20
Recyclable Paper	5.9
Card Non-recyclable Paner	6.3
Non-recyclable Paper Dence Plastic	8.9
Dense Plastic Plastic film	7.8
Textiles	5.5
Misc. Combustible	9.3
Misc. Non-Combustible	3.6
Other Wastes	0.3
Glass	2.6
Ferrous Metals	2.4
Non-Ferrous Metals	1.1
Food Waste	27.0
Garden Waste	2.7
Other Organic	2.3
Wood	2.3
WEEE	1.1
Hazardous	0.5
Fines	2.2
Net Calorific Value (MU/kg)	93
Total waste input (somes/vr)	613.5
Total Carbon (% by weight)	26.20
Biogenic Carbon (% of Total Carbon)	57.20
Non-Biogenic Carbon (% of Total Carbon)	42.80
Step 2a) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 20
Total waste input (tonnes/yr)	613,57
Total Carbon (% by weight)	26.20
Non-Biogenic Carbon (% of Total Carbon)	42.80
Mass of fossil carbon in residual waste (tonnes carbon)	68,79
Fossil derived CO2 emissions (tCO2)	252,24
N2O emissions from residual waste combustion (tonnes)	
Equivalent CO2 emissions (tCO2e)	6,19
CH4 emissions from residual waste combustion (tonnes)	17
Equivalent CO2 emissions (tCO2e)	4,93
Auxilliary Burners - Fuel: Gas Oli (litres)	1,745,42
Auxilliary Burners - emissions for use of fuel (tCO2e)	4.81
EfW Gross emissions (tCO2e/yr)	268,16
EfW Facility electricity generation (MWe)	
EfW Facility operations (hrs/yr)	8.0
Electricity generated by EfW Facility (MWh)	440,00
CO2 emissions factor for energy generation (g/kWh)	18
EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/vr)	80,08
Step 2b) Carbon emissions from CCS for EfW CHP Facility from 2030	
Operating Parameters	
Proportion of EfW fossil derived CO2 emissions captured	85
EfW emissions captured (tCO2e/yr)	214.40
Energy for carbon capture, using electricity (kWh/tCO2)	30
Energy for CO2 compression and transport, using electricity (kWh/tCO2)	13
Energy for CO2 storage injection, using electricity (kWh/tCO2)	11
CO2 emissions factor for CCS energy inputs, using electricity (gCO2e/kWh)	18
Carbon capture, compression, transport and storage CO2 emissions (tCO2e/w)	21.07
Fugitive CO2 emissions during pipeline transport (Gg/km/yr)	0.01
Pipeline length (km)	1
Fugitive CD2 emissions during transport (tCO2e/yr)	1,54
Leakage rate for CO2 during storage	0.1
Leakage of CO2 during storage (tCO2e/yr)	21
EfW net CCS emissions captured and stored (tCO2e/yr)	191,58
Construction Parameters (connecting pipeline)	191,30
Length of CCS connecting pipeline (km)	-
Central for CCS Contrecting pipeline (unit)	1.40
Carbon factor for CCS connecting pipeline construction (tCO2e/km)	
Carbon for CCS connecting pipeline construction - manufacture, transport and installation (tCD2e)	21,00
EfW Net emissions (tCO2e/yr)	N
Step 3) Carbon emissions from landfilling residual waste and LFG combustion	Scenario 70
Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter	Scenario 20
Step 3) Carbon emissions from Landfilling residual waste and LFG combustion Parameter Mass of biogenic carbon in residual waste (connes carbon)	Scenario 20 91,93
Step 3) Carbon emissions from landfilling residual waste and LFG combustion Parameter Mass of biogenic carbon in residual waste (tonnes carbon) Talic arbon comvetto LFG (tonnes schon)	45,96
Step 3) Carbon emissions from Landfilling residual waste and LFG combustion Parameter Task of bagenic carbon in residual waste (tonnes carbon) Task carbon converted to LFG (tonnes carbon) Homann in LFG released from residual waste (bCH)	45,96 34,93
Hap 3) Carbon reminions from Landfilling residual waste and LFC combustion  Arameter  arameter  arameter  bits and arameters	45,96 34,93 23,75
Itep 3) Carbon emissions from Landfilling residual waste and LFG combustion  Parameter  Table Carbon in residual waste (tonne, carbon) Tabl Carbon converted to LFG (tonne, carbon) Tabl Carbon converted to LFG (tonne, carbon) Methanie III Greesers from residual waste (CH4) Methanie III Greesers to C20 In Indfill Carbon (CH4)	45,96 34,93 23,75 1,11
Step 3) Carbon emissions from landfilling residual waste and LPC combustion brannets: trad carbon conversion la residual waste (tonnes carbon) trad carbon conversion la trife (tonnes carbon) Millerahane in Str. carpanet for using as gringers (CMA) Uncaptured 10° cardeads to CO21 in Indifil can (ICO4) Uncaptured 10° cardeads to CO21 in Indifil can (ICO4)	45,96 34,93 23,75 1,11 10,08
Step 3) Carbon emissions from landfilling residual waste and LPC combustion brannets: trad carbon conversion la residual waste (tonnes carbon) trad carbon conversion la trife (tonnes carbon) Millerahane in Str. carpanet for using as gringers (CMA) Uncaptured 10° cardeads to CO21 in Indifil can (ICO4) Uncaptured 10° cardeads to CO21 in Indifil can (ICO4)	45,96 34,93 23,75 1,11 10,08
Stap 2) Carbon emissions from LandTilling residual waste and LFE combustion           Variantest           Kar of Disperic carbon in residual waste (tornes carbon)           cald carbon converted to LFG (tornes carbon)           cald carbon converted to LFG (tornes carbon)           carbon carbon for messadual waste (tornes)           carbon for the resolution for the resolution (tornes)           carbon for the resolution of th	45,94 34,92 23,77 1,11 10,00 281,71
Status         Status<	45,9 34,9 23,7 1,1 10,0 281,7 23,7
tises a 1 Control emission from Isadiffing residual wate and LFG combustion  Star  Star Star	45,9 34,9 23,7 1,1 10,0 281,7 23,7 21,5 21,5
Status reminions from bandfilling residual wate and LFC combustion         Arranket           Branket         The Status (Internet, cabon)           March Cabon         USE (Internet, cabon)           March Cabon         USE (Internet, cabon)           March Cabon         USE (Internet, cabon)           March Internet USE (Internet, cabon)         March Cabon           March Internet USE (Internet, cabon)         March Cabon           Marchane Int GC captured USE (Internet, Cloth)         Marchane (Internet)           Marchane Inter Captured USE (Internet, Cloth)         Marchane (Internet)           Marchane Inter Captured (IOS ensemble)         Marchane (INTER)           Marchane Inter Captured (IOS ensemble)         Marchane (INTER)           Marchane Inter Captured (IOS ensemble)         Marchane (INTER)           Marchane Inter Capture (IOS ensemble)         Marchane (INTER)           Marchane Internet (Internet)         Marchane (INTER)           Marchane Internet (Internet)         Marchane (INTER)           Marchane INTER Capture (IOS ensemble)         Marchane (Internet)           Marchane INTER Capture (IOS ense	45,9 34,9 23,77 1,11 10,00 281,71 23,77 21,55 338,66
Signal Carbon emissions from Landfilling residual wate and LSC combustion         Image: Carbon emission in the initial wate (Initian Carbon)           Markan Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen Life Carbon emission (Streme Carbon)         Image: Carbon emission (Streme Carbon)           Michaen in Life Carbon effort use in gas engines (ICH4)         Image: Carbon emission (Streme Carbon)           Michaen in Life Carbon effort use in gas engines (ICH4)         Image: Carbon effort use in gas engines (ICH4)           Michaen in Life Carbon effort use in gas engines (ICH4)         Image: Carbon effort use in gas engines (ICH4)           Michaen in Life Carbon effort use in gas engines (ICH4)         Image: Carbon effort use in gas engines (ICH4)           Michaen in Life Carbon effort use in gas engines (ICH4)         Image: Carbon effort use in gas engines (ICH4)	45,96 34,93 23,75 1,11
Step 3) Carbon emissions from landfilling residual waste and LVE combustion  Parameter  Parameter  Was of biogenic carbon in residual waste (bones carbon)  Withhave in 155 carboned from residual waste (b0H4)  Methave in 155 carboned from residual wastes (b0H4)  Methave in 155 carboned from residual wastes (b0H4)  Methave in 155 carboned from residual wastes (b0H4)  Methave in 155 carboned to anotypers as methane (b1H4)  Methave in 155 carboned from residual wastes  Methave in	45,94 34,9;9 23,7; 1,1; 10,00 281,7; 23,7; 21,5; 338,6; 10,7,9; 11,5; 338,6; 10,7,9; 11,5; 34,5;
State and State and LFR combustion         Annual State and LFR combustion           Presenter         State of State and Combustion in residual water (brones carbon)           Markan bits         State and State and State (brones carbon)           Markan bits         State and State and State and State and LFR and LF	45,9 34,9 23,77 1,11 10,00 281,71 23,77 21,55 338,66
teg a 1 Carbon remission from Landfilling residual wate and LGC combustion  Assa of basenet: Carbon in residual wates (froms carbon)  Assa of basenet: Carbon in residual wates (from carbon)  Methana in LGC gastreed from residual wates (CH4)  Methana in LGC gastreed from residual wates (CH4)  Methana in LGC gastreed from set as engines (CH4)  Methana in LGC gastreed from set as engines (CH4)  Methana in LGC gastreed from wates and the strength of the strengt	4 5,9,8 3 4,9; 2 3,7; 1,1; 10,00 2 81,7; 2 3,7; 2 3,7; 3 38,6,6 107,9,9 11 19,65
teg a 1 Carbon remission from Landfilling residual wate and LGC combustion  Assa of basenet: Carbon in residual wates (froms carbon)  Assa of basenet: Carbon in residual wates (from carbon)  Methana in LGC gastreed from residual wates (CH4)  Methana in LGC gastreed from residual wates (CH4)  Methana in LGC gastreed from set as engines (CH4)  Methana in LGC gastreed from set as engines (CH4)  Methana in LGC gastreed from wates and the strength of the strengt	45,9 34,9 23,7 10,0 281,7 23,7 23,7 23,7 23,5 23,7 21,5 388,6 107,9 1 1 5,6
Signal Carbon emissions from landfilling residual wate and LSC combustion         Statusetting           Statusetting         Statusetting         Statusetting           Statusetting         Statusetting         Statusetting         Statusetting           Statusetting         Statusetting         Statusetting         Statusetting         Statusetting           Statusetting	45,9 34,9 23,7 10,0 281,7 23,7 23,7 23,7 23,5 23,7 21,5 388,6 107,9 1 1 5,6
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Stage 3[ Carbon enclosions from JourdBilling residual waste and USC combustion         Stage 32           Strain of the stage 32 and	45,9 34,9 28,7 1,11 281,7 281,7 235,6 385,7 385,7 385,6 385,7 385,6 385,7 385,6 385,7 395,7 395,
Stag a) Carbon envisions from Jondfilling residual wate and LVC combustion       Darmature       Darmature    <	4 65,90 3 455 2 3,77 1 11 2 28,57 2 28,57 2 38,57 2 38,57
	4 65,95 3 45,97 3 45,97 3 10,07 3 1
Step 3 Contenentiation from LandBilling residual water and LFG combustion  Asses of bioagenet: carbon in residual water (Excence carbon)  Stef achon converted by 10 (Lonner, carbon)  Methans in LFG released to 10 (Lonner)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans in LFG released to 20 in subdill water (EXCE)  Methans water (XCE) offer ther descripting americation (KCE)  Methans water (XCE) offer ther descripting americation (KCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in subdill water (XCE)  Methansed in LFG released to 20 in su	4 65,9 3 45 3 45
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Stag a) Carbon envisions from Jondfilling residual wate and LVC combustion       Darmature       Darmature    <	4 65,9 3 45 3 45

Project Lifecycles	Scenario 20) 2030 adoption facili	
	LFG	EfW CHP Facility
	(ktCO2e)	(ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55
A5 – Construction process stage		4.90
A4 – Construction Transport		7.93
AI – A2 – A3 – A4 CCS connecting pipeline (manufacture, transport and construction)		21.00
Operation		
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91
B6 – Operational energy	25.04	10,726.58
B7 – Operational water		0.24
88 – Other operational processes: Landfill	11,268.48	
B8 – Other operational processes: Operational transport	103.85	271.68
88 – Other operational processes: IBA and APCr		142.60
Decommissioning		
C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.38
C1 - C2 -C3 -C4 - CCS connecting pipeline: End of life		21.00
General		
D – Avoided emissions	-786.01	-10,100.13
TOTAL	10,611.36	1,184.64

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgC02e / kgN20)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Oil) emissions factor (kgCO2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

Networket: "Visite composition variation" See worksheet: "Visite composition variation" See worksheet: "Visite composition variation" SEE (2017). Isel Mit Occlosure Data Table 2005 2011 EEG (2017). Isel Mit Occlosure Data Table 2005 2011 CVC (2006). 2008 PPC Guidelines for National Genehouse Gas Inventories. Yolume 2: Energy, Chapter 5: Curbon Double Transport, Injection and Geological Storage, Section 5.3 Jackson and Marcial (2015). Optimization of the Inergy Communitoria of Laboho Calpura and Secuerization Intel and Campacity Comparison of Internet Compression Processes Jackson and Marcial (2015). Optimization of the Inergy Communitoria of Laboho Calpura and Secuerization Index Cale Calpura Interesses Jackson and Marcial (2015). Optimization of the Inergy Communitoria of Laboho Calpura and Secuerization Index Cale Calpura Interesses PCC (2008). 2009 PCC Guidelines for National Greenhouse Gas Inventories. Yolume 2: Energy, Chapter 5: Curbon Double Transport, Injection and Geological Storage, Table 5.2 WVV estimate For Concention to Col Storage and Extrans. Uncented Interest Concention Interesses USSNE (2013). Deep andorgical Storage of Laboh Calpura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura Acipurational Storage Acipuration National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipurational Storage Acipurational N

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BES fore-set emission. factors for UK grid electricity generation over 40 years (for the period 2028 to 2080)	BETS (2020). Treasury Greek Back - Ca	ia Tables 3-DB supporting the toolkit and the guidance (updated 37 April 2023, to fix formatting errors)
Hectivity export only for the HM CHP facility, no clean export 1997 curves one for modern laws 1977 perfil = 999	N/A	Whith the Resource Modellant
CCS part combuction systems from 200 onwards (19 years)	N/A	
Unaquine for sealanch large statistication de la construcción de la co	IPCC (2006) 2006 IPCC Guidelines for Jackson and Brodal (2009) Permission	sational Greenhouse Sactiventaines, Valume 3, Energy, Chapter S, Carbon Duxide Yaingoot, tripction and beological Morage, techn and The Energy Consumption of a Carbon Casture and Neurestration Related Carbon Duxide Camperson Resources
CCL - Hectricity for compression (including pypeline transport) = 120009/1000	Jackson and Brodal (2009). Optimizati	in of the Bregg Consumption of a Cabon Capture and Sequestization Related Cabon Disoide Compression Protected
CC3 - electricity for charage = 3300eh/bC03	Average accurred to be came ac elect	uity for compression General General-sure las inventores, Volume 2, Energy, Chaster 5, Gelson Davide Tomasof, InterCon and Bestopical Borger, Table
CCL - Sanchestan provine length + 122 km	MVV estimate for connection to CO2	aanna areenaar aa meesane. Yuune 2 meeg, coque 1 canan aanne mangun, opraan an aeaagaa songe, taar ta'ag attactor duder
CCX - leakage rate for CO2 during charage (less than 0.2N)	DEME (2021). Deep gediagkal darap	of calcondoxide (CCD), offshore UK containment sertainty
a) Specific Constraints and a group of a specific constraints and a group of a specific constraints and a specific constraints a	MVV estimate for connection to main internal estimate based on other pro-	pipeline at KingsLynn HC examples
Nep 1) Recidual Warte Composition Warte Name	Average T	
Recyclable Paper	5.85	
Call Minimum Web Tanar	5.8% 4.8% 2.8% 2.8% 3.8% 3.8% 3.8% 2.8% 2.8% 2.2%	
Decis Platic	7.8%	
Place from Textiles	8.2%	
Misi. Conisultile	5.25	
Muz. Non-Combuzzille	145	
Other Walles Blass	245	
Pervau, Metak	2.4%	
Food Wade	27.0%	
darden Walte	2.7%	
Nad Nada Sadan Waja Sadan Waja Wala Wala Sadalada Sadalada Sadalada	2.7% 2.8% 2.8% 2.8%	
west	1.75	
Hashbot Mes	4.5%	
	11	
Total wate must home dwit	611.172	
Rosens Carbon N of Telde Carboni	17.205	
Non-Boarnix Carbon IN of Total Carbon	42.875	
Step 2d) Carbon endodoec/runn recidual waste cambustion in 1FW CNP Facility	<u> </u>	
	homatic II	
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Nan-Bogenic Carbon (% of Total Carbon)	42.80%	
Mass of fossil carbon in recidual wade (sonnec carbon) Received advand CPD assessment (CPD)	68,793 210,362	
	21	
Jacobiet Consequences (2014) Annotation Consequences (2014)	6.287	
uma eminioanes inam resianae walik Galidadilian (Tannés) Equivalent CCI eminioanes(ECI24)	175 4,811 1,786,428	
AurillaryBurrex - Pael Gac OI (Idrec)	1,705,420	
Exemplery sectors, entropies (for set all fuel InCODE)	6721	
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for Targity exhibits generation (MMI)     Heritary e	483,000	2021 2027 2028 2029 2020 2020 2020 2020 2028 205
CC2 encoders factor for energy generation (g/KMh) Fife to another CC1 offset for elements and the testing (CC156.6.1)	See only BET ABUT	50 47 54 67 55 56 50 21 1 18400 21400 21430 21440 14501 16502 18300 486
ting designed have ensure on exhibiting energiated by Facility Incoders. Here 26) Carbon emissions from CCS for this OP Facility from 2012	See ONLY THE ARM	PERMA 28.000 21.030 21.000 18.000 18.720 18.200 15.000 8.86
Operating Parameters		
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Affect and an experimental and a second a	201.094	
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CO2 encodors factor for CC5 energy inputs, using electricity (gCC2e/kWh)	See ONLY TRANTS	
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Public (D2 enclose duraction) (2026/a)	1140	
Journa of CO2 during throad INCOMENT	211	
Effet and CE3 annualies contravel and daved IND26/with Prosterior Texas Researchers (consection scientized	43	
Longth of CCL connecting pipeline (km)	15	
Langelt effectionenening payeries (construction (ECOR) (An) Carden Statut (CCC) conventing payeries construction (ECOR) (An) Carden for CCC conventing another construction: manufacture. Yorkisof and institution (ICOR)	15 1,400 23,000	
17W Net emission (1002a/w)	8/6	
Nep 3 Carbon emissions from land lifting residual waste and DR combustion		
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Table Gebon Generated to IPS (Sonnet Cabon)	00,000 03,000 03,000 23,755 1,116	
Methane is UNI released from readual waste (ICHE)	34,805	
Unceptured LPD audited to CO2 in landfill cap (ICHI)	1,118	
Uncadured INE interated to democration an inclusion ICPdI DNE Reprodect CDD Group emissions released to atmosphere (ICD3e/yr)	30.060 380,712	
Welchae in Dis Lightwel for use in gas engines (Dol) Welchae use al signs engines (DON) Puel input lab UTB engines (DD) Near generational by DB engines (DDM)	20,755 22,956 880,687	
Fuel input to IPG engines (GI)	20,000	THE'S THE'S THE'S THE'S THE'S THE'S THE'S THE'S
Power generated by IPE engines (MMN)	207,668	2020 2027 2029 2020 2020 2020 2020 2020
UK and CO2 encoders factor for electricity generation (a/koh) DR Squident CO2 offset for electricity generation from conduction (ICCDe/yr)	See selicitization and the	1,717 7,214 4,242 1,280 4,884 4,328 1,289 2.181 2.26
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EfW Represent CCD captured by CCS from 2080. Myyeax (62CCDe) EfW Net constroad environme. IntCCDe1	7,814	
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# Scenario 22 2040 adoption of CCS by the EfW CHP facility Link back to index table

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  Heading assumption for Security 2017 prefix for Figure 4
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  (1) what composition for the WIV of the WIV

- 1) Residual Waste Composition

Step 1) Residual Waste Composition	
Waste Stream	Scenario 22
Recyclable Paper	5.9%
Card	6.3%
Non-recyclable Paper	8.9%
Dense Plastic	7.8%
Plastic film	8.2%
Textiles	5.5%
Misc. Combustible	9.3%
Misc. Non-Combustible	3.6%
Other Wastes	0.3%
Slass	2.6%
Ferrous Metals	2.4%
Non-Ferrous Metals	1.19
Food Waste	27.09
Sarden Waste	2.7%
Other Organic	2.3%
Nood	2.3%
WEEE	1.1%
Hazardous	0.5%
Fines	2.29
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	613,573
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Step 2a) Carbon emissions from residual waste combustion in EfW CHP Facility	
Parameter	Scenario 22
Fotal waste input (tonnes/yr)	613,573
Total Carbon (% by weight)	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	68.793
ossil derived CO2 emissions (tCO2)	252,242
N2O emissions from residual waste combustion (tonnes)	2
Equivalent CO2 emissions (tCO2e)	6 193
Equivalent CO2 emissions (CO2e) CH4 emissions from residual waste combustion (tonnes)	6,157
Equivalent CO2 emissions (tCO2e)	4.911
quivalent CO2 emissions (tCO2e) Auxiliary Burners - Fuel: Gas Oli (litres)	4,91
Auxilliary Burners - emissions for use of fuel (tCO2e)	4,815
Auxiliary Burners - emissions for use of fuel (t.O.2e) EfW Gross emissions (tCO2e/yr)	4,815
riw closs emissions (ccoze/w)	200,102
EfW Facility electricity generation (MWe)	
rw Facility electricity generation (wwe)	55
fW Facility operations (hrs/yr)	8,000
Electricity generated by EfW Facility (MWh)	440,000
CO2 emissions factor for energy generation (g/kWh)	182
EfW Equivalent CO2 offset for electricity generation by Facility (tCO2e/yr)	80,080
Step 2b) Carbon emissions from CCS for EfW CHP Facility from 2040	
Operating Parameters Proportion of EfW fassil derived CO2 emissions captured	
	85%
EfW emissions captured (tCO2e/yr)	214,406
Energy for carbon capture, using electricity (kWh/tCO2)	300
Energy for CO2 compression and transport, using electricity (kWh/tCO2)	120
Energy for CO2 storage injection, using electricity (KWh/tCO2)	120
CO2 emissions factor for CCS energy inputs, using electricity (gCO2e/kWh)	182
Carbon capture, compression, transport and storage CO2 emissions (tCO2e/yr)	21,072
Fugitive CO2 emissions during pipeline transport (Gg/km/yr)	0.014
Pipeline length (km)	110
Fugitive CO2 emissions during transport (tCO2e/yr)	1,540
Leakage rate for CO2 during storage	0.1%
Leakage of CO2 during storage (tCO2e/yr)	213
EfW net CCS emissions captured and stored (tCD2e/yr)	191,581
Construction Parameters (connecting pipeline)	
Length of CES connecting pipeline (km)	15
Carbon factor for CCS connecting pipeline construction (tCD2e/km)	1.400
Carbon for CCS connecting pipeline construction - manufacture, transport and installation (tCD2e)	21,000
fW Net emissions (tCO2e/yr)	N/A
Step 3) Carbon emissions from landfilling residual waste and LFG combustion	
Parameter	Scenario 22
Mass of biogenic carbon in residual waste (tonnes carbon)	91,933
Fotal carbon converted to LFG (tonnes carbon)	45,966
Methane in LFG released from residual waste (tCH4)	34,935
Methane in LFG captured for use in gas engines (tCH4)	23,755
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	1,118
Uncaptured LFG released to atmosphere as methane (tCH4)	10,06
FG Equivalent CO2 Gross emissions released to atmosphere (tCO2e/yr)	281,712
Methane in LFG captured for use in gas engines (tCH4)	23,75
Methane used in gas engines (tCH4)	21,59
Fuel input to LFG engines (GJ)	388,68
Power generated by LFG engines (MWh)	107,969
JK grid CO2 emissions factor for electricity generation (g/kWh)	18
FG Equivalent CO2 offset for electricity generation from combustion (tCO2e/yr)	19,650
· · · · · · · · · · · · · · · · · · ·	13,03
FG Net emissions (tCO2e/yr)	N/A
	1
tep 4) Carbon emissions from operational processes over 40 years	
Parameter	Scenario 22
fW Gross operational emissions (ktCO2e)	10,72
EfW Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	3.20
EfW Equivalent CO2 consector for electricity generation by Pacinty (RCC22e)	3,20
rw Equivalent CO2 captured by CC5 from 2040: 26 years (ktCO2e) rW Net operational emissions (ktCO2e)	4,98. 2,54
TTT THE OPENHOUTH CITEMANN'S (MCO2E)	2,54.
TC Create assessible and assistance (MCOOn)	
FG Gross operational emissions (ktCO2e)	11,261
FG Equivalent CO2 offset for electricity generation by Facility (ktCO2e)	781
FG Net operational emissions (ktCO2e)	10,482
Step 5) Lifetime carbon emissions	Scenario 22) 2040 adoptic

Step 5) Lifetime carbon emissions		
Project Lifecycles	Scenario 22) 2040 adoption facili	
	LFG (ktCO2e)	EfW CHP Facility (ktCO2e)
Construction		
A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55
A5 – Construction process stage		4.9
A4 – Construction Transport		7.93
A1 – A2 – A3 – A4 CCS connecting pipeline (manufacture, transport and construction)		21.00
Operation		
B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91
B6 – Operational energy	25.04	10,726.58
B7 – Operational water		0.24
B8 – Other operational processes: Landfill	11,268.48	
88 – Other operational processes: Operational transport	103.85	271.68
88 – Other operational processes: IBA and APCr		142.60
Decommissioning		
C1 – C2 –C3 –C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal		48.38
C1 – C2 -C3 -C4 – CCS connecting pipeline: End of life		21.00
General		
D - Avoided emissions	-786.01	-8,184.32
TOTAL	10,611.36	3,100.45

EfW Parameters:	
N2O Emissions Factor 4 kgN2O/TJ (IPCC)	4
N20 Global Warming Potential (kgC02e / kgN20)	265
CH4 Emissions Factor 4 kgCH4/TJ (IPCC)	30
CH4 Global Warming Potential (kgCO2e / kgCH4)	28
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor (kgCO2e/kWh)	0.2731
Fuel (Gas Dil) emissions factor (kgCD2e/litre)	2.75857
LFG Parameters:	
Calorific value of methane (MJ/kg)	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%
Proprtion of methane in LFG	57%
Proportion of LFG recovered from residual waste	68%
Oxidation of LFG released from residual waste to CO2 in landfill cap	10%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

Networket: "Visite composition variation" See worksheet: "Visite composition variation" See worksheet: "Visite composition variation" SEE (2017). Isel Mit Occlosure Data Table 2005 2011 EEG (2017). Isel Mit Occlosure Data Table 2005 2011 CVC (2006). 2008 PPC Guidelines for National Genehouse Gas Inventories. Yolume 2: Energy, Chapter 5: Curbon Double Transport, Injection and Geological Storage, Section 5.3 Jackson and Marcial (2015). Optimization of the Inergy Communitoria of Laboho Calpura and Secuerization Intel and Campacity Comparison of Internet Compression Processes Jackson and Marcial (2015). Optimization of the Inergy Communitoria of Laboho Calpura and Secuerization Index Cale Calpura Interesses Jackson and Marcial (2015). Optimization of the Inergy Communitoria of Laboho Calpura and Secuerization Index Cale Calpura Interesses PCC (2008). 2009 PCC Guidelines for National Greenhouse Gas Inventories. Yolume 2: Energy, Chapter 5: Curbon Double Transport, Injection and Geological Storage, Table 5.2 WVV estimate For Concention to Col Storage and Extrans. Uncented Interest Concention Interesses USSNE (2013). Deep andorgical Storage of Laboh Calpura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura and Secuerization National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipura Acipurational Storage Acipuration National Calmonson Interesses USSNE (2013). Deep andorgical Storage of Laboho Acipurational Storage Acipurational N

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lectricity export only for the BNR CMP facility, no steam export PD carture size for modern, large UK landfill = 60%	N/A DEPEN (2014), DEPEN Review of Landfill N	Arthure Environm Modelling
23 post-combuction cyclems/ram 2002 onwards (39 years)	N/A.	nor" Silah 3 Minupenng Minukit and Angolawa (galand 12 April 2015, talis, farneting erect) antara terumantantahing and bendawa terumantan (yahar 2 Jang, Chapter 5 Sakas Davado Tangari, tyactara ad denigraf Mango, ter
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and a second	6.05	
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son Boannis Carbon Int of Total Carbon I	42.80%	
Rep 24) Carlson encicioses from residual waste combustion in 1FW CHP Pacifity		
aamter	Tornario 22	
and advant report partners (m) Mail Carbon (% By weight)	413,379 26.22%	
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Instance of CD2 Burley (Instance INCODARD) When and CD2 Burley (Instance) contrasted internal (INTODARD)	228	
Construction Parameters (consecting pipeline)		
ength of CCS connecting pipeline (km) Salvan factor fair CCS connecting pipeline construction (ICCDP/km)	15	
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Archane is UKS released from residual waste (ICHE)	00,000 03,000 34,005 28,715	
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Includered (PE interated to Atmosphere at methane IC/rel) PE Equivalent CC2 Gross emissions released in atmosphere (CC3e/yr)	10.040	
	180,012	
dethane is UNI captured for use is gal engines (ICM4)	28,755	
Relation is Urd captured for use in gas explore (UD46) Relation used in gas explored (DD41) en input to Urd explore(UD41) Sware generated by Urd explore (UD40)	28,785 22,396 388,687	Thera thera thera thera thera thera thera thera thera
Namer generated by UNL engines (MMM) or and FYT associated factor for all Christian (advantation (advanta))	207,668	2038 2027 2028 2029 2030 2030 2021 20
28 and CO2 emissions factor for electricity generation (a/kob) 28 Injuralent CO2 efficient for electricity generation form conduction (iCCDe/jv)	See units 1206 AX206	1,717 7,264 6,362 1,280 6,088 6,328 1,280 2,981 2,0
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fill test gas otheral emissions, fett totel	4.000	
26 Social operational environment (BACDBH) 26 September CO2 alf Section elemanator generation (by Tacility (MCDDH) 25 Section elemanator MCDDH)	11,368	
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and an an and a second constraints of MAMPI	11.00	
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hajed Lifectures	facility - including grid decadoori UNS Bhurco	adan Marina
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r - Oprisional Water IF - Miles countries I southill	11,008,07	0.24
R - Other operational processes: Operational transport	221.85	271.48
R - Cheroperatorial processes. Bit and APC -		10.00
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035	11.000.0	
sort change is dirth encoders relating from the Proposed Development (s2023e)		-1,814.23
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	4 365 32 28	
ND Global Warning Potential (NJCCan / KgN20) Del Bernislani Padar (NJCCan / KgN20)		
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	Senario 24		
	2040 addedition of CCS by the EFW CHP facility – including and decarbonisation and reduced recyclables (65% target) UNK task to identifie		
	Meadline accurations for transmission draw inductors writing with recent to the 15 Court	Release	
- 10	Nearline accurations for transmission in your motions constants with resident 20 the ST Scale Matter composition based on target BHC of municipal-water competed by 200, with 64 300 already necycled in 2020 Matter OF Scaling Concerning Januares (algested for NEC yeards) = 453,664 V/p(	See worksheet, March com	and Real variables?
-	BETS forecast environes factors for UK proteinstry generation over 42 years (for the period 2020 to 2001) Electrony export only for the ETACOP facility, no cleans export	MITS (2023). Trikasury Green	Nock - Data Tables 2-DR. supporting the toolkit and the guidance (updated 17 April 2023, to fix formatting entors)
1	tiectnoty export only for the thirtCHP facility, no clean export LPG capture rate for modern, large UC landfull + BBS		e of Landfill Wethane Emissions Modelling
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N	CCL - electricity for capture - KOSWA,RCC2 CCL - electricity for compression functional approximation to 1000M//RCC2	Jackson and Bradal (2008). C	gitmization of the Energy Concumption of a Carbon Capture and Sequestration Related Carbon Disade Compression Processes
	CCL - Herdinicity for clarage = 1201Wh/ICC2	Average assumed to be say	pomolecen in the energy-consemption of a cancer captor and angene and in many cancer on an an compression manuals.
- 14	CCS - Vancounces papeline length = 120 km CCS - leakage rate for CCD during Dorage (less than 0.24)	MVV edinate for connectiv	n to CCI clastige at Baction cluster Lai classige of carbon disease (CCI), of chare LIC containment certainty
	CC3 - connecting pipeline length = 11km CC3 - connecting pipeline carbon factor for manufacture, transport, exclusion and construction = 1,8250029/km	MVV estimate for connection	n ta main pipeline at Kings Lynn ather project examples
2	EEE - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,800 0020e/km	Internal estimate based on	alber propell examples
	Nog X Residual Walle Composition		
	Wale Ream	tornario 21	
	Carl	6.2%	
	Nor-vicyclake Paper Dense Placis	8.9% 7.8%	
	Fisicin	825	
	Textiles	5.5%	
	Mic. Canbullile Mic. Non-Canbullie	5.2% 1.4%	
	OtherWorks		
	Glass Persona Mittala	2.4%	
	Persous Metals. Non-Persous Metals	126	
		17.0%	
	Gardes Wate Differ Organic	2.7% 2.8%	
	Wood	2.8%	
	WITE Microfiles	1.1%	
	Pines.	0.3N 3.2%	
	Net Calorfic Yoluw (Mi/kg)	9.50	
	Sotal waste input (Sonney'yr) Sotal Carbon (% by weight)	411,448	
	Riagenic Carbon (% of Total Carbon)	MANN	
	Non-Bagenic Carbon (16 of Notal Carbon)	4140%	
	Step Ze) Carbon emissions from-residual worke combustion in ENV OIP Facility		
	Pasaneter Total walde stput (Sanne (Vyr)	Scenario 28 621,668	
	Nan-Begeni Calden (K. d. 1stal Calden) Mar Wigeri Calden (K. d. 1stal Calden) Max of footication in instalial works (tames calden)	41.40% 67.213	
	Max of Toolicardan in recolution water (Sames Carbon) Fossil devined CO2 emozans (SCO2)	87,218 206,009	
	N3D enocoore from mickul water conduction (connect) Bauroleti CC2 emissioni (ICC24)	28	
	Part and the control of the control of the control of the control	179	
	Equivalent CO2 emissions (ICO2e)	4834	
	Auxiliary Burners - Fuel: das DB (ISDW) Auxiliary Burners - encodons/for use of fuel (ISD3e)	1,10,434	
	EfW Grosseniocians ()CC32+/y)	242,179	
	the Facility electricity generation (MRe)		
		8,000	Tear 2 Tear 2 Tear 2 Tear 2 Tear 3 Tear 8 Tear 9 Tear 9 Tear 20 Tear 21
	tiectrotygewarded by the facility (Mith) CC2 emission factor for energy generation (g/Wh)	680,000	2026 2027 2028 2029 2030 2011 2020 2021 2031 2031 2031
	Effer Equivalent CC2 office (in enclosely generation by Facility (CC2e/yr) Weg 24 (Carbon emotions from CC1 for Effer CMP Facility from 200	See or CLEARANCE	95,600 25,680 25,520 21,580 26,720 13,200 13,580 5,980 7,920 7,92
	Properties of 17W focal derived CD2 emissions, Geburnd	85%	
	Rft# emissions captured (KCDW/yr) Theogyda carton capture, ucing electricity (RRH/KCD)	2011-042	
			1967 2 1967 2 1967 8 1967 8 1967 8 1967 8 1967 7 1967 8 1967 9 1967 20 1967 20 1967 20 1967 20 1967 20 1967 20 1
	Inergy for CD2 starage separates, using electricity (KMI,1002)	130	2020 2027 2028 2029 2030 2011 2032 2031 2031 2031 2031
	CCD emissions factor fair CCL energy inputs, using electricity (JCCD#/WH) Carbon copture, compression, transport and storage CCD2#missions (ICCD#/yc)	See (#05/27.0K/7	
	Pugitive CD2 emission: during popeline transport (tig/kn/yr) Pipeline length (km)	0214	
		1107	
	Leakage rate for CD2 during Clurage Leakage of CD2 during clurage (ICD2a/yr)	0.1% 208	
		208	
	Construction Parameters (connecting pipeline)		
	Centstwick Phone-term (Janeau Lag Japania) Langth of CCL sub-schage Japania (Japania) Califon Adad CCL sub-schage Japania executivation (JCC20/km)	13 1,600	
	Carbon for CCS connecting pypelme construction (score)(in) Carbon for CCS connecting pypelme construction - manufacture, transport and initialization (SSD24)	31,000	
	If the And and address (ICC2.2x/yr)	NA	
	Step 2) Carbon emissions from land filling residual worke and UPS conduction Factoreter		
	Macc of biogenic carbon in re-adual waste (tonnec carbon)	94,182	
	Total Carbon converted tocPD(Isones Carbon) Methane In IPD missioni from recolution works (ICHE)	47,011	
	Uncaptured DNI and red to CC2 in land fill cap (ICMI)	1,145	
	Uncaptured UPG intervand to abmorphere ac methane (ICHE) UPG Byolvalevit CCD Guiss embodies intervand to atmosphere (ICODe/yr)	23,807	
	Methane in 195 captured for one in got engines (1044)	24,887	
	Fuel insulta (PD engines (DJ)	398,197	1967 2 1967 2 1967 8 1967 8 1967 8 1967 1967 8 1967 9 1967 20 1967 20 1967 20 1967 20 1967 20 1967 20 1977 2020
	Pawer prevaled by UTG regime.(MMH) UK and CCD emission States for view/score/a/WHI	130,830 Tex (etc. 130), AF3(0)	2024 2027 2028 2029 2030 2021 2020 2028 2024 2025 2026 10 67 34 69 60 58 50 21 29 35 5
	UPG Equivalent CO2 offset for electricity generation from conduction (ICO2e/yr)	See cells \$300 ARIDE	8,995 7,411 6,413 5,420 4,817 4,223 3,818 2,405 2,562 1,990 1,99
	LPG Net emissions()CD2e/yr)	8/8	
	Stop © Carbon emissions from operational processors over 62 years Financelor	Transfer W	
	Parameter 1990 Grosse aperational environmen (IntODAH) 1990 Equivalent CCD affast for elections previous by Pacifity (IntCDAH)	30,015	
	INV Reprodect CCD offset for electrony generation by Facility (IRCCDe) INV Reprodect CCD calcuned by CCS from 2000, 29 years (IRCCDe)	30,095 273 3,088	
	IFW Bigwatest CCD Captured by CCS Yuan 2081. 29 years (NICCDV) IfW Net operational emotions (NICCDP)	1,000	
	LPG Dook specificati enropsing (stctche)	11,544	
		67	
	LPG Net operational emocions (ACCOIP)	11,475	

Stee & Lifeine cales anticipat	facility - including grid	Scenario 26) 2002 adoption of CCS by the SFW CMP facility – including grid decarbonication and reduced recyclubles (SIDS Lager)	
	uns Baccard	BIW OVP FACILITY (MCCOV)	
Carabiadian			
A1 - A2 - 83 - New materials cupply, transport and manufacture		8.9	
AS - Candituction pravess stage		4.90	
A4-Candination Transport		2.90	
A1 - A2 - A4 CC1 convecting ppeller (manufacture, banque t and construction)		21.00	
Operation			
82 - 85 - Mandenance, repair, replacement and refurbitment		4.90	
ES - Operational energy	25.04	32,495.14	
87 - Operational water		0.21	
EE - Other operational processes Landfill	11,546.17		
EE - Other operational processes: Operational transport	228.85	275.68	
BE - Other operational processes IBA and APGY		142.60	
Deconvertationing			
C1 - C2 - C3 - C4 - End of Life, including deconstruction, transport, wastly processing for resolvery and disposal		05.33	
C2 - C2 - C2 - CC3 cannecting payment and of the		21.00	
General			
D - Avoided encodors	-62.00	-5,661.03	
50744	11,606.17	5,352.31	
Net change in SPD environmentation from the Proposed Development (MCD2e)		-6.222.12	

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Link back to index table	
Headline accumulator for transmission of their inductors uncutine with research to the EX Cate) a Voter completion lands in XMI reduction in final and plant and the completion in XMI reduction in other negatibilities in MIC VM Statistic opercomplexamenter adjusced for MIC (walden = 4XX,MIC) (Vychan = 7, AMI and party), MMI = 4X,MI	Telesco
the CMP facility operating patienters adjusted for NCV (wade + 625,605 V/v) hours + 7,667 per v), MWV + 56.00]	New worksheet. 'Mode consolition upstation' See worksheet. 'Mode consolition upstation'
2 BER forecast emotions factors for UK grid electricity generation over 42 years (for the period 2028 to 2001)	MITS (2020). Treasury times Nook - Data Tables 1-DR supporting the toolkit and the guidance (updated 17 April 2021, to fix formatting event) N/A
2 HES for east execution. Nation for UK god electrolog generation over 42 years (for the penod 2228 to 2008) 8 Histority expand only for the thirt Core facility, no taxin expan 1 UK colpone to the for indexes, loging Clashifi is east	DEPAA (2004) DEPAA Review of Landfill Methane Emissions Madeling
B CC1 - Nood derived CD2 capture AKE = XDX K CC1 - Wednichy for Capture - XDXAN, ECD2	yor. PCC (2001). 2001/PCC Guidelines (Ar National Generationer Stat Swentsteins, Valuere 2, Berlig, Chapter 5, Carlon Guinede Thomport, Sujection and Beological Stacage, Socia Datasen and Wald (2007). Spinisation of the Temp Consumption of a Carlon Capture and Engineer State Carlon Consult Comparison Processors Datasen and Wald (2007). Spinisation of the Temp Consumption of a Carlon Capture and Engineer State Carlon Capture and Sector State Carlon Capture and Sector State Carlon Carlon State Carlon Sector State Carlon Carlon State S
	taking and Bradel (2018). Optimization of the Energy Consumption of a Carbon Capture and Sequedication Related Carbon Disorde Compression Processes
CCL - electricity for clarage - 120006,8CCE      CCL - functive CC2 emissions during aperties transport. Nath =0.000 (ar/km/v)	Average assumed to be came as electrolity for compression IPCC (2008). 2004 PCC Studies for National Generational Sector (Volume 2, Iterus). Chatter 5 Carbon Double Transact, member and Bestappid Notate. Table
ECE - Kanonisson sperime length - 100 km	MVV extensite for connection to CD2 damage at Botton chatter
A CCS - leakage rate for CCD during duringe (less than 0.2%)	DRIME (2028). Deep gestagical clarage of carbon disorde (CO2), all share tait, containment certainty MVV estimate for convention to many spectrum at Kings Lenn
<ol> <li>CCI - cannecting pipeline length - SIMn.</li> <li>CCI - cannecting pipeline carbon factor for manufacture, transport, exclusion and construction + 1,8000000/km.</li> </ol>	and a summary and another property of a single spectrum.
Ying Y) Recidual Warle Comparizion Waste Kinam Manathia Kinam	benati 3
Regulativ Paper Card	5.9%
Device Flatts Plastic film	285
MGC Cambudible MGC Non-Cambudible	1.05 1.05
Class:	2.8%
Persons Metals Non-Persons Metals	2.0% 1.1%
Food Wade	27.2%
Gardes Walte Other Ossans	2.7%
Wood	2.5%
WEEL	
FineL	6.9N 2.2N
Net Calorific Yalue (M)/kg)	10
Sotal wakte input (sonne-cyv) Sotal Carlson (% by weight)	433,400 23.60%
Ridgenic Carbon (N of Sotal Carbon)	74584
Non-Bagenic Caldon (% of Total Caldon)	7.0%
Ying Su) Carbon emissions from recidual works combuction in EfW CVP Facility	
Falsetar	Research 21
Sotal wade signal (Sonne Vyr) Sotal Carlon (% by weig(M)	623,600 25.6%
Non-Blagenic Carbon (N of Total Carbon) Max: of facol carbon in recolul water (tannes carbon)	25.62% 42,538
man at reconstraint in research wildle (Sathers Calibre) Possi devined CC2 environmes (SCC2)	105,675
Passi dente-dCO2 emissioni (ICO3) ND2 emissions fram Hollaut autor combuction (ponte-t)	22
Nguvident CC2 emissions (ICC24) CH8 emissions/train involutif waste combuction (Ionneri)	5,807
Backdeel CO2 emission (ICO24) Auxillary Burleti - Fuel Gal OI (ICO4)	440
	176,05
EfW Gressendodaes (CCD+/y)	14,100
the Facility electricity generation (Mille)	
	TARZ THE'S
the Christy generated by the Pacific (MMN) CC2 emission Chater for energy generation (g/VMN)	414431 2028 2027 2028 2029 2020 2011 2020 2011 No. 0410 101 101 101 101 101 101 101 101 10
Colo Immaanso caasi am mingi yeminaani (jji televi Effer Taposale Colo official fan Activitik yeminaani by Focility (ECOlo/ye) Taley 26 Carbon eminates franc CCI fan ERV OPF Facility fans 328	See articlistantiat 21,779 24,008 20,316 24,688 20,755 23,688 5,891 7,878 7,6
Step 26) Carlon emissions from CC3 for tifly CHP Faulty from 3540 Fiscaneter	
	85%
Effer environme captured (ECDar/pr) Environfor carbon-capture view electricity (ERM-RC22)	224.122
Events for CD2 conservation and its reach, while electricity (MBN/SCD2)	120 THEFT THEFT THEFT THEFT THEFT THEFT THEFT THEFT THEFT
Energy for CD3 clarage repetion, using electricity (KM/s)0000 CD2 emissions fador for CD3 energy inputs, using electricity (gCD2+,KM/s)	130 2028 2027 2028 2029 2020 2011 2020 2021 2020 2021
CD2 existance fabric fait CD exergin sputch, under existing (gCD26,VMI) Cardian capture, compression, drampant and drampe CD2 existing (GCD28/yH) Fugther CD2 emission drampaptine transport (SgRin/yH)	See adu/71A07
	0314
Pipeline length (lan) Pupiline CC2 emissions during transport (ICC28/yr)	132
Papeline length (Uni) - Magnite CCD and sector (Lung Transport (ICCDBV/p) - Lengthy CCD Transport (ICCDBV/p) - Lengthy CCD Transport (ICCDBV/p) - Lengthy CCD Transport (ICCDBV/p)	0.0%
R/W eet CCL enissions captured and stand (SCD3H/yr)	10
Canstruction Parameters (connecting pipeline)	
Length of CCS connecting papeline (km) Carbon factor for CCS connecting appeline candination (ICC2)e/km)	13
Carbon factor for CCS connecting pipeline construction (ICD3e/km) Carbon for CCS connecting pipeline construction - manufacture, transport and installation (ICD2e)	31,000
ENV Net envisions (ICO2P/yr)	n/h
You 2 Calum existing from Level line residual works and IPS conduction	
Fainteer	Security 2
Macc of biogenic carbon in readual wate (tones carbon) Total carbon converted tochti(tannes carbon)	100,012
Methane in DRI interand from reduct wate (CHI) Methane in DRI captured for use in got engines (IDHI)	40,587 30,727
	1,000
Uncaptured UPG released to abmoghery as methane (CHE) UPG Revisition CO2 discs enhouses minused to atmosphere (CO2#/yr)	1,716
Methane is DD captured for use is gat engines (IDM)	80,727
Methane-sciedin gist engines (1204) Fuel inputta IPG engines (121	27,000 502,700 THEFE THEFE THEFE THEFE THEFE THEFE THEFE THEFE THEFE
Pawergeneticed by IPG engines(MDB)	184,644 2028 2027 2028 2029 2020 2010 2020 2020 2020 2020 2020
UK god CCD emissions faster far electricity generation (g/kvh) IPG Tapolatient CCD offset far electricity generation from conduction (SCCDe/yr)	New Cold 1220 ANDIX         NO         AD         AD         AD         Date         AD         Date         Date         AD         Date         Date         AD         Date         Date         Date         AD         Date         Date         Date         AD         Date         Date         AD         Date         Date         Date         AD         Date         Date <thdate< th="">         Date         <thdate< th="">         Date         <thdate< td="" tht<=""></thdate<></thdate<></thdate<>
UTG Not emissions ()CCD2e/yr)	N/A
Nog & Carbon natistians, fram sporational processor and di yean. Parameter	
	Lonato 21
If W bauvalent CD2 offset for electricity envectors by Pacifity (ICCD2)	717
MW Reprodent CCD captured by CCS from 2080. 29 years (MCCDV) MW Net operational emasures (MCCDP)	1,2m 1,0m
LPG Gross operational emospans (HCCDP) LPG Bourvalent CCD offset for electricity generation by Pacility (KCCDP)	14,575
Urs squradeet CC2 off set for electricity generation by Facility (sECC3e) Urs Net operational emocoors (SECC3e)	87 34,009
Was William chine estation	
	Science in 20) 2003 adoption of CCL by the IVW COP
Paijed Likoydes	Facility - including gold decarbonication and 10% from fixed and platfice
	UP3 BEW OF PAULTY

Nea 11 Lifetine cabon entroises				
Proint Liferoides	facility - including grid dec	Scenario 25) 2043 adoption of CCL by the STAC COP facility - including grid decarborization and 90% less food and plactics		
	UNS BICCODEL	ETW CHP Facility (MCC24)		
Canabadies				
A1 - A2 - X8 - Kew materials copply, toesport and manufacture		35.33		
A5 - Candiuction prior to claps		4.90		
A4-Candburthee Transport		2.90		
A1 - A2 - A4 CC1 convecting apprine (manufacture, banque Land construction)		21.00		
Operation				
82 - 85 - Maintenance, regain, reglacement and refurbidiment		4.95		
III - Operational energy	25.04	6,357.42		
87 - Operational water		0.26		
III - Other operational processes Landfill	14, 375-42			
EB - Other operational processes: Operational transport	201.85	275.68		
EE - Other operational processes IBA and APCr		142.40		
Decompliationing				
C1 - C2 - C1 - C6 - End of 1/fe, including deconstruction, transport, wastle processing for recovery and dispocal		0.18		
C2 - C2 - C2 - CC3 canneting pueloe and of the		21.00		
Geeral				
D - Available environment	46.75	-0,490.33		
10184	36.627.39	1425.27		

I'W Paraneters	
N2D Emissionis Padler & kgN2D/T1 (IPCC)	
N20 Sixbal Warning Patential (kgC02e / kgN20)	
CHE Envisiones Padler disgOnE/11 (IPCC)	
CH0 Slubul Warning Patential (kgCO2e / kgCH0)	
Total tax OII (diesel) cansumption (litres)	
Auxiliary burners - N of annual das Oil consumption	
Puel (Sas Oil) emissions factor (kgCO2e/WWk)	
Fuel (das Dil) emissions factor (kgCD2x/libre)	
URG Parameters	
Bugenic carbon in readual watte converted to landfill gas (195)	
Bigenic Cellion in resoluti wate converted to landfill gat (195) Propition of methane in 195	
Biogenic carbon in readual wade converted to landfill gas (DS) Propition of methane in DS Propation of DEDrecovered from readual wate	
Response cardian in realisati watte converted to tandhil gas (195) Proportion of methanes in DS Proportion of US recovered from readual watte Destation of DS released from readual watte to CCD in tandhil cap	
Biogenic carbon in readual wade converted to landfill gas (DS) Propition of methane in DS Propation of DEDrecovered from readual wate	

 
 No.21
 <th New 28 New 17 2012 2017 7940 22 2017 12 194/13 7 2058 764/24 2019 194/23 2047

 
 New 20
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 New 28< 194/27 194/28 2012 2013 Theor 29 10 w 80 Theor 82 10 w 82 2016 2000 2016 2016 3 2 3 3 3 3 2019 2019 2019 11 Tear 28 Tear 27 Tear 28 2062 2062 2062 2068 2 2 2 2 20

Sormario 26 2040 adoption of CCS by the EFW CHP facility – including and decarbonication and CCC: current residual waste	
Link back to index table	
Handline accumulates for frameworks with speed with concern constraints with investers to the HS Stand Tax transmission based as in considerability of ends and accumulation of the stand of the stand Tax that the facility operating parameters is algorized for the (watch + 450,000 (V), have + 7,700 per y)	Reference Sea wordshare", Mich commerciae wordshar
18 If W CHP facility operating parameters adjusted for NCP (waste + 825,800 (/yr) hours + 7,708 per yr)	
2 Bits forecast envisors factors for DK god electrolity generation over 82 years (for the period 2020 to 2000) 3 Electrolity export only for the thy COP facility, no strain export	MTIS (2021). Treasury Green Rock - Data Tables 1-28. supporting the toolist and the guidance (updated 17.4 pril 2021, to fix formatting enters)
3 Electricity explicit anty for the EPWCHP facility, no clean export 6 LPG capture rate for modern, large CE familiti + 68%	N/A DEPAA (2010), DEPAA Neview of Londhill Mechane Emissions Modeling
NA CCA - Nool derived CCB capture rate + XVII. No CCA - Hiedzichy for capture + XXII.N.	IPCC (2008). 2008/PCC Guiderines for National Generationes and Americanies. Volume 2: Stering, Chapter 5: Carbon Change 7: Newsport, Newson National Processing Stering (Newson National States). Section 5:3 Jackies and Brodid (2018). Optimization of the Stering Concumption of a Carbon Capture and Sequestization Protect Carbon Duncke Compression Processing.
CCS - electricity for capture = RDXW5,ECC2     M CCS - electricity for compression (including pipeline transport) = 120CR5/ECC2	Takkon and Brudd (XDB). Optimization of the Energy Concumption of a Cadion Capture and Sequentization Related Cadion Disaide Compression Protocose Takkon and Brudd (XDB). Optimization of the Energy Concumption of a Cadion Capture and Sequentization Related Cadion Disaide Compression Protocose
M CEL - fugitive CE2 emissions during pipeline transport. High +0.004 (ig/km/yr)	IPCC (2008). 2004 PCC Guidelines for National Generativesce Bas Inventories. Volume 2: Binergy, Chapter 5: Carbon Chande Transport, Injection and Geological Storage, Table 5:3 MVV estimate for connection to CO2 change at Baction chapter.
CL - Vallage rate fair CD2 during darage (excition 0.26)     CL - Vallage rate fair CD2 during darage (excition 0.26)	MVV estimate for connection to CC3 stange at Bacton cluster DBSNZ (2023), Deep geological stange of carbon shoulde (CC32), offshow six: containment cetainty
ECL - connecting pipeline calor factor for manufacture, transport, excavation and construction = 1,8201020e/km	Internal estimate based on other project examples
Nop 2) Besidual Warde Composition White Elevan	1
	1.5%
Card New woodable Faser	6.75 275
Nor-vecydalae Paper Dense Plathi	8.0% 7.0%
Padiction	8.2%
Textiles Mic. Combuiltine	135
Mic. Conduction Mic. Non-Conduction	5.75 1.05
OtherWalks	0.3%
Cileos	248
Period Metals	2.05
Food Wards	27.0%
Gardes White Other Organic	2.7% 2.8%
Other Organic Wood	2.00
NAME OF CONTRACT OF CONTRACT.	125
Hardbox	0.3%
Pines Net Calorific Statue (MDNa)	128
Net Caloritis Kalue (Mijkg) Total water input (Sonie (Vr)	0.0
500 Group (N by weight)	30,000 32,270
Biagenic Carbon (N of Solal Carbon)	55.92%
Non-Bagenic Carbon (% of Social Carbon)	46.0%
Neg 24) Carbon existions from recidual words combustion is SNX CVP Facility Patienter	
	ternatio 20
Total wate signal (somerylyn) Total Carbon (% by weight)	671,600 M 874
Non-Bagenix Carbon 15 of Total Carbon)	44.0m
Maxx of facolication in recidual wate (tannes cation)	6(33)
Nassi der herd CO2 entwolers (ICO2) NYD antennoor form micht is a bie rendwrten Renneri	21,445
Equivalent CD2 emissions (ICD2e)	4,000
CHE encoders/fram recidual waste cambuction (bonec)	270
Rejuvalent CO2 emissions (ICCO4) Availlary Burnets - Puel das CII (IICnet)	4,737
Auxiliary Burners - envisions for use of fuel (2002e)	4,749,849
EfW Grocceenicolaes (ICCI3e/y)	281,030
the facing electricity previous (MBR)	
BW Facility constitions (http://w)	7733 Nev1 Nev1 Nev1 Nev1 Nev1 Nev1 Nev1 Nev1
Electricity generated by ERV facility (MBH) CCD electronic factor for energy prioritation (gNVH)	434,725 2024 2027 2024 2024 2024 2024 2024 2024
CC2 emission failer for energy generation (g/VM) BMR Baussiert CC2 offort for electricity amenators by Pacifity (CC2Ie/w)	New add SEX Added 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
The 20 Carbon emissions from CC3 for 15W OIP Faulty from 328	10,17 20,11 200 201 200 201 201 201 201 201 201 2
Facameter	
Propartice of EPMount deviced CC3 encoders captured EVEr encoders captured (ICC3R/vr)	20.2
Investor cables capture, using electricity (RMI-RCCD)	
	00 100 Nex'2 Nex'2 Nex'2 Nex'3 Nex'3 Nex'3 Nex'7 Nex'8 Nex'7 Nex'8 Nex'3 Nex'2 Nex'3 Nex'20 Nex'20 Nex'20 Nex'20
Energy for CD2 charage rejection, using electricity (KMI,1002)	130 2028 2027 2028 2029 2028 2020 2021 2028 2021 2028
CC2 emissions fastor for CC3 energy inputs, using electricity (gCC2e/NVN) Carbon capture, compression, transport and storage CC32emissions (ICC32e/yr)	Se alu77AK7
Pagetive (22 environme during approve transport (Sig/kn/yr) Faircline brack land	0.014
Pipelane length (lun) Puatter CS2 emissions during transport //CS32e/wi	133
Laskage rote for CD2 during Clarage	
Leakage of CO2 during starage (ICO3n/yr)	
after een CCE eenssens coaptured and itsined (HCO2e/yr)	
Caratanities Revenues (Januarites physica) Length of CES connecting physical (Ike) Carbon Robar for CES connecting physican cancilaction (ICD29/Nn)	
Carbon factor for CCS somecting pipeline candivation (ECC3eylim)	1,022
Carbon for CCL connecting pypeline construction - manufacture, Vansport and initialization (X2224)	
EfW Net enricions (ICO2e/yr)	8/6
Step 2) Carbon entrolines from Landfilling residual worke and UPG combustion Research	
Max of bugenic ontoin in residual walde (tornes carbon)	10 00 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Total carbon converted to CPE((tanners carbon)	41,000
Methane in 195 mileased frammendual wate (1014) Methane in 195 captured far site in gat engines (1014)	88,273K 22,080
	100
Unceptured URI released to atmosphere as methane (IDHI)	9,531
UPD Equivalent CO2 Gross embolants released to atmosphere ()CO2x/y)	260,382
Methane in 17th carbured for use in asc ensines. (12mb)	22.00
Methane used in gat engines (3014)	20,000
	BECKELLER BECKEL BECKELLER BECKELLER BECKELLER BECKELLER BECKELLER BECKELLER
Pawer (pre-cale) by D10 engines (3000) UK and C02 emissions (adder for electrolicity energinae (al/001)	344 (45) 120 AN201 80 67 34 69 60 88 80 20 29 18 20
UE grid CCD existanciacian factor for electricity generation (g/WH) UPD Equivalent CCD offset for electricity generation from conduction (ICCDe/je)	Tee Cell 1200-04128 9,100 4,805 1,926 1,026 4,508 1,882 1,016 2,402 1,911 1,839 1,889
	80
URD Not anticident/(CD2e/pr)	- NJA
Step () Calum entrolance from operational processes over 42 years	
Fuametar	Longin 2
If W Good operational encourse (RCD2W) If W Reproduced CC2 offset for electricity generation by Facility (RCC2#)	22,652
If W Equivalent CC2 captured by CC5 from 2083. 26 years (ACC24)	1,000
EfW Net operational emosions (IRCCOP)	6129
URG Gooss appendional environme. (KCCO2e)	22.667
	2240
UPD Net operational emocoust (NECO2e)	23400

Step 1) Lifetime calson entroises		
Proint Liferoid es	Scenario 26) 2002 adoption facility – including grid de cancert redd	COD best reducine deal
	LNS BYTCHU	ETW OHP Facility (MCO2V)
Construction	(kicciae)	(MCO3v)
A1 - A2 - A3 - Rev materials cupply, Standard and manufacture		ID 11
AT - Candiuction provid claim		4.90
A4-Candhucher Transert		7.91
A1-A2-A4-A4 CCI connecting agenter improvfacture, benage Conditional conditional		23.00
Densition		
82 - 85 - Maintenance, repair, replacement and refurbidment		4.95
BS - Operational energy	25.04	22,482.83
E7 - Operational water		0.24
EE - Other operational processes Landfill	20,668.30	
E8 - Other operational processes: Operational transport	205.83	275.68
RE - Other operational processes: IBA and APG		142.40
Decompositioning		
C1 - C2 - C1 - C6 - End of life, including deconstruction, transport, wastle processing for recovery and disposal		48.38
C2 - C2 - C2 - CC1 connecting pipeline and of the		21.00
General		
D - Avoided emissions	-43.45	-5,785.35

CH Parameteria Tele Parameteria Characteria de la consecuencia de la an Brance A Brance Common Brance Branc Brance Branc Bra

	Scenario 27 2040 adoption of CCS by the DFW CHP facility – including grid decarbonization and CCC: 50% reduced plantics		
	Link lack to index table		
	Headline accomptions for transmission drugs indicates variation with recent to the BL Case)	Reference	
	NextBins securementions for transmitterion of yours indicates' variations with invested 1.0.2.9.9.9.5.5.0.00. Variant composition based and cambridge dure current resolution waters weblighted to reduced the line to the based one WW CWP facility operating patienterine audiented for WCP (waters + 420,000 V(r), hours + 7,442 per vp. MMH + 33.36)	See worktheet. Mark comes	
3	HITS forecast environes factors for UK goal electricity generation over 42 years (for the period 2228 to 2001) Histority export only for the tRW:Der facility, no clean export	MITS (2021). Treasury Green Box N(A	ok - Data Tables 5-DR supporting the toolist and the guidance (updated 17 April 2023, to fix formatting errors)
		DEPAA (2014). DEPAA Review of	f Landfill Methane Imissions Midelling
- 5	CCS poch-sambaction systems from 2000 onwards (26 years)	n(A	
	CCS - food derived CCD capture cate = KEK CCS - electricity for capture = KEKKN/CCD	IPCE (2006). 2006 PCC Guideline Jackson and Bradal (2005). Opti	es for National Generatores as investores. Values 2: linergy, Chapter II: Carbon Disulte Transport, superior and deviago al Sarago, tectors 3:3 mazzon d' Par servy: Consumption of Acabon Capture and Sequences in Robert Cabon Davide Campanian Processo mazzon d' Par Servy: Consumption of Acabon Capture and Sequences in Robert Cabon Davide Compression Processo
2	CCL - ele-diricity for compression (including papetine transport) = 130008/(1C02 CCL - ele-diricity for causage = 130006/(1C02	Jackson and Bradal (2018). Opti Average assumed to be same a	inization of the Energy Consumption of a Carbon Capture and Sequedration Related Carbon Disade Compression Processes
-	CCS - framework and consequent and anti-section of the section of		
			a CC2 d'ange al Balton ducter dialor d'arbon disorde (CC2), alfilhane UK containment cettanty
	CC3 - cannecting pipeline length = 15km CC3 - cannecting pipeline caliborifactor for manufacture, transport, exclusion and construction = 1,8250029/km	MVV estimate for connection to internal estimate based on oth	a man pipeline at Kings Lynn
	CC3 - cancecting pipeline calconitation for manufacture, transport, exclusion and construction = 1,820 002 bytem	Internal econote based on oth	er propect examples
	Ning 2) Beckhail Walle Composition		
	Natif Urban Regilative Paper	Servario 27	
	Card Nor-recyclable Paper	6.2% 8.2%	
	Platition Testins	8.2%	
	internet Mic. Candoutlale Mic. Non-Candoutlale	5.25	
	Mic. Non-Cambuzzäile Mice. Non-Cambuzzäile	145	
	Circl .	2.6%	
	Persua Metali Nar-Persua Metali	2.4%	
		27.0%	
	Garden Wakte Other Osaans	2.7%	
	Wead	2.8%	
	unts Manibas	1.1%	
	Prints Net Calorific table Million	2.2%	
	Total waste-signt (Some Qyr)	821,600	
	Social Cardion (% By weight)	24.07%	
	Regence Carbon (N or Hole Carbon) Non-Biogence Carbon (N of Total Carbon)	11.02%	
	The 2d Carbon emissions from residual works combustion in 1997 OP Facility		
	Faculty	lanaria 27	
	Total water input (some (yr) Total Carbon (% by weight)	825,800 24.07%	
		35.02%	
	Macc of facol carbon in rescalari water (barries carbon) Possil derived CC22+mosane (FCC2)	49,742 192,999	
	N2D enrotoon fram wickus wade cambuction (conec) Rejuvalent CC2 enrotaus (cCC2e)	25	
	CHE enocoorc/ran recidual wade canbuction (some)	560	
	Equivalent CC2 emissions (ICC2e) Auxillary Burners - Fuel: Bas CH (RD14c)	4,008	
	Auxiliary Burners - energons for use of fuel (1003e)	4.523	
	The Great endoders (CCOP/y)	597,309	
	If W Facility electricity generation (MBW) If W Facility operations (Inv(yr)	12	THEFE
		198,241	2026 2027 2028 2029 2020 2011 2012 2013 2014 2011 2016
	CCC existinan Calaber for energy generation (g/VMA) R/P Repeater CCC afford (nervex ray generation by Facility (ICCSF/yr) May 34 (active enervicence from CCC In MC OF Pacility (ICCSF/yr) May 34 (active enervicence from CCC In MC OF Pacility (ISCSF/yr)	See artististatis	10 67 14 69 68 18 80 24 29 18 28 10,842 28,642 21,058 20,014 17,411 10,118 11,947 9,568 7,569 7,568
	10xg 78 Carlies endedoor from CCL for 17W CHP Facility from 2040 Facilities		
		85%	
	g/ter encourse captered (RCDay)(v) Exemply for CDD comprovisia and Services (VMR)(CCD) Exemply for CDD comprovisia and Services (VMR)(CCD)	211.002	
	Energy for CD2 compression and transport, using electricity (MM//CD2) Energy for CD2 charges median, using electricite (MM//CD2)	130	Tear 2 Tear 3 Tear 3 Tear 6 Tear 6 Tear 6 Tear 7 Tear 8 Tear 9 Tear 32 Tear 12 2020 2027 2028 2029 2020 2020 2020 2020 2020 2020
	CC2 emissions failur for CC3 energy inputs, young electroidy (aCC2e-AVM)	See articIDEARS	
	Carbon capture, compression, transport and charage CO2 emissions (ICO28/yr) Pugitive CO2 emissions during popeline transport (Sigfun/yr)	3ee 201/7748/7	
	Pipeline length (km) Auditer CC2 missions during Stangert / ICC2 //vil	130	
	Leakage rate for CO2 during charage	0.1%	
	Leskage of CC2 during starsge (VCD2H/yr) #/wr.wt.CC2 executors captured and toured (VCD2H/yr)	210	
	Construction Parameters (connecting pipeline)		
	Length of CCS scienceCing pipeline (km) Carbon factor for CCS scienceCing pipeline canciluction ()CCDP/km)	15	
	Carbon for CCI connecting pipeline construction - manufacture, transport and installation (XXD24)	31,000	
	The Net emission (CCDP, (p)	n/z	
	Nex & Falses existing from teal like certified with and 100 statistics		
	ang di Lander Pressant dan Lander ang Pransa kabar ang dis kamadanan. Pasandar	tornario 77	
	Max of bagenic orden in residual wate (brines orden) Tabli orden converted tocht/(taniescation)	100,825	
	Michane In DR measured from recolutal water (ICHE) Michane In DR captured for use in gas engines (ICHE)	36,813 26,918	
	Unceptured DNs and/red to CC2 in landfull app(IDH4)	1,226	
	Uncaptured URI released to admosphere ac methane (ICHE) URI Reprodent CO2 Gross embosies released to atmosphere (ICO2P/p)	11,034	
	Methane in 170 captured for use in gas engines (ICM) Methane used in gas engines (ICM)	24,253 23,482	
		434,292	Tear 2 Tear 3 Tear 3 Tear 6 Tear 6 Tear 6 Tear 7 Tear 8 Tear 9 Tear 32 Tear 12 2020 2027 2028 2029 2020 2020 2020 2020 2020 2020
	Pawerigene cond by D'G engine C(MIRM) UK gold CO2 encoders, Canto for electrolity gene cation (g)/UM) D'B Spularez Co1 diversity electrolity generation from conduction (CCDe/Jv)	See cells E305 AF305	10 07 14 07 05 18 10 20 27 14 18
	URD Equivalent CO2 offset for electricity generation from conduction (ICO2e/yr)	See cells \$200 ARIDS	20,457 2,858 6,868 5,852 5,529 4,550 8,552 2,852 2,250 2,315 2,552
	UPD Not anticident/(KD2a/yr)	N/6	
	Stop & Calum understand Sum operational processes over 42 years		
	Fasaelar	tornario 27	
	If W Equivalent CCD offset for electricity generation by Facility (KCCDP)	247	
	tifW Najwaleet CC2 captured by CCI. Num 3082. 39 years (ACC39r) tifW Net operational emissions (ACC39r)	3,877 3,668	
	UPG Good operational encoders (InCCDe) UPG Reprodent CCD offset for electricity generation by Pacifity (InCCDe)	12,858	
	UPD Net operational emocous (MCD3e)	11,280	

Nep 1) Effeting cabon entroper.		
Proint Liferoid es	Scenario 27) 2002 adoption facility – inducing grid de S2X reduces	Contraction and CCC
	UNS BIOCODH	ETW ORP FACILITY (MCCOP)
Construction		
A1 – A2 – A3 – Raw materials copply, transport and manufacture		8.33
A5 - Candituction prioritis stage		4.90
Ad - Candiuction Transport		7.93
A1 - A2 - A3 - A4 CCI connecting papeline (manufacture, banque tand construction)		21.00
Operation		
E2 - E5 - Maintenance, repair, replacement and refurbichment		4.90
Bi - Operational energy	25.04	7,892.35
E2 - Operational water		0.24
BE - Other operational processes: Landfill	12,858.89	
EE - Other operational processes: Operational Stansport	225.85	275.68
E8 - Other operational processes: IBA and APCr		142.60
Deconvertationing		
CS - C2 - C3 - C4 - End of life, including deconstruction, transport, wattle processing for recovery and dispocal		05.58
C2 - C2 - C3 - CC3 - CC3 - CC3 - CC4		21.00
General		
D - Avoided emissions	-71.51	-4,226.27

In the second se

	Senario 28 Senario adoption of CCS by the EfW CHP facility – including and decarbonization and CCC: 59% reduced organics		
	2040 adoption of CCS by the DFW CHP facility – including and decarbonisation and CCC: 50% reduced organics and lack to index table		
	Notifies according for Executed and Ever indicates variations with indices 5 as the ES Cash. Bath composition based an Casher Casher and the output with signal and add MC least than baseline More the oblig operating parameter signal for INT space of a SUDDER (V).	Referenze	
13	Racte composition based an Candinage dore current resolutil watte with organics reduced SDIL test than base time (MICHP Society specifies partmeters adjusted for NCV (worde + 101.001 Uv))	See worksheet. Make com	and the second and
2.	BER forecast emotions, factors for UK god electricity generation over 43 years (for the period 2228 to 2005) fectivity expant only for the tRWCHP facility, on clean expant	METS (2021). Trikasury Green IS(A	Notk - Data Tables D 18. supporting the toolist and the guidance (updated 17.6pril 2021, to fix formatting errors)
		DEFEA (2016), DEFEA Review	e of Landhil Methane Britsbare Modelling
34	ICS post-conduction systems from 2000 onwards (26 years)	n(A	
38	III - Sooil derived CO2 capture size - IIIII. III - electricity for capture - IIII/III.	IPCC (2006). 2006 IPCC Guide Tackness and Readed (2018). 7	lines for National Generihouse das Inventories, Volume 2. Energy, Chapter 5. Carbon Disorde Youngont, Injection and deplogical Storage, Section 5.3 gonization of the Energy Consumption of a Carbon Capture and Sequentization Related Carbon Disorde Compression Processes
- 54 1	CS - Hedricity for clarage = 130KW5,8CC2	Average assumed to be care	e ac electricity for complexizion free: for National Overshouse Bas Inventores, Volume 2, Brenze, Chaster 5, Carbon Doucle Transact, Invention and Deviational Bassaer, Table 5,2
- 14	CD - Explore CC2 emission during pipeline transport. High +3.054 (Q/km/yr) CD - transmission pipeline length + 305km	MVV estimate for connection	e ta CD2 stanbar al Bacton cluster
	221 - Gamesting pipeline length = 15km 221 - Gamesting pipeline Carbon factor for manufacture, transport, excavation and construction = 1,02010020e/km	MVV ectimate for connection internal ectimate based on r	n ta main pipetine at Kings Leon ather project examples
	Ing 2) Beckluit Water Composition Riche Meson	Transfer W	
- 1	tecyclalia Paper Jard	5.85	
	and kan-recyclable Paper	6.2% 8.9%	
	Dense Placis	7.8%	
	No. 7 Sec.	8.2%	
	MGC. Canduutible MGC. Non-Canduutible	5.2% 3.4%	
	Mor. Non-Canductilia 20er/Walles	14%	
	Serie Contract of	2.6%	
	teroux Metals Sor-Persoux Metals	2.0% 1.2%	
	And their	27.0%	
	Sarden Walte 20er Ossans	1.7%	
	nood	2.8%	
	ATTE	1.1%	
	Gandous Unes	2.2%	
	set caude table (M/M)	11.45	
	Stal wide sput (Some v(y)) Stal Carbon (K by weight)	28.905	
- 2	Eugenic Carbon (N of Soci Carbon)	50.29%	
	san Bagerix Caldan (% al Sidal Caldan)	45765	
	They Zu) Carbon excitations from necidiaal words combaction in THM CHP Pacifity		
	facemeter/ Notal watch Insut Danner/Vrl	Servario 28 SOL BOO	
	total CarGon (% kyweight)	28.90N	
	ban Beagwin Carlan (N of Total Carlan) Hac of Facult artises in recidual watte (tannes carbon)	05.70% 25.871	
		276,898	
	122 enrosons fram wisikali walte sandwistan (ponec) Iguivalent CC2 enrosans (ICC24)	28 6,118	
- 1	persente coo ministerio (cooli) 24 enerodorio fran recidual walde canduction (tonnec)	178	
- 4	hauvalent CD2 ennistans (ICD2e) Santtary Burnets - Net - Sas Of (ID2e)	484	
	wellary Burners - entrosons for use of fuel (SCO3e)	4.023	
- 2	IN Grosseniocians (ICO3e/yr)	290,665	
	dw racity electrolygeneration (brite)	55	
	MM Facility operations (Inv/yr) Institute operational by MM Facility (MMH)	#,000 600,000	Tear 2 Te
	Technolygenerated by ETW Facility (Millin) 202 enissions factor for energy generation (g/VMI)	See and LEET ARE?	2016 2017 2018 2019 2010 2011 2010 2011 2014 2011 2016 10 67 13 69 60 38 50 24 29 13 13
4	CCC emissions Labor for energy prevation (g/VMA) for Taponder CCC afford for electrical prevalence (prevalence (pr	See or LEARNING	H(400 26,481 25,520 21,560 16,800 14,720 15,200 13,560 7,820 7,820 7,920
- 6	"almeter		
- 1	Nopartian of ITM fault derived CD2 emissions appared (Mr emissions suptained (IC32e/yr)	85%	
1	yw hanasan sapana (casalyn) negy fa'r cabar ganw, nog ei einalang (awin/bccz) negy fa'r CC3 cangeriosaa and taingar, sang elesting (keth/bccz)	800	
1	terrigy for CD3 compression and Itaniquet, using electricity (kttl//ICC3) territy for CD3 clarate interction, using electricite (kttl//ICC2)	130	19672 19673 19673 19674 19674 19675 19677 19678 19673 196720 196723 2029 2027 2028 2029 2020 2021 2021 2021 2021 2021
	DZ emissions fador far CC3 energy Insult, wone electricity (aCD2+/WH)	133 her prils 176 AST	2026 2027 2028 2029 2010 2011 2010 2011 2011 2011 2011
- 4	Carbon capture, compression, transport and storage CC2 emissions (ICC28/yr) Ng/the CC2 emissions during pipeline transport (Sg/kn/yr)	See 945177AK17	
		130	
- 4	Suptrae CO2 emissions during transport (ICO2H/yr)	1.540	
	xalage rate for CD2 during clarage xalage of CD2 during clarage (ICD2#/yr)	0.1%	
- 3	(West CCL encodercoptuned and stared (ICD3e/yr)	4/4	
	Canadiana Manamatera (inconnecting pipeline) Anglin of CCS scienceCing pipeline (Inc)	13	
	arbon factor for CCS some cline sandhacton (ICC2+/km)	1,400	
- 1	Tables for CCL connecting pypeline construction - manufacture, Kangsot and Initialization (2022e)	31,000	
- 3	the Ret entrations (ECC2e/yr)	N/L	
	Dea & Carbon entropies from Landfilling residual works and IPS conduction		
	nazy of biologenic carbon in readual waste (connec carbon) Max of biologenic carbon in readual waste (connec carbon)	tornario 21	
		71,740	
	McDare in LPG released from resolution works (3CHD) McDare in LPG captured for size in got engines (3CHD)	28,793 28,373	
	Methane in DS captured for use in gat engines (IDH) Ancastured US contined to CO2 in landfill capitDHD	26371	
	Acceptured LPD minored to atmosphere as methane (ICHE)	8,289	
- 4	PO Tquivalent CO2 Gross emissions released to atmosphere (CO28/p)	212,011	
	Methane in DR captured for use in gat engines (IDM)	28,375	
	McNane used in gas engines (ICHE) had input ta UPG engines (ISH)	17,790 830,236	THEFT
	Saver generated by UFG enginec()MBh)	86,952	2020 2027 2020 2020 2020 2010 2010 2011 2010 2011 2010
4	2K grid CC2 emissions factor for electricity generation (g/VXN) PG Tapinalised CC2 offset for electricity generation from conduction (ICC22e/yr)	See cells 1305 AR305	80 47 18 49 48 18 30 24 29 18 18 8.008 1.962 5.193 4.199 4.008 8.180 2.669 2.115 1.490 1.601 1.401
3	20 Net emissiona()CO2e/yr)	N/6	
	ling & Calbon enticians from operational processes over 42 years		
	factmeter /fer Geoccaperation.if energians./http://	10407 I	
	fW Equivalent CD2 offset for electricity generation by Facility (#CCD#)	278	
	MV Biglinalent CC2 captured by CC3 from 2082. 39 years (IACC29) MV Net operational emoscons (IACC29)	6,014 1,109	
- 1			
- 3	PE Encic operational emotions. (InCCDe) PE Equivalent CCD officet for electricity generation by Facility (InCCDe)	9,286	
- 1	PG Equivalent CCD office1 for electricity generation by Facility (NECCDe) PG Net operational emicodes (NECCDe)	9,228	

Step 1) Lifetime calum emotions		
Tested Librorites	Scenario 28) 2002 adoption of CCS by the 87M FacIBby – Induding grid decarbonication and 50% reduced organics	
	UNS BIZCO2HI	ETW ORP Facility
Carstudies		
A3 - A2 - A3 - Rev materials copply, transport and manufacture		85.33
A1 - Candituction products stage		4.90
A4-Candinuction Transport		2.93
A2 - A2 - A2 - A4 CC3 connecting apprine (manufacture, transport and construction)		21.00
Operation		
82 - 85 - Mandenance, repair, replacement and refurbidment		6.95
III - Operational energy	25.06	11,626.60
87 - Operational water		0.24
EB - Other operational processes Landfill	9,288.72	
EB - Other operational processes: Operational transport	226.85	271.68
EB - Other operational processes IBA and APGY		142.60
Decommissioning		
C2 - C2 -C3 -C6 - End of 16e, including deconstruction, transport, watte processing for recovery and dispotal		46.38
C2 - C2 -C3 -CC - CC3 connecting pipeline. End of life		21.00
Descal		
D -Avoided encodors	-11.31	4,287.53
10184	9,117.17	5,897.35
Net charge in EMS enounce-recalling from the Proposed Development (KECS24)		

Provide 
 Provide 

	Link back to indee table		
	Headline accumultance for Exemption into Even indicates variation with respect to the EX Case) Water composition based on WHMP 2022 profile for togland	Reference	
a	If W CHP facility operating parameters for NCV of 9.38 Mi/kg (waste 633,3781/yr) hours = 8,000 per yr) MWP = 68.8	See worksheet: Watercampos	ition variation"
5	BBIS forecast emotions factors for UK and electricity generation over 40 years (for the period 2020 to 2001)	BITS (2026). Treasury Grees Box	ak – Clata Takies 2-20: supporting the basikit and the guidance (updated 37 April 2023, to fix fam
5	Part for heating offset to 2019 based on tatest return gas envisoons thetar 2013/22 + 202 AF given Part for heating offset after 2019 based on BBS forecast envisoons factors for UK gird electricity generation	LK Government (2028). Greenh	ouse gis reporting conversion factors 2020, BBS (2022). Teasury Green Back - Data Tables 1-20
1	Restories associate and for the REACHING Soliday on characteristic	N/8.	
1	LPG capture vite for modern, large CRC landfill + 60% CCS polt-conduction ryclemic from 2000-onwords (26 years)		Candill Methane Innozons Modeling
	CEX - Social derived CEI2 capture size = IEEK CEX - electricity for capture = IEEKAN/RCE2	IPCC (2006). 2006 IPCC Guidelin	es far National Greenhouse Gas Inventories. Valume 2: Brengy, Chapter 1: Cadion Dioxide Trans
i	LLA - HIMANIANY NA LABORT - RANAVIOLULA CEL - HIMANIANY NA LABORT - RANAVIOLULA papeline Stansport) = 130088//SC02 CEL - HIMANIANY NA CHANARE = 130098/,SC02	Jackson and Bredail (2029). Opti-	er can believe unterentation of a carbon of a carbon capture and tequerization fielded carbon be impaction of the treegy concumption of a carbon capture and tequerization fielded carbon bio carbon of the treegy concumption of a carbon capture and tequerization fielded carbon bio carbon carbon of the treegy concumption of a carbon capture and tequerization fielded carbon bio carbon carbon carbon carbon carbon carbon carbon capture and tequerization fielded carbon bio
4	CCS - Stationnautor popeline tength = 100 km CCS - leakage rate for COD during storage (less than 0.3%)	MVV estimate for connection to DEINE/2021, Development	er tar bekenn operinde tak terminen, valare z bergg, objer i Calain bisker han o DD dooge it Ballon doode (CO), dî'share SK containment certainty o man pigelne at Ging Synn
	CCL - sunnecting pipeline length + Tillen CCL - sunnecting pipeline carbon factor for manufacture, transport, exclusion and construction + 1,400/00204/km	MVV estimate for connection to othernal estimate based on other	o man pipeline at Kings Lynn
		Interna Harran Later in 191	r protection of the second
	Neg 2, Secielari Marie Campadilian Walda Mawan	Scenario 20	
Ĩ	Recyclular Paper Card	4.05	
	Non-weigedake Paper Denos Plastis	8.9% 7.8%	
	Sense Faces Pacific Testin	825	
	Mu. Canbudble	5.05	
	Mic. Non-Cambuzitie Other Waters	145	
	Ellasi Persus Mittals	2.6%	
	Pennak Metalik Nan-Pennak Metalik Nani Water		
		27.0%	
	Miler Organic Wood	2.8% 2.8%	
	Wead with a second seco	1.2%	
	Fines	2.2%	
ļ	Net Calorific Yalue (M)(kg) Sotal waite input (Sonney)(r)	655	
2	Sidal Carlson (S. by weight)	36.30%	
2	Biogenic Carbon (N of Total Carbon) Non-Biogenic Carbon (N of Total Carbon)	42.85%	
	New Jal Carlson resistants from residual wate combustion in EW CHP Facility		
ł	Factmeter Social walks input (Sonnel/yr)	5044.052 78 613,371	
		26.225	
	uaa cumo (a vynego) Wee augune Candau (t uf staat Cadau) Mae of Brou Candau in secularia waar (panes carbon) Mae of Brou Candau in secularia	66,793	
		292,282	
ł	Nauvalent CC2 ensistens (ICC04) CHE ensistens (ICC04)	6,297	
	Rayvalent CC2 emissions (ICCDe) AucTury Burnets - Net - Gas OI (Dow)	6,911 1,705,621	
	Auxiliary Burness - Fuel-Gall DJ (USIN) Auxiliary Burness - enrocoos.for use of fuel (2003e)	1,10,00 6,80	
ł	BTW Grocccemiosisms (BCD3+/y)	266, 365	
	the Facility electricity generation (MRW) the Facility operations (IVIC/y)	41.8	mard mard mard mard mard mard
	tim P Anny apertation, (Integr) Existiculty generation (B at 100 Finite (MMA)) CCD ensisten Catal: fair energy generation (g/MA) (If P apacheter CCC) affects/or interfaction generation (g P Assilly (ICC24/y))	390,420	3020 2027 2028 2029 2080 20
	CC2 emission taller for energy prevation (g/VM) RfW Rquestert CC2 officet for electricity generation by Facility (ICC2e/yr)	See Offic BET AMIZ	80 87 98 68 80 81,136 21,137 22,641 29,130 17,168 14,0
		28.4 8,000	70ar 2 70ar 2 70ar 3 70ar 4 70ar 3 70ar 4 2020 2027 2028 2029 2030 2
	tim P Annie yw edwy (prostania) (manu) Med e Aganty edwy (bry (bry (pr Med e Aganty edwy (bry (bry (pr)))) Cor emission Charlon (brack (per ensisted (g)/WM)) - gar So 2008, gird elec "Bar 2018	268,800	2029 2027 2028 2029 2030 20 2014 27 2014 27 2014 27 2014 27 2014
	gite payment copy offset for heat prevention by facility (CO24)	See Cells \$75,0875	N204 N204 N204 N204 N204 N204 N2
	Roy Ib) Carbon encoders from CCL for IFW OIP Facility from 2580 Pacameter		
	Propulsion of INV focul demod CD2 emissions captured BM emissions calculated (CD2 eVel	201.00	
2	Neegy for callon-capture, using electricity (NMM/CCO) Reegy for CCO compression and transport, using electricity (NMM/CCO)		Ther? Ther? Ther? Ther? Ther? Ther?
		120	764/2 764/2 764/3 764/4 764/3 764/4 2020 2027 2028 2029 2020 2
	CCD executions failed for CCL energy Inputs, using electricity (jcCDs, k006) Californi aphrone, camprosised, consequent california (CCDs/V/c) Registre CCD energistres family california (jjcChright) Registre CCD energistres family california (jjcChright)	See only \$2 ARE See only \$2 ARE	-
1	Fugitive CD2 elements during operine transport (Sig/km/yr) Pipeline length (km)	0.054	
	Fugitive CC2 emissions during transport (ICC39/yr)	1.502	
	Leakage rate for CD2 during Cturage Leakage of CD2 during cturage (TCD2e/yr)	0.2% 228	
1	pftr est CCs energies captured and cared (CCOA)pr) Carstruction Parameters (connecting pipeline)	<u>aria</u>	
		15	
	Carbon factor for CCS sciencesing appeline candivation (ECD3eykin) Carbon for CCS connecting pupeline construction - manufacture, transport and installations (ECD3e)	1,400 21,000	
1	TRY Net encloses ()CD3P/yr)	8/8	
1	The Process sectors from Land Titler revolution with and IPS conduction		
	Step II Caldon entriciant from Landilling recidual words and IPS conduction Factore(ar	Scenario 20	
	Macc of bagenic Carbon in residual water (tonnes Carbon) Total Carbon converted tochti(tonnes Carbon)	90,963 45,964	
	Methane in DRI released from residual wate (ICHE) Methane in DRI carbord for use in and engines (ICHE)	34,985	
	amount in the applicate and the poly regions (streng Uncaptured UNI antibiod to CCD in backfill cap (IDH4) Uncaptured UNI informat to attraciptives an instance (IDH4)	1,118	
ŝ	Uncaptional UTG interaind to atmosphere ac methane (ICHE) UFG Byuhullent CO2 Galess embodies interained to atmosphere (ECO2e/yr)	31,010 281,712	
1	Methane in 19th captured for size in gas engines. (IDHS)	21,755	
	Methane sceding gis engines (1016) Puel input la UPΔ engines (30)	21,394	mar2 mar2 mar3 mar4 mar3 mar4
	Pawer generated by IPG engine c(btth)	207,968	220 227 228 229 230 2
3	UK grid CC2 emissions faster far electricity generation (g/kWh) LPG Equivalent CC2 offset far electricity generation from combuction (ICC3e/yr)	See cells \$111 AK111 See cells \$112 AK112	90 47 58 49 45 9,717 7,254 6,263 5,290 4,839 4,3
ļ	US Ant emissions/http://wi	8/8	
1	Die All Entretenschutzungen		
	Tableter	 Scenario 20	
2	the Group aperational environmen (MCCOM) the Danvalent CCD offset for electricity and heat energy generations by facility (MCCDP)	30,727 662	
	If W Republicat CCD captured by CCS from 2083. 26 years (MCCDP)	5,515 4,512	
	MM Net operational environment (UCCDe)	11.20	

are Environment Modeling	
Strendhouse Disk Vereitainse, Walver 2. Steepy, Chapter 15 Cables Disanter Stansport, Hojetterin and Devlopical Manage, Nettorn 3.3	
Energy Cancerption of a Carbon Capture and Inquestation Related Carbon Disorder Compression Processes.	
heregy Caretany State (Salar) Salar	
Strendouse Dis Inventiones, Ware 2 Strends Could's Toulous Toucant, Interfaire and Bestandi Margan, Table 1.2	
E Balan dudari	
on Boulde (CCD), dYslove XX: containment certainty	
e at they take	
ngdek	

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Paget Libragins	Scenario 29) 2000 adapti Sacity - including gold d expart of steam. Som	ecarbonication and OR
	(MCO2V)	(100024)
Canadana di Canadan		
A1 = A2 = A8 - New materials copply, transport and manufacture		85.1
A3 - Candituction protects stage		41
A4-Candhadon Tranpot		71
A1-A2-A2-A3-A4 CEL convecting apprine (manufacture, burnpe tand construction)		21.0
Operation		
#2 = #5 = Maintenance, regain, replacement and refurbitment		41
86 - Operational energy	21.0	
E2 - Operational water		03
BB - Other operational processes Landfill	11,268.4	
88 - Other operational processes: Operational Stansport	225.8	
EB - Other operational processes IBA and APCY		1424
Decommissioning		
C1 - C2 - C1 - C6 - End of life, including deconstruction, transport, waste processing for recovery and disposal		46.1
C2 - C2 - C3 - CC3 - CC3 annexCiting pipeline and of life		21.0
General		
D - Avoided envicoons	-67.0	

N2D Benocees Patter 6 kgR3D(T) (PCC)	
N20 Slubal Warning Putertial (kgC02e / kgN20)	265
CHE Environment Partier d'AgONE/T1 (IPCC)	80
CHI Glabal Warning Putential (lqCO3e / lqCHI)	28
Total Gas Oli (diesel) cansamption (litred)	1,898,860
Auxilliary Burners - N of annual das OI consumption	92%
Fuel (Sas Cil) emissions factor (kgCO2e/KWh)	0.2793
Fuel (Sas Cil) emicolass factar (kgCO2e/libre)	2.7589.7
URD Parameters	
Calorfic value of methane (MD/kg)	90
Biogenic carbon in resoluti waste converted to landfill gai (195)	52%
Propilian of methane in 215	37%
Propartice of D/Directavend State residual water	an.
Dedution of IPS released from recidual works to CO2 in landfill ap	22%
Propartice of LPD used in gas engines	92%
UR engine efficiency 30%	85

Headline assumations for Scenario (in druce indicate) variation with recard to the SS Coord White composition based on WRM 2017 public for England	Reference	
Wests compaction based on WMP 2017 profile for England EfW OP facility concerning accompters for NCV of 9.31MU/ba (words 623.371 U/v; hours + 8.000 per v; MMH + 10)	her worktheat. Minde annaochte varia has worktheat. Minde annaochte varia	itar'
ntw Ore Builty spectrogrammers in Starty of STARTy (Quarte EL, NT (V)), how = 8(000 per v), MM = 10) ERT farmed measure factor for DC gala instantion generative over 00 peak (for the period 2006 to 2000) Historican equation (of for the THC CONTENT Configuration over sport	BES (2020). Treasury Greek Back - Cata T	dan" Tables 5 19 supporting the bankit and the guidance (updated 17 April 2021, to fix forwarding even)
Electricity export only for the EMICHP facility, no cleann export 175 carbure cite for older aperational UK landfill (two EMININTS) = 1275	N/A DEFNA (2014), DEFNA Review of Landfill A	
FTR seaf-conductive surfaces from WHI constants (18 water)		
CCs - No.61 devined CC3 capture othe - X0N. CCs - Heckscry for capture - X0MM//CC3	IPCC (2006) 2006 IPCC Guidelines for Nat	aand treenhause taa torentaries. Valume 2: treegs, chapter 1: Carban Davide "Sinaport, topetion and Beological Storage, 5 of the treegy Consumption of a Carban Capture and toportization Method Carban Davide Companisation Protectors of the threegy Consumption of a Carban Capture and toportization Method Carban Davide Compression Protectors
CCS - electricity for capture = 300kmh/bC03 CCS - electricity for compression (including pipeline transport) = 1200mh/bC02	Jackson and Bradal (2009). Optimization is	of the Energy Consumption of a Carbon Capture and Sequestration Related Carbon Dioxide Compression Processes
FTR - Machine for charge - TRADE ATT		
LLL - Henning) na sanger y zachanget.us (CLL - Sanconstany pipeline tength = 122 km	Average accurred to be care as electricit IPCC (2004), 2006 IPCC dualetimes for Nati MVV estimate for connection to CO2 stor	ry on umpersoon Ional Greenhouse Bactoventaries, Volume 2 Knegy, Chapter 5: Geban Davide Yanquot, opecton and bealogical Borage, T
CC3 - Stansmission prpeline length + 122 km	MVV estimate for connection to CO2 star	age at Bactor ducter
CCs - trailage cote for CO2 during charge (with the 0.1%) CCs - connecting systeme length + 15km	DEME (2028), Deep georageat danage of MVV eclimate for connection to-main and	Califor disable (CCD), officiale DC containment sertainty selline of Engl Lann
CCL - connecting appelme carbon factor for manufacture, transport, excivation and construction = 1,400 ECO Jeylem	Internal estimate based on other project	examples
Nep 1] Residual Weste Composition Waste Steam	Instantia II	
Negelikis Paper Card	575	
Lanu Nan-weyeladar Paper Device Plantic	475	
Dense Plazis	7.8%	
Pacts from	8.2%	
walles R.L. Conductatio R.L. Nao-Conductatio	5.3% 5.2% 1.4%	
Asir. Non-CombustMe	145	
likos	2.6%	
who who we want the set of the se	2.4% 2.4% 3.3% 27.4%	
wed Wales	27.0%	
2Der Grigenic Node	2.8% 2.8%	
Wood WEE	2.95	
tatandous	0.9%	
Wes	2.2%	
net Calorific Value (MU/kg)	833	
NSX walk input (Some (yr)	414,177	
seems Calson IN of Total Calson	17.22	
the Bagencoatton (% of futilitation)	42.80%	
Rep Zu) Carlson enclusions from recidual waste canduction in 17W CHP Facility Tataneter		
atal wate input (some q/yr)	1000001012 611,171 26,275	
Sala Janko Hyuo (Janono Uyo) anal Canton (Y. Si yu wegin) ana Wagen (C. Canton (Y. al. "Data) Canton (	26.275	
san-Bogenic Calbon (Is of Tutol Calbon) diss of Sociel Calbon in recidual wate (Sonnes Calbon)	42.80%	
	48,798 292,342	
seeli derived CC2 emissions (ICC2) IC2 emissions from ecidual valde combuction (tannes)	21	
Iguraliest CO2 ensocans()(CO2e) Ht ensocans fram recidual wate combuction (turnes)	6,297	
ONE emissions from recidual wards combuction (tannes)	175	
toperalient CC2 enrocement(CC2#)	4,612	
usellikary/Burners - Fuel Gax DI [Itans] havillary/Burners - emicodent fai use of fuel (ICCDe)	1,705,620 4,821	
TW Gross emissions (ICODe/yr)	268,365	
MV facility electricity generation (MMV)	55	
includes an enclosed by this facility (MMH)	403,000	Tear 2 Tear 2 Tear 3 Tear 3 Tear 8 Tear 7 Tear 8 Tear 7 Tear 8 Tear 7 Tear 8 Tear 7 Tear 8 Tear 8 Tear 8 Tear 8
NW facility venticities (previdence (MWP) Her facility operations (Int(Vp)) CCD encodes facility for mailing (MMB) CCD encodes facilities renegy generation (gNBB)	Take Cells BET-ARES	10 47 18 69 65 18 10 24
(W Ryunalent CC2 offurt for electricity generation by Rudity (SCC2e/pr)	See only BEEAMLE	H(400 24),480 21,530 21,560 18,400 16,720 11,200 12,540
dep 2b) Carbon emissions from CC3 for 1991 OPP Facility from 2010 'arameter		
larameter Napartian of this fault derived COD emicounic captured	203	
	224,456	
eregy for cables capture, using electricity (00%)/CC0) wergy for C00 campersons and transport, using electricity (00%)/CC0) mergy for C00 camperson, using electricity (00%/CC0)	800	
nergy for CCD compension and bioinpart, using electricity (KWA/CCCD)	120	19a/3 19a/3 19a/3 19a/4 19a/5 19a/5 19a/7 19a/8 19a 2020 2027 2028 2029 2020 2020 2020
nergy far CCD starage injection, using electricity (VMI)(ECCD) 100 eniodons fadlar for CCS energy injusti, using electricity (gCCDe/KNIN)	120 Tele cells 170-007	AND 2027 2028 2029 2020 2020 2020 2020
ca innovani saar na co mingri mano, sang minoning gooding minoning goodingoning Janban capture, compression, transport and clange COZ emiciones (ECOM/pr) gglove COZ emicolone during profession Stangart Sglove/pr)	See GRX 177-MIT7	
vgEve CO2 envisions during provime Stanguot (SgRun/yr)	0.054	
spelae leegh (ko)	110	
NgElve CD2 emissions during bransport (ICC2e/yr)	1,840	
ngalen Cur Amazana atang angalangan (KUMIY) asalaga da (Coo Aung Sanga) (KOMIY) asalaga da (Coo Aung Sanga) (KOMIY) (Mar MCC amazana cajande ada da atang BODB/y)	116	
	401	
Sansbucilian Parameters (connecting pipeline) angth of CCS connecting pipeline (km)		
ength of CEX.connecting pipeline (km) Carbon factor for CEX.connecting pipeline construction (IEO2e/km)	15	
alion factor for CCS connecting pipeline construction (ICCDe/km) alion for CCS connecting pipeline construction - manufacture, transport and installation (ICCDP)	1,400 21,000	
W Net emission (ICD3e/p)	n/a	
tep 1 (Carbon embolares francisad Niteg evolusi al watte and UPG simblection National III sata d'angles est el l'angles est est est est est est est est est e	Instantia 22	
tess of Biogenic Carbon in recidual waste (tannes Carbon)	95,868	
atal Carbon canverted to LPG (tonnec Carbon) Withone in LPG miniated from mixidual water (ICHG)	45,968	
	34,885	
magtured IPD undered to CO2 in landfill cap (ICHI)	28,266	
Incaptured LPD released to atmosphere as methane (ICHE)	15,092	
PB Rquivalent CO2 Grass emissions released to atmosphere (ICO2e/yr)	622,568	
Refilments (1974 captured for une in gate engines (1924) Refilmen uned in gate engines (1924) wel hight 16176 engines (1931)	18,308	
Archane used in gaz engines (ICHE)	10,388 16,513 207,215	
hvel input to IPG engines (03) Nover seneristed by IPG ensines (M00)	207,235 82,566	There's There'
ix and CC2 emissions factor for electricity providion (a/stati)	See cells 1505 A 8325	10 47 58 69 45 26 20 201
PD Equivalent CO2 offset for electricity generation from combustion (ICO2e/yr)	See artiction Arton	7,411 3,312 4,789 4,086 3,713 3,187 3,417 3,912
PE Net emissions (SCD3e/yr)		
concentration framework had	10p	
Tep 💐 Carbon endodens from operational procesars over 80 years		
farameter	Townarie 32	
fW desce operational environmen (NECED) fW bounderst CC2 offset for electrolity generation in Facility (NECED#)	10,727 279	
fW Nauvalent CCD affort for electricity generation by Facility (NCCDV) fW Nauvalent CCD captured by CCS from 2000 26 years (NCCDP)	5,525	
fW Net operational emissions (IRCCOP)	4,938	
PD Basic operational emicodors (RECOM)	14,901	
PD bauvalent CO2 offset for electricity annexation by Facility (MCO2e)	10	
US Net operational envisions (RCCOP)	16,011	
Jep 1 Ufetime carbon emboloos	hermalie III 2000 adaptive of 77 hor	te the cor
	facility - including grid decadeoniation Capture	w 12% UPG
Vajed Efreydes	una minico	er radity
	(KEC24) (M	(02r)
andra Sen		
Construction 12 - 47 - 41 - Nor instructions supply, torough and manufacture		8.55
Canatorialian 32 - 92 - 91 - Esan materiale capping, Conceptor Landonau-Cature 34 - Concentration Stangard 34 - October 2010 - Stangard 34 - October 2010 - Stangard and Anna Schwartz Instance Canatorial Stangard		80.55 4.80 7.86

		10	67		M		- 65		. Ö	0	24	28	28	18	19 ar 22 22 27 22	38	21		. 1	1	-		1 7	1				2					194/30 2013 2	764/32 2254	Tear 32 2017	Tear 33 200	76w M 220	1647 JB 7 308	1947.38 0 201	764 D G X J	2	7647 20 43 - 27 2	1	43 2000 3
	20,0	100	29,80	2	1730 3	1,360	18,800	36,720	3 1(2)	8	140 X,1	60 T	,000	7,800	7,480	7,540	6,600	6,62	6,38	1,0	1,52	1,12	1,000	1,26	2,200	2,300	1,820	10	885	880		- 10	88	880	80		80	89		0 7	880 8	60 P	880	880
	798/2	The l		1.44	THE		1 W 1	Tear 6	Tear 7	Tes I	764-7	Tear 2	20 TH	w 11 1	9ar 12	Tear 23	They 24	194/ JJ	79w 28	Tear 17	THW 18	19a/28	Nor 22	Tear 27	796/22	19 <i>w 21</i>	7607 21 1708	Their 23	194/24 1947	New 27	Tear 28	Tear 28	19ar 30	Nor 22	Tear J2	THE 23	70w M	ner B	Tear 30	Tes I	17 1964 M	Tear JI	8 m	- 43

 International status
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	2040 adoption of CCS by the EfW CHP facility - including grid decarbonisation at 85% LPG Capture		
	Law black to volve table	Palanca	
	Noadline accumulation for Taxanda (min theor indicator calculation with escaper to the NI Case) Noate composition have do WMMP 2017 public for Ingland Min Core Dailly, appending accuments for NI Y of It hashed (a loade KLI, 1011 (a/c, hours + 10202 per yr), MMP + 30)	Seeworksheet, Mode some	other variables"
5	If W DPF Society operating parameters for NCV of 9.333M/hg (wade 663,379 G/yr, hows + 8,000 per yr) MWe + 50	tee worksheet. Mode some BES (2020). Treasury Greek B	octor variation'
	BES furnications states for UK gold electricity generation over 40 years (for the period 2028 to 2000) Electricity export only for the thir CHP facility, no clears export	BUS (2020). Treasury Green B N/A	aux - Calla Tables 3-1
4	Upper limit for instantaneous CPG capture rate for a modern UK landfill + XML based on experts' opinion	DEPRA (2014) DEPRA Review	of Landhil Methane
2	experiment for instantaneous UTC inpluses rate for a modern UE landfill « ETM lasard on experts' opinion CCF pair combuction-patients/instant Combuction (prevent) CCF - Sould derived CCT appliers rates - REML	N/A (PCC (2006), 2006 (PCC Guider)	out for National Ave
k	CC - Hecksolg for capture = 800488/,0C03 CC - Hecksolg for compression (including papeline transport) = 120088//CC0	Jackson and Brodal (2008). Op Jackson and Brodal (2009). Op	designed the In-
		Jackson and Brodal (2009). Op Average assumed to be came	dimitation of the In-
ì	ου το δεμβαιού (CD - διακριστικό σύντης μερολογιού (Suspino) (Sugli Suspino) CD - διακριστικό μεροδου διακρίζας το 10 μπο CD - διακριστικό και (Succidence) (Suspino) (Suspino		
e	CCS - bianomission proprinte length + 120 km	MVV eclimate for connection DEINZ (2028). Deep gediages	to CO2 storage at Ba
1	CCs - sense ting pipeline length = 10km	MVV estimate for connection internal estimate based on of	tomax apeline at
N	CCL - connecting pipeline carbon factor for manufacture, transport, excavation and construction = 1,400 ECO Jeylon	Internal estimate based on of	ther propect example
	CC seventing pyelles sinker factor for nanolativer, tanapart, escavation and construction + 1,400 (CDIs)/km UMP (E) Restard Within Companition Water Talant Registration Fager		
	Wale Steam Seculation Paper	Scenario 15	
		4.75	
	Non-weyddie Paper Dense Pladic	8.9% 7.8%	
	Pasts film	825	
	Textiles Msc. Combuditie	5.05	
	Other Waldes	0.85	
	diax Persua Melak	2.6%	
	Non-Pervice Medic	1.2%	
	Food Walde Garden Walde	27.0%	
	Other Diganic	2.8%	
	West	2.8%	
	Maandous	0.5%	
	Pites Met Calorifs: Value (Mil/M	2.2%	
	Tatal wate input (tomes)(e)	610,171	
	Tatal Carbon (K By weight)	26.32%	
	Regenc Ceber (N of Total Ceber) Non-Reserve Ceber (N of Total Ceber)	41.80%	
	New 2d Carbon emissions/how residual waste conduction in IfW CHP Facility		
		Transitio TT	
	Table wade input (tomes/yr)	613,379	
	Tatal Carbon (N. By weight) Nan-Rogens Carbon (N. of Tatal Carbon )	26.32% 62.82%	
	Mass of fassil carbonis recidual wade (sames carbon)	68,793	
	Peccil derived CD2 emissions (ICD2)	210,302	
	Equivalent CO2 emocions.(CO2e)	4,297	
	OHL emicodos fram recidual water combuction (tannes)	175	
	AurillaryButters - Fuel Gal OI (1014)	4,913	
	AurillaryBurnets - environmentariate all fuet (0000e)	122	
	MW Gross emissions (ICDDe/yr)	20,00	
	the facility electricity prevation (MMH) the facility operations (MA(y)	55	
	Electricity provided by ENV facility (MWH)	601.000	
	CO2 encloses factor for energy encertaion (a/Nth)	See CEIX BET AME?	
	tfW Revisions CCD affort for electricity generation by Reality (ICCDs/jor) May 20 (Carlon emission from CCS for TRE CMP Facility from 2000 Parameter	See only BEEAMSE	
	Pacameter Proportion of thit face: derived CO2 emocians, galaxied		
	Proportion of ETM Total derived CO2 emissions, appared ETM environment CO2 mission, appared	20.0	
	r/er wassen opported (PCDM/e) Tanego for caldeo opporte, volaj encolocity (MAN/CCD) Tanego for CCD impericiano and baseguic, unag electricar (MAN/CCD)	800	
	Energy for CO2 compression and transport, using electricity (KMI/ICCO)	120	
	Energy for CCII classinge importain, using electrology (VMH/CCII) CCII enrosoons fadair for CCII energy inputs, using electricity (pCCIa/NIM)	See Cells \$75,AU75	
	Earbon capture, compression, transport and stanspe CD2 emissions (ICD3e/yr) Fugitive CD2 emissions during pipeline transport (og/km/yr)	See Cells 077-AR77	
	Papeline length (km)	133	
	Fugitive CD2 emissions during drampant (ICCDe/yr) Lwikage rate for CD2 during drampe	1,842	
	Lexinge in the CCI during stange (SCI 24/yr)	223	
	nför net CC3 ennsanni captured and stared (ICO20/ju) Construction Perumeters (canenaling pipeline)	<u>40</u>	
		13	
	Calizon factor for CCS connecting pupeline construction (ECOe/km) Calizon for CCS connecting pupeline construction - manufacture, transport and installation (ECO2#)	1,400	
		21,000	
	IfW Net emissions (ISD2e/yr)	N/A	
	Nep 2 Carbon emissions from land lifting recidual matter and UC combuction		
	Facewater Vacual beaming carbon in introduct wadar (ternet carbon)	Scenario 33	
	Total carbon converted to UPG (Sonver carbon)	43,966	
	Methane In UN released from residual walde (ICHI) Methane In UN captured for use in gas engines (ICHI)	34,855 29,494	
		20,494	
	Unceptured IPE released to Atmosphere as methane (ICME)	4,738	
	LPE Byviolent CCD Gross emissions released to atmosphere (ICCDe/yr)	112,043	
	Methane in UNL captured for use in gas engines (IDH4)	29,894	
	Methane used in gas engines (ICHE) Fuel input to IPG engines (ICHE)	26,992	
	Paner generated by 175 engines (MMA)	130,960	
	UK grid CC2 encoder. Fadar for electricity generation (g/UBA) UFB Tip-indext CC2 offset for electricity generation from conduction (ICC2e/yr)	See sels 1105 AX205	
		art art. 1.46.1153	
	D/L Net emissions (DCD3e/pr)	N/A	
	Step II Carbon emicidos: from operational procesars over 65 years		
	Facameter IfW druct operational emocions (SICO2H)	Scenario 33 10.727	
	If W Busivalent CO2 offset for electricity generation in Facility (MCO2+)	279	
	tW Equivalent CD2 captured by CD3 from 2000 26 years (ISCC02e) tW Net operational emission (ISCC02e)	5,515	
		4,10	
	LPD Boast operational environes (BLCODe) LPD Equivalent COD offset for electricity generation by Pacifity (NICODe)	5,282 84	
	LPD ByJavalent CCD afford for electricity generation by Yacility (NICCDe) LPD Net operational emissions (NICCDe)	81	
	May 1] Effetime carbon emissions		

Presed Lifectures	facility - including grid dec	Sumaria III) 2003 adoption of CCS by the BMC OP facility - including grid devariantion at III's OP Capture					
Pagea Languas	LPG (NED3H)	ETHECHP Facility (NECO24)					
Conduction							
A1 = A2 = A1 - Raw materials supply, transport and manufacture		35.55					
AS - Construction process stage		4.90					
Ad-Construction Transport		7.88					
A2 - A2 - A3 - A4 CCS connecting pipeline (manufacture, transport and construction)		21.00					
Operation							
82-85-Mantenance, repair, replacement and refudintment		4.95					
85-Operational energy	25.00	20,736.58					
E7-Operational water		0.36					
BX - Other operational processes: Landfill	5,283.52						
88 - Other operational processes: Operational transport	223.85	271.68					
BE-Other operational processes: BA and APCr		342.60					
Decommissioning							
C1-C2-C3-C6-End of 1/e, including decondituction, transport, worde processing for recovery and disposal		46.38					
CI-CI-CI-CII-CII connecting pyrelaw. Indiaf Ife		21.00					
General							
D-Availed emotions	-8145	-1,788.68					
TOTAL	5,127.18	1,616.25					
Net change in DetLemococorc resulting from the Proposed Development (NDCDDe)							



2 Treegs, Chapter II. Carbon Daxide Tomport, typetton and tendepoil Monge, testion 5.3 nas and Toopenticition Related Carbon Distable Competition Protection for and Toopenticition Related Carbon Distable Competition Protection 2.3 Reegs, Chapter II. Carbon Daxide Tomport, typetton and Bealogical Monge, Table 5.2

Sonnario 31 2040 adoption of CCS by the EfW CHP facility – including grid decarbonisation at 85% LFG Capture

