Medworth Energy from Waste
Combined Heat and Power Facility

PINS ref. EN010110
Document Reference: 12.2b
Revision 1.0
Deadline 4
May 2023

Written Summary of the Applicant's Oral Submissions at ISH4

We inspire
with energy.

Contents

Table 1.1 Written Summary of the Applicant's Oral Submissions at ISH4

Item	ExA Question/ Context for Discussion	Applicant's Response
Agenda item 1 - Welcome, introductions, arrangements for the hearing		
1	The Examining Authority ("ExA") opened the hearing, introduced themselves. The ExA set out the practicalities and technicalities behind a virtual hearing using Microsoft Teams. The ExA then invited parties present to introduce themselves.	Applicant The following parties introduced themselves on behalf of the Applicant: • Gary McGovern, Partner, Pinsent Masons LLP • Ms Claire Brodrick, Legal Director, Pinsent Masons LLP • Paul Carey, Managing Director, MVV • Tim Marks, Head of Planning, MVV • Gary Parkinson, Construction Manager, MVV • John Wade, Head of Construction, MVV • James Ashton, Head of Engineering, MVV • Swen Grossgebauer, Head of Innovation and Proposals, MVV • David Kenyon, Technical Director, WSP • Bev Coupe, Technical Director, WSP • Matt Ösund-Ireland, Director, Susteer Cambridge County Council (CCC) and Fenland District Council (FDC) • Andrew Fraser-Urquhart, KC, Francis Taylor Building Chambers, representing CCC and FDC Borough Council of King's Lynn and West Norfolk (BCKLWN) • David Alford, Senior Environmental Quality Officer specialising in air quality, representing BCKLWN Norfolk County Council (NCC)

Item	ExA Question/ Context for Discussion	Applicant's Response
		• Ralph Cox, Principal Planner at NCC UKWIN • Mr Shlomo Dowen • Mr Josh Dowen
Agenda item 2 – Purpose of the Issue Specific Hearing		
2	The ExA explained that purpose of the ISH4 hearing is to undertake an oral examination on Environmental Matters, particularly in relation to traffic and transport, air quality, and climate change (including carbon mitigation and carbon capture). The ExA explained that the hearing would be a structured discussion and would follow the agenda that was published on the PINS website on 2 May 2023.	N/A
Agenda item 3 - Traffic and Transport		
3a	The ExA explained that the purpose of this item is to examine the Proposed Development in relation to traffic and transport, mainly: • traffic generation; • assessment of traffic and transport effects at the construction and operational phases; • traffic management and highway safety; • the Outline Construction Traffic Management Plan; • the Outline Operational Travel Plan; and	Ms Coupe, for the Applicant, began by explaining that the Construction Transport Strategy related to the three distinct elements of the Proposed Development: 1. The EfW CHP Facility – 65% of the construction traffic will access the site via New Bridge Lane and 35% via Algores Way. Construction of the EfW CHP Facility will also involve widening a 170m section of New Bridge Lane, including the at-grade road crossing of the disused March to Wisbech Railway, up to the new operational access of the facility, and improvements to the Cromwell Road/New Bridge Lane crossroad junction. Abnormal Indivisible Loads (AILs) will route via New Bridge Lane.

Item	ExA Question/ Context for Discussion	Applicant's Response
	• the Outline Operational Traffic Management Plan and the effects of the Proposed Development on the accessibility of other premises. The ExA set out that the documents listed in the ISH4 agenda published on 2 May 2023 (the "**Agenda**") would form the basis of the questions asked to the Applicant. The ExA explained he would not read these out given how many documents there are. The ExA confirmed that all parties agreed with the key documents listed in the Agenda for agenda item 3. The ExA requested that the Applicant set out, in broad terms, its transport strategy for the construction and operational stages of the Proposed Development.	2. The Grid Connection – which heads east from the EfW CHP Facility Site and broadly follows the route of the A47 around the eastern periphery of Wisbech, then routeing along Broadend Lane to the Walsoken Substation. The entire route will be constructed within the adopted highway/highway verge. A temporary construction compound (TCC) for the Grid Connection construction materials will be located within the EfW CHP Facility Site. A temporary access for construction activities will be provided off the A47 at a location that will be agreed with National Highways. 3. The CHP Connection - which runs north from the EfW CHP Facility and follows the route of the disused March to Wisbech Railway into Wisbech. Three temporary accesses for construction activities are proposed, two off Weasenham Lane located adjacent to each other where the disused March to Wisbech Railway crosses Weasenham Lane and one at the end of the CHP Connection which is the end of Oldfield Lane. Ms Coupe then explained that **Table 6.10** in **ES Chapter 6 Traffic and Transport (Volume 6.2) [APP-033]** sets out the daily two-way construction traffic flows for all construction elements. Two-way means a vehicle arriving at a location and departing. Table 6b.11 shows that Month 14 is the peak month with 187 two-way HGV movements (93 arrivals and 93 departures, noting that in some instances rounding of figures has meant that there is a discrepancy of 1) and 456 two-way light vehicle movements (228 arrivals and 228 departures) per day. Construction activities will be over a 12-hour period, from 07:00 to 19:00. Staff arrivals and departures will be before and after these times respectively and therefore won't contribute to peak hour traffic periods. HGV movements will be spread across the working day, resulting in approximately 16 two-way HGVs per hour over the 12-hour day, which is an accepted approach. There is likely to be fluctuations, and also likely that the HGV movements would be lower during the AM and PM peak hours.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Ms Coupe moved on to discuss **Table 6.27** in **ES Chapter 6 Traffic and Transport (Volume 6.2) [APP-033]**. The table records the total construction traffic increases over the baseline condition would only exceed 10% on two of the twelve links assessed (that is Algores Way at 17.10% and New Bridge Lane at 15.33%) with all other links not exceeding 2.5%.
3a	The ExA asked the Applicant to clarify what the limits mean in practice in terms of the percentage increases.	Ms Coupe explained that these are based on comparison with the baseline situation, background traffic without the construction and the proportional increase in traffic as a result of the construction vehicles.
	The ExA requested that the Applicant continued to set out, in broad terms, its transport strategy for the construction and operational stages of the Proposed Development.	The HGV movements temporarily on Algores Way would be largely comparable with existing vehicle numbers. The Applicant's response to the **Relevant Representations – Part 9 Appendix 9.2A [REP1-036]** is a Technical Note which sets out existing operational activities. The site is currently Waster Transfer Station permitted to accept 75,000 tonnes per annum (tpa). This equates to an average of 24 HGVs (44 two-way) and 5 LGVs (10 two-way) daily movements via Algores Way. Based on the traffic data provided in **ES Chapter 6 Traffic and Transport Appendix 6B Transport Assessment Volume 6.4 [APP-073**], the net change in traffic would be greatest along Algores Way in Month 10, whilst Month 14 is the peak construction transport month overall. Taking the maximum amongst Algores Way, this would equate to an increase of 12 and 2 two-way HGV and LGV movements respectively per day. Therefore, the construction traffic movements are comparable to the existing operations. In 33 of the 36 construction months, HGV/LGV movements would be lower than the current permitted levels. Ms Coupe then moved on to explain the Operational Transport Strategy. During the operational period, only the EfW CHP Facility will generate regular daily traffic. The CHP Connection and Walsoken Substation will require maintenance vehicles but these would only be occasional. Access to the EfW CHP Facility for HGV traffic will be via

Item	ExA Question/ Context for Discussion	Applicant's Response
		New Bridge Lane only. A new vehicle entrance for staff and visitors will be created from Algores Way, replacing the existing access.
	The ExA asked the Applicant in relation to access via New Bridge Lane, in the eventuality that the Local Highways Authority does not adopt Algores Way, how will the access be guaranteed.	Ms Brodrick, for the Applicant, explained that the Applicant is seeking compulsory acquisition powers for a right of access along the unadopted section which would enable vehicles during construction to enter the site via the unadopted section of Algores Way. The Applicant remains willing to enter into a deed of easement for right of access with Fenland District Council. However, in the event that a voluntary agreement cannot be reached the compulsory acquisition powers have been included in the draft DCO. Ms Brodrick added that the compulsory acquisition powers are justified as they will ensure the deliverability of a Nationally Significant Infrastructure Project ("**NSIP**").
	The ExA asked the Applicant if the existing access is not being monitored by the Highways Authority, then how will the Applicant guarantee that the HGV vehicles will access via the New Bridge Lane entrance.	Ms Coupe confirmed that all HGV movements during operation will be via New Bridge Lane. Ms Brodrick explained that all operational HGV vehicles will utilise the New Bridge Lane access because the access routes are secured in the outline **Operational Traffic Management Plan [REP3-025**] secured by DCO Requirement 12 in Schedule 2 of the **draft DCO [REP3-007]**. Ms Coupe added that all operators will comply with the traffic plan and only use the identified routes.
	The ExA queried the impact that traffic would have around Cromwell Road / A47 roundabout and asked the Applicant to explain what work has been carried out regarding this.	Ms Coupe explained that a transport assessment (**ES Chapter 6 Traffic and Transport (Volume 6.2) Appendix 6B Transport Assessment [APP-033]**) was produced at the request of the Highway Authority. This assessment reviews the capacity of junctions and identifies any detrimental impacts. The assessment reviewed two junctions: the

Item	ExA Question/ Context for Discussion	Applicant's Response
		Cromwell Road / A47 roundabout and the Cromwell Road / New Bridge Lane junction. The transport assessment concludes that the impact of the Proposed Development will not cause a significant impact on the operation of the junctions. Ms Coupe explained the increase of traffic was not at significant levels. Ms Coupe confirmed that the existing capacity of these junctions is able to cope with the anticipated operational traffic, including the HGV vehicles.
	The ExA asked the Applicant to explain the role of the Outline Operational Travel Plan, Outline Construction Environmental Management Plan, Outline Construction Traffic Management Plan and the Outline Operational Traffic Management Plan. The ExA asked the Applicant to explain the differences between the documents and how they interact with each other.	Ms Coupe began by explaining the **Outline Operational Traffic Management Plan (OTMP) (ES Chapter 7 Volume 7.15 [REP3-025])** relates to the traffic movements during operation and establishes the permitted HGV routing to and from the EfW CHP Facility. It also identifies any mitigation requirements in relation to traffic routing. The **Outline Operational Travel Plan (ES Chapter 6 Traffic and Transport (Volume 6.2) Appendix 6C [APP-074])** sets out physical and influencing travel behaviour measures to encourage sustainable travel by staff and visitors during operation. This will be monitored and updated on a regular basis. **Outline Construction Traffic Management Plan (CTMP) (ES Chapter 6 Traffic and Transport (Volume 6.2) Appendix 6A [REP3-019])** sets out the mitigation measures to manage construction traffic to minimise the likely effects on existing road users, the local community and the natural environment. **Outline Construction Environmental Management Plan (CEMP) (Volume 7.12 [REP3-023]**) sets out the responsibilities and environmental standards that the Applicant will comply with and will require its EPC Contractor(s) to comply with during the construction of the Proposed Development.

Item	ExA Question/ Context for Discussion	Applicant's Response
	The ExA asked the Applicant to provide an update introduce on any changes to these documents submitted at Deadline 3, namely Outline Construction Traffic Management Plan (tracked) [REP3-014] and (clean) [REP3-019], Outline Construction Environmental Management Plan (tracked) [REP3- 022] and (clean) [REP3-023] and the Outline Local Air Quality Monitoring Strategy (tracked) [REP3-034] and (clean) [REP3-035].	Ms Coupe explained that the Outline CTMP [REP3-019], has been updated and the changes include the following: • the inclusion of approval of the Final CTMP by the highway authorities prior to construction and subsequent reviews. • Inclusion of consideration for non-motorised users (NMUs) within the proposed mitigation, specifically potential road closures and diversions and temporary diversion signage • Inclusion of a communications plan in advance of road and footpath closures • Specification that the proposed permanent speed limit on New Bridge Lane would be 30mph, to be executed via Article 17 of the DCO or via a Traffic Regulation Order (TRO). • Maintenance of Network Rail sign at the former crossing of the discussed March to Wisbech Railway. • Clarification on highway condition surveys to include NMU and public rights of way (PRoW). • Inclusion of all bodies involved in emergency services requiring to be part of a liaison group. • Inclusion of drawings to show the construction accesses from Weasenham Lane into the CHP Connection Corridor. The **Outline CEMP [REP3-023]** has been updated to take account of comments made by the stakeholders. This includes the inclusion of Community Liaison Manager role. The Outline OTMP has been updated with the following changes: • Identification of Community Liaison Manager role • Inclusion of improvements for NMU on New Bridge Lane • Maintenance of Network Rail sign at the former crossing of the discussed March to Wisbech Railway so that NMUs are clear of their rights of access status.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Submitted at Deadline 3, the **Outline Local Air Quality Monitoring Strategy (LAQMS) [REP3-035]** was updated to include the following. • Inclusion of agreement to share information collected by the LAQMS. • Inclusion of real-time particulate monitored in agreed locations.
	The ExA asked the Applicant when the Community Liaison role will be functional and, specifically, whether it would only be functional once the Proposed Development is operational.	Paul Carey for the Applicant confirmed that the Applicant would employ a Community Liaison Manager once consent for the Proposed Development was granted, if not sooner. The Community Liaison Manager would be in place before construction commenced.
3b	The ExA asked Applicant to explain the methodology used (including sensitivity of receptors), particularly to explain what traffic surveys were carried out, when and the work that was carried out in order to identify a suitable Study Area.	Ms Coupe explained that the Study Area for the construction and operational stages have been identified on the basis of the traffic routes to be taken by HGVs associated with the Proposed Development around Wisbech. At the time of the preliminary environmental assessment work, the COVID-19 pandemic meant it was not possible to undertake a traffic assessment because travel behaviours were not normal. As a result of this the Applicant used available data from the Department of Transport website. Following the end of COVID-19, travel behaviours returned to normal in mid-2021. The Applicant therefore discussed and agreed traffic surveys with the local highways authority and these surveys were undertaken in October 2021 once travel behaviours had normalised.
	The ExA asked the Applicant to explain Table 6.24 (at page 66 of Chapter 6 of the ES [APP-033]). The ExA asked the Applicant to explain the 4 receptors (those being Weasenham Lane, A1101 Elm High Road and link 9 and 10) were identified as high and what was the criteria that the Applicant took into consideration.	Ms Coupe explained that the table identifies the routes to be taken by HGV as part of construction; these are the study area road links. The Applicant has reviewed the character of the routes, if there are properties alongside the roads, and the general use of the road. The sensitivity of the roads receptors was based on professional judgement and considered the type of road, the types, location and number of properties along it and NMU usage. High sensitivity would include locally sensitive receptors located

Item	ExA Question/ Context for Discussion	Applicant's Response
		alongside the road, such as a school, high levels of property frontage and a high volume of pedestrian use.
	The ExA asked the Applicant to explain the highway links and Figure 6.4 [APP-050]	Ms Coupe explained that Figure 6.4 shows the location of the traffic surveys that were undertaken. These were chosen based on the routes within the study area and where the Applicant felt there were different characteristics and where traffic numbers may differ.
	The ExA asked the Applicant point out where the sites which were being discussed in Figure 6.24 are identified and mapped out.	Ms Coupe explained that the table provides a written description of the sites but there is not currently a figure that sets the sites out graphically but that the Applicant would provide that to the ExA. This figure is provided as **Appendix A** to this document.
	The ExA asked the Applicant to how the significance evaluation matrix was applied to the receptors identified and to discuss the magnitude of change. The ExA also asked the Applicant to discuss Table 6.26.	Ms Coupe explained that the sensitivity of the identified receptors within the agreed Study Area was defined. Then the Applicant looked at the magnitude of change in traffic flows during the peak construction period and during the operational stage as a result of the Proposed Development was identified for each of the environmental effects for each receptor. Through this process the Applicant identified the significance as shown in Table 6.26 **[APP-033]**. Ms Coupe explained the assessment is based on the Institute of Environmental Assessment (IEA) publication *Guidelines for the Environmental Assessment of Road Traffic* (GEART) which sets out thresholds for assessments. GEART provides two rules that are used to establish whether an environmental assessment of traffic effects should be carried out on Receptors: • Rule 1: Include roads where traffic flows are predicted to increase by more than 30% (or where the number of HGVs is predicted to increase by more than 30%) then this would trigger the need for an assessment; and • Rule 2: Include any specifically 'sensitive' areas where traffic flows are predicted to increase by 10% or more.

<table>
<tr><th>Item</th><th>ExA Question/ Context for Discussion</th><th>Applicant's Response</th></tr>
<tr><td></td><td></td><td>A detailed assessment of effects was undertaken for each of the receptor roads where the increase in traffic was higher than 30% for non-sensitive roads or higher than 10% for sensitive roads.

The different potential categories of sensitivity are:
• Negligible or low sensitivity
• Medium sensitivity
• High sensitivity

If the receptor has a high sensitivity and high magnitude of change then it will be major significance. However, with New Bridge Lane in the existing situation there are very low levels of traffic so there are instances where there can be a disproportionate increase in traffic due to very low levels in the baseline.</td></tr>
<tr><td></td><td>The ExA explained the sites identified in Table 6.27 highlighted significant residual effects and the ExA made specific reference to paragraph 6.10.84, which refers to the necessary consideration required for the residual effect. The ExA asked the Applicant to explain the consideration and what would be carried out to mitigate the effects.</td><td>Ms Coupe explained that the Applicant reviewed each receptor within the Institute of Environmental Assessment (IEA) guidelines. When undertaking an assessment, looked at each of the factors identified:
• Severance;
• Driver delay;
• Pedestrian amenity;
• Pedestrian delay;
• Fear and intimidation; and
• Accidents and safety.

Whilst also reviewing the implications of the vehicle numbers on each of those effects. Ms Coupe explained there are a number of tables that the Applicant has prepared that set out the outcome to those assessments.</td></tr>
</table>

Item	ExA Question/ Context for Discussion	Applicant’s Response
	The ExA explained that discussion would move on to discuss the operational phase. The ExA explained in 6.11.9 there are two sites that have been identified (receptors 2 and 3) which trigger the threshold for the detailed EA assessment. The ExA asked the Applicant to set out their conclusions in relation to this.	Ms Coupe explained that the Access Improvements for New Bridge Lane include widening and pedestrian provisions. Taking into account these Access Improvements, paired with the nature of the road and the properties along it, it is concluded that the impact is not significant. For Cromwell Road there are improvements to the junction that will be undertaken. There were concerns raised CCC in terms of number of HGV that will be turning right at that junction. As a result of discussions, an approach has been agreed that the junction will be signalised and those improvements will mitigate the impacts of the Proposed Development. Therefore, the Applicant has concluded that neither of the receptors have significant impacts.
	The ExA referenced the summary Table 6.35 on page 6-85/6-86/6-87. The ExA asked the Applicant to explain the receptors marked significant and to identify if any information has changed.	Ms Coupe confirmed that whilst the identification of some effects were major and significant, after consideration of operational mitigation measures and the improvements that the Applicant has already set out, the overall effect has moderated so that the impacts have been reduced to not significant.
3c	The ExA asked the Applicant to confirm that the development will accommodate for future rail network changes, namely the potential reopening of the disused March to Wisbech Railway Line.	Mr Marks, for the Applicant, explained the proposals have been discussed with Network Rail to ensure that both the Proposed Development and the railway line could co-exist. Mr Marks explained that the **Statement of Common Ground [PDA-002]** sets out the extensive consultation with Network Rail and that current work is being done by the parties to finalise voluntary agreements for easements.
3e	The ExA then gave CCC and FDC the opportunity to comment, highlighting particular areas of disagreement between the parties and any concerns identified in the CCC and FDC joint Local Impact Report [REP1-074] which might not have been adequately addressed yet and those identified in CCC and FDC Deadline 2 Written Representation [REP2-033] and Letter from CCC in relation	In response to comments from Mr Ashman, Highway Records Manager for CCC, on engagement on protective provisions, Ms Brodrick, responded that following the Issue Specific Hearing 1 on the draft DCO, the Applicant amended Requirement 7 in Schedule 2 the **draft DCO [REP3-006]** which specifies that all highway works must be approved by the relevant Highway Authority before such work can commence and which therefore addresses CCC’s concern.

Item	ExA Question/ Context for Discussion	Applicant’s Response
	to ISH2 [AS-014], Deadline 3 Submission - Post-hearing submissions including written submissions of oral cases [REP3-044] and CCC and FDC Deadline 3 Submission - Response to ISH2 and CAH2 Action Points [REP3-046].	Additionally, a draft section 278 agreement was sent to CCC’s solicitor along with draft Protective Provisions. The Applicant has not yet received any comments back from CCC but noted that the draft documents had only recently been sent to CCC. The Applicant is willing to discuss the Protective Provisions with CCC and is hoping to include a set of agreed Protective Provisions within the draft DCO. The Applicant has drafted the wording of the s278 agreement to address the concerns of the CCC whilst also ensuring there was no duplication or conflict with the draft DCO. In conclusion, the Applicant is confident that each of the concerns raised by Mr Ashman on behalf of CCC can be adequately addressed. In response to an action from the ExA to update the **Statement of Common Ground [REP1-038]** to reflect the current position, Ms Brodrick confirmed that the Applicant was willing to do so but noted that the Applicant is waiting on comments on the Statement of Common Ground from the host authorities. In response to comments made by Mr Ashman on the potential for damage to be caused by “*extraordinary*” levels of traffic outside of the Order limits, Ms Brodrick highlighted that parties should be careful with the use of language as there is some concern that parties are not using consistent terminology. For example, Mr Ashman used phrases like ‘*extraordinary*’ and ‘*significant*’ but the Applicant’s understanding is that those terms are not being used in accordance with their meaning as set out in the Environmental Impact Assessment. Ms Brodrick added that it would be helpful to clarify when talking about increases in traffic that CCC agrees with the meaning of the word ‘*significant*’ in the context of the Environmental Statement, and that the increases in traffic movements as a result of the Proposed Development are not considered to be significant in EIA terms. Ms Brodrick explained that the Applicant is seeking to upgrade the surfaces of the road as part of the Access Improvement works and these will be covered by a section 278 agreement and constructed to the appropriate standard with future maintenance costs covered as part of a commuted sum.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Ms Brodrick reiterated the concern that the parties are not necessarily referring to the same terminology when trying to address CCC's concerns. In response to comments from the ExA that there is still an increase in terms of receptor numbers 2 and 3, Ms Brodrick explained that the condition of New Bridge Lane will be upgraded by the Applicant as part of the Proposed Development. In respect of highways located outside of the Order limits, the Applicant's position is that there is already a regime under s59 of the Highways Act 1980 to deal with any impacts caused by "*extraordinary*" traffic and, should the Proposed Development meet that high threshold, then there is already a statutory process that CCC could use to recover costs for any damage. The Applicant's position is that it would not be appropriate or necessary to duplicate the statutory protection that is already available to CCC in the draft DCO. Ms Brodrick confirmed that the Applicant will continue to work with CCC and hopes that the drafting can be agreed in relation to the Protective Provisions.
3f	The ExA asked the Applicant to explain it's approach to PRoW as set out in Chapter 6 of the ES, Traffic and Transport [APP-033] and Access and Rights of Way Plan (Rev.4) [REP3-005] and why no direct impacts upon any PRoW were identified.	Mr Kenyon, for the Applicant, explained that PRoWs could be potentially affected in two ways, directly as a result of construction or operational activities taking place on or over them, or indirectly, such that effects arising from the development may lead to changes in the way in which they are used, for example users being more or less inclined to use them. In the case of the Proposed Development there would not be any direct effects upon PRoWs because no PRoWs would be crossed by the Proposed Development. The closest PRoW to the Order limits would be Emneth FP9, Footpath 266/21 and Walsoken FP8 (see Access and Rights of Way Plan (Volume 2.4) [REP3-005]). These footpaths terminate at the point that they reach the verge of the A47. The Grid Connection would not therefore affect them directly and hence no directs impacts have been identified. Mr Kenyon explained that indirect effects upon users of the PRoWs are considered within **ES Chapter 15 Socio-economics, Tourism, Recreation and Land Use [APP-045]**. Mr Kenyon explained it could be visual or noise impacts that could discourage a user to use the PRoWs. There are informal crossing points to cross over the A47, the Applicant will cross those when constructing the cabling for the connection. The

Item	ExA Question/ Context for Discussion	Applicant's Response
		Applicant's proposals to mitigate this are advanced notification, signage, and a banks person. Mr Kenyon noted that the works would take place overnight. Therefore, management processes will be put in place to protect people's ability to cross the PRoW.
3g	The ExA asked the Local Host Authorities (LHAs) and Interested Parties (IPs) if they had any comments, highlighting particular areas of disagreement in relation to PRoW between the parties.	In response to comments by Ms Rhodes on behalf of CCC regarding existing NMU access over the disused March to Wisbech railway line at New Bridge Lane, Ms Brodrick explained that the existing situation on the disused railway crossing is that vehicular access is prevented by a bollard and there are signs, erected by Network Rail, which state that there is no PRoW. The Applicant is in discussions with Network Rail in relation to a provision of right of way for owners and occupiers of number 10 New Bridge Lane. Ms Brodrick set out that she had understood that Ms Rhodes was requesting an improvement on the existing situation in the form of Network Rail granting permissive rights, rather than asserting that there are no rights of way (notwithstanding that in practice people are using the crossing). The Applicant will put forward CCC's request to Network Rail. However, it is the Applicant's position that it is within Network Rail's control as to whether it wishes to change the rights of access across their land and Network Rail may not wish to do so for operational reasons.
	The ExA asked the Applicant to clarify why those rights of access are only being negotiated for 10 New Bridge Lane and not for NMUs. The ExA noted that in practice there has been the use of the crossing despite the sign. The ExA commented that he was finding it difficult to understand why the access being proposed for 10 New Bridge Lane could not be expanded for others.	Ms Brodrick explained that the existing access which Number 10 New Bridge Lane uses (via New Drove) is being altered as a result of the Proposed Development. In comparison, the position in relation to NMUs remains the same as currently there is no formal right of way for NMUs and the Applicant is not proposing any change to the current situation.

Item	ExA Question/ Context for Discussion	Applicant's Response
	The ExA asked the Applicant to respond to the points raised by CCC in relation to a permissive agreement and to specifically address the assertion that 10 New Bridge Lane is not the only land impacted by the Proposed Development	Ms Brodrick explained that the Applicant notes that FDC is the owner of land to the south of New Bridge Lane and rights for FDC are forming part of the discussion with Network Rail. In respective of a permissive agreement, the Applicant's position is that it cannot comment on what position Network Rail would take in respect of current use by NMUs and the extent to which Network Rail considers the current signage to be sufficient or not. The Applicant will raise the possibility of a permissive rights agreement with Network Rail and will report back to all parties. The Applicant notes that Ms Rhodes confirmed that CCC had not had any discussions with Network Rail to date regarding a permissive agreement. Ms Brodrick confirmed that the Applicant would keep the ExA updated on the progress of discussions that there are already some tripartite discussions planned.
	The ExA noted that it was aware of CCC's concern in relation to land take but given that these concerns were linked with the notification for a change application, the ExA confirmed that this discussion would be placed on hold for a later hearing in order to give all parties the opportunity to review the request and information provided.	N/A
3i	The ExA invited any IPs to ask questions on the issues discussed.	N/A
Agenda Item 4 – Air Quality		
4a	The ExA explained that the purpose of this item is to examine the Proposed Development in relation to air quality, mainly: • baseline assessment and methodology;	Dr Matt Ösund-Ireland, for the Applicant, explained that the identification of receptors requires defining the Study Area. The factors that were considered where road traffic, construction dust and the emissions from the chimney stack that can impact both human and ecological receptors. Guidance assisted the Applicant to identify the Study Area, for example, LAQM technical guidance and guidance from the Institute of Air Quality Management were used to identify the types of road traffic situations and

Item	ExA Question/ Context for Discussion	Applicant's Response
	• construction and operations effects on human and ecological receptors; and • mitigation and monitoring and impact on Air Quality Management Areas. The ExA explained that given the long list of documents identified in the Agenda for this agenda item, she did not wish to repeat these. However, the ExA confirmed that the parties were in agreement with the key documents as listed in the Agenda. The ExA asked the Applicant to explain its approach to air quality issues as detailed in Chapter 8 of the ES, Air Quality [APP-035], focusing particularly on the identification of potential receptors, assessment methodology, likely significant effects and mitigation measures.	distances for their assessment [*Post hearing note: Department of the Environment, Food and Rural Affairs (2021) Local Air Quality Management Technical Guidance LAQM and IAQM/EPUK 'Land-Use Planning & Development Control: Planning for Air Quality' (2017) guidance*]. The Study Area for the consideration of effects from the operation of the chimney covers a 15km radius. This is in line with guidance issued by the Environment Agency [Post hearing note: Air Emissions Risk Assessment for your Environmental Permit guidance', 2016 as amended Environment Agency], which refers to a distance of 10-15km. SPAs, SACs, Ramsar sites and Sites of Special Scientific Interest within 15km of the Proposed Development and all further statutory and non-statutory biodiversity sites within 2km are considered in the assessment of chimney emissions. Guidance was followed to identify ecological receptors within 15km of the site [Post hearing note: IAQM's 'A guide to the assessment of air quality on designated nature conservation sites' (2020)]. Mr Ösund-Ireland explained that the Zone of Influence and Study Area are the same for these purposes and are based on distances defined by guidance. Within the study areas, the Applicant identified types of receptors as set out in LAQM technical guidance *[Post hearing note: Department of the Environment, Food and Rural Affairs (2021) Local Air Quality Management Technical Guidance LAQM],* for example individual properties, schools and hospitals. Mr Ösund-Ireland explained that representative receptors were considered, with a balance between considering every receptor and including enough receptors to make the assessment robust.
	The ExA noted Figure 8.3 [APP-052] and asked the Applicant to clarify how it arrived at the model receptors and how such models link to the Applicant's conclusions.	Mr Ösund-Ireland explained that the receptors were used to reflect the developed residential areas and includes those within close proximity to roads where construction traffic would travel and receptors within the Air Quality Management Areas, which is shown on Figure 8.2. Mr Ösund-Ireland confirmed that the receptors are representative of types and locations at different stages of the Proposed Development.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Mr Ösund-Ireland explained that there is no formal process to determine the exact number of receptors, rather it is professional judgement. The Applicant has modelled the air quality impacts at all of the receptors, identified in Figure 8.3, and Mr Ösund-Ireland explained that the Applicant pulled the value of the receptors with the greatest change between the baseline and the Proposed Development through into the assessment.
	The ExA asked the Applicant to discuss the assessment methodology and link this discussion to table 8.18 and how sites have been divided into the different categories **[APP-035].**	Mr Ösund-Ireland for the Applicant explained that there are 4 types of impacts assessed: - The potential air quality impact of construction traffic - The potential air quality impact of operational traffic; - The potential air quality impact of emissions from the chimney stack; and - The potential air quality impact of odour during operation. With the impacts being experienced by human and ecological receptors, different significance criteria were used within the assessment. The IAQM/EPUK 'Land-Use Planning & Development Control: Planning for Air Quality' (2017) guidance **[Table 8.18 in APP-035]** is used for urban air quality assessments as it enables the Applicant to review the long-term changes in annual mean concentrations. For example, nitrogen dioxide is emitted from road traffic and the chimney. The long term impacts are assessed using the criteria in Table 8.18 **[APP-035]** and the short term impacts are assessed using criteria published in EA guidance *[Post hearing note: 'Air Emissions Risk Assessment for your Environmental Permit guidance', 2016 as amended. Environment Agency]*.
	The ExA asked the Applicant to explain how it arrived at the summary of significant effects identified in Table 8.35, particularly where the Applicant has identified a higher sensitivity and higher magnitude of change.	Mr Ösund-Ireland explained that IAQM 'Guidance on the Assessment of Dust from Demolition and Construction' (2014), sets out both residential and industrial receptors within 350m of the construction. Those distances comprise the Study Area.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Mr Ösund-Ireland stated that the first step is to determine the sensitivity of the receptor. By way of example, using construction dust, a residential property is highly sensitive and commercial facility that is a car show room would also be highly sensitive. However, if the commercial facility is a brickyard, then the receptor would not be deemed highly sensitive to dust nuisance. Therefore, Mr Ösund-Ireland set out that there is a pragmatic approach to determine the sensitivity. The Applicant also considered the nature of the activity, for example, demolition or earth works, and the extent of the activity to generate a potential impact. Once these have been considered, the Applicant is able to combine sensitivity and the extent of change to determine the risk level and then the level of mitigation that is required. This then feeds into the Outline Dust Management Plan, found in Appendix A of the **Outline CEMP [REP3-023]**. Mr Ösund-Ireland confirmed that the assessment is a risk-based approach. Depending on the level of risk, this directly impacts the level of mitigation applied. For example, with construction dust, if the level of risk was identified as low then dust management aspects would be minimal, whereas if a high risk was identified then dust management elements would be extensive. Mr Ösund-Ireland confirmed that residential receptors have a high sensitivity. T Mr Ösund-Ireland explained that the magnitude of change is based on the percentage of change. The Applicant concluded that the air quality impact of the Proposed Development is not significant. Where the potential significance (in the case of dust) is medium risk, once the appropriate mitigation measures are applied this reduces the risk to negligible. Mr Ösund-Ireland explained that the starting position is that risks can be managed. *[Post hearing note: ES Chapter 8 Air Quality Section 8.6 Assessment Scope paragraph 8.6.15 [APP-035] explains that the consideration of construction dust generated follows the IAQM's 'Guidance on the assessment of dust from demolition and construction' (2014). This guidance is used to inform the assessment of dust risk and to recommend appropriate mitigation measures to be included in a Dust Management Plan.]*

Item	ExA Question/ Context for Discussion	Applicant's Response
	The ExA commented on the Applicant's use of the phrase 'embedded mitigation measures'. The ExA asked the Applicant what mitigation was considered as additional and what was embedded mitigation?	Mr Kenyon explained that the embedded measures are set out in the **ES Chapter 8 Air Quality Section 8.7 [APP-035]**, that the process forms part of the application and that they are considered prior to the assessment. Mr Kenyon further explained it is the **Outline CEMP [REP3-023]** and the documents that support it, such as the Outline Dust Management Plan at Appendix A to the Outline CEMP. The assessment has been undertaken on the basis that those measures are embedded and they are secured through the **draft DCO [REP3-007]**. Mr Kenyon explained that where the risk is medium, with the embedded measures such as for example the CEMP, the significance is reduced to negligible.
	The ExA asked the Applicant if they have considered any optional mitigation measures in regard to air quality.	Mr Kenyon explained that the **Outline Local Air Quality Monitoring Strategy (LAQMS) [REP3-035]** was submitted at Deadline 3 following discussions with Borough Council of King's Lynn and Norfolk (BCKLWN) and FDC and that this is in addition to the embedded mitigation. Mr Ösund-Ireland confirmed that following the implementation of mitigation measures that the Applicant is confident that it has mitigated against air quality impacts.
4c	The ExA then asked the Local Host Authorities (LHAs) and Interested Parties (IPs) to comment, highlighting particular areas of disagreement between the parties. The ExA noted that it had reviewed the submissions from BCKLWN notably their Relevant Representation [RR-001] and BCKLWN Local Impact Report [REP1-064] which identified concerns relating to air quality that might not have been adequately addressed yet by the Applicant.	In response to comments from Mr Alford, Senior Officer for BCKLWN, on air quality monitoring, Mr Marks, for the Applicant, explained that since Deadline 3 the Applicant has updated the **Outline LAQMS [REP3-035]** and sent it to BCKLWN for comment. An update to the **Outline LAQMS (Rev 3)** has been submitted at Deadline 4 which constitutes the agreed form of this strategy. The Applicant and the host authorities have agreed that the method for delivery of the LAQMS is by way of DCO Requirement 27, rather than by way of a separate section 106 agreement. The ExA noted that the Statement of Common Ground (SoCG) should reflect this. The Applicant agreed that this will be set out in the next iteration of the SoCG. *[Post Hearing Note: Mr Alford commented that the traffic data used in the air quality assessment was initially different from that used in the traffic assessment. The Applicant responded to this point in its **Applicant's Comments on the Relevant***

Item	ExA Question/ Context for Discussion	Applicant's Response
		Representations Part 1 Local Authorities and Statutory Parties [REP1-028] *and updated a revised* ***Air Quality Technical Report (ES Appendix 8B Chapter 8 Air Quality Appendices) [REP2-007]*** *at Deadline 2.]*
4d	The ExA then asked CCC and FDC to comment, highlighting particular areas of disagreement between the parties.	The Applicant notes that Ms Wilson, Technical Director acting on behalf of CCC and FDC confirmed that CCC and FDC agreed that the impacts are negligible, and the monitoring strategy is required to provide transparency to the public. In response to comments from Ms Wilson as to whether any management measures are being proposed in addition to monitoring measures, Mr Marks explained that there are a number of management strategies, which include: - **Outline Construction Environment Management Plan [REP3-023]** - **Outline Construction Traffic Management Plan [REP3-014]** - **Outline Operational Traffic Management Plan [REP3-025]** - **Outline Local Air Quality Monitoring Strategy [REP3-034]** - **Outline Odour Management Plan [REP1-021]** In addition, the Environmental Permit will also have its own Management Plans. In response to comments from Ms Wilson on how the Applicant would monitor and mitigate any exceedances, Mr Marks confirmed that reporting would be on a quarterly basis but the Applicant would consider the most appropriate way to notify of any exceedances. Mr Marks also explained that the Applicant will have monitoring under the Environmental Permit, under which it will be required to regularly report to the EA on the emissions and any exceedances, with a regime in place to control exceedances.
4e	The ExA then invited any Interested Parties to comment, highlighting particular areas of disagreement between the parties.	In response to comments from Mr Little, on behalf of Kings Lynn Without Incineration, on the type of instruments used to monitor any exceedances, Mr Marks explained that submitted at Deadline 3, the **Outline LAQMS [REP3-035]** was updated to accelerate the period of monitoring to the start of construction, enabling the Applicant to build up the additional data, including weather monitoring capabilities. In terms of the locations this will be agreed with the environmental health officers as part of the detailed LAQMS submitted for approval under Requirement 27 of the **draft DCO [REP3-007]**.

Item	ExA Question/ Context for Discussion	Applicant's Response
		The Applicant confirmed that the Outline LAQMS would be updated to address the points raised. *[Post Hearing note: the updated Outline LAQMS Revision 3 (Volume 9.21) is submitted at Deadline 4]*
Agenda Item 5 - Climate Change including Carbon Mitigation and Carbon Capture		
	The ExA set out that the purpose of this item is to examine the Proposed Development in relation to climate change including carbon mitigation and carbon capture, mainly: • the assessment of greenhouse gas (GHG) emissions, including the Applicant's methodology and assumptions during construction, operation, and decommissioning; and • the approach to carbon mitigation through Combined Heat and Power (CHP) and Carbon Capture and Storage (CCS). The ExA confirmed if all parties were happy with the list of documents listed in the Agenda. The ExA noted two additional documents that were not listed in the Agenda which would be key to this agenda item: **APP-030** Description of the proposed development and the draft DCO **REP-007**. The ExA asked the Applicant to set out their approach to carbon mitigation through combined heat and power and the level of certainty they have that this can be delivered. The ExA also asked the Applicant to explain how requirement 25 in the draft DCO would work in practice.	Mr Carey explained that the Applicant wants to find opportunities to provide heat and MVV is committed to making its facilities not just CHP ready but CHP in practice. Mr Carey explained that the EfW CHP Facility Site was specifically chosen as it lends itself to supply heat to existing heat demands, as well as the future heat demands in the land identified as ready for industrial development. Mr Carey explained that the Applicant is keen to maximise the use of the energy that is recovered from the waste. Ms Brodrick explained that the drafting for the CHP Requirement is based on similar requirements in other granted DCOs for development of this type. Requirement 25 requires the Applicant to submit a report to the relevant planning authorities that updates the CHP assessment and demonstrates how the Applicant has considered the opportunities for the export of heat from the EfW CHP Facility along the CHP Connection (being Works Number 3, 3A and 3B within Schedule 1 to the **draft DCO [REP3-007]**). The purpose of Requirement 25 is to ensure that where there are no existing contracts in place for users of CHP, the Applicant must ensure that there are opportunities for the heat to be taken by local users. This increases the potential for heat to be exported with opportunities to be explored throughout the lifetime of the Proposed Development. However, the intention is to enter into agreement with users once the DCO has been granted. Mr Carey explained that this kind of obligation is something that the Applicant is committed to at other facilities and is something the Applicant actively does. Once the DCO has been granted, the Applicant will start marketing the opportunity to relevant

Item	ExA Question/ Context for Discussion	Applicant's Response
		heat and power users. A pipeline will be required and the disused railway provides a corridor for some potential customers. The Applicant may also require further approvals for pipelines to other customers. The Applicant will actively market the supply of steam and hot water at competitive prices, and users would have the benefit of carbon savings.
	The ExA noted the importance the Government attached to CHP. The ExA stated that it is not clear at present that the CHP has yet been fully explored. The ExA need to understand the benefits of CHP and the Applicant's deliverability. The ExA would expect to see proof of evidence to demonstrate the extent of the benefits offered and the deliverability of CHP.	Ms Brodrick explained that the adopted NPS EN-1 states that substantial positive weight should be given to applications that incorporate CHP, as is the case for the Proposed Development. It then sets out the list of criteria the Applicant should provide where a project does not include CHP, including demonstrating why it is not economically or practically feasible to provide the heat demand. However, the Applicant is not in this position. The Applicant is proposing to provide CHP and has included the necessary apparatus as part of the Proposed Development. The issue is how much weight can be given to the benefits offered by CHP in the planning balance in light of the fact that there are no specified users contracted to take the heat. However, it should be noted that at this stage in the process it is not typical to have contracts in place. Ms Brodrick referred to paragraph 4.6.12 of NPS EN-1 which provides that the DCO can contain requirements to ensure a generating station is CHP-ready in the event that there are no potential users currently identified but it is likely that there could be users in the future. The Applicant's position is that the Proposed Development is in compliance with NPS EN-1, as provided for in the **draft DCO [REP3-007]**. Mr Carey confirmed that the steam turbine will have a suitable extraction point from which the steam will be taken. The Applicant has designed the Proposed Development with the objective of having a pipeline. The Applicant has identified four potential customers and asked for data on their current energy demand, with some data provided to the Applicant. This has enabled the Applicant to be confident that the size of the extraction is adequate to provide for the required demand. In response to a query from the ExA queried as to the weight that can be given to the CHP since there is no evidence of customers, Mr Carey explained that the Applicant's heat customers in Germany change over time, with customers there today that were

Item	ExA Question/ Context for Discussion	Applicant's Response
		not customers 20 years ago. Mr Carey added that the ExA should not look at a single point in time, but instead at the potential for CHP customers. Ms Brodrick reiterated that the Applicant's position is that the potential to provide CHP can be considered as a positive benefit and it would be unreasonable to not attach any weight to the Proposed Development's CHP potential solely on the basis that the Applicant could not provide evidence of committed customers at this point in the process.
	The ExA asked for any comments from the LA or any interested parties regarding combined heat and power	N/A
	The ExA will ask the Applicant to set out their approach to Carbon Capture and Storage (CCS) as part of the proposed development, including the draft DCO requirements [REP3-007] and how these are intended to work in practice.	Mr Carey explained that it is part of MVV's policy to reduce carbon and be climate positive in 2040. This depends heavily on how the UK government decides to support these projects, including other aspects around carbon taxes. The Applicant has reserved land in the right location, close to the chimney, in which CCS can be built and has begun discussions about how the carbon can be taken out of the atmosphere. Mr James Ashton, Head of Engineering for the Applicant, explained that the Applicant has reserved an area of land on the EfW CHP Facility Site and that there are number of technologies in the market, with many still in early stages and not proven on a commercial scale. Amine base solution is currently selected as the preferred technology, but this could change as the technology evolves. The Applicant has employed a well-known technology supplier to carry out a pre-feasibility study and the Applicant is confident that the area is adequate to build the CCS apparatus. Mr Ashton explained that the turbine will be retrofit ready. The Applicant has included allowance for space to divert the flue gas from the chimney to the CCS apparatus and will have the space for carbon capture switch gear. The Applicant will obtain and store the required turbine parts to retrofit once the CCS apparatus is installed. The Applicant is therefore confident that the Proposed Development can deliver a CCS solution within the EfW CHP Facility Site.

Item	ExA Question/ Context for Discussion	Applicant’s Response
		Mr Carey explained that amine is a group of chemicals that absorb carbon dioxide – amine is the most proven technology and the Applicant is confident the standard amine solution will fit. Mr Ashton explained that another technology being considered is a rotary pack absorber, which is smaller in size. The Applicant is confident that the space reserved for CCS is adequate. Mr Carey explained that the challenge is not just to capture the carbon, but also how to take it out of the environment and store it, which known as “sequestering” the carbon. The Applicant’s parent company has become a participant in the Bacton Thames Net Zero consortium, which is examining a project to sequestrate carbon dioxide in expired gas and oil fields linked to the Bacton gas terminal in Norfolk. This includes new pipelines from carbon emitters to Bacton and as such are outside the scope of this DCO Application. Decisions on how carbon will be exported and stored under the seabed will not be made until after the DCO Application has been determined. Mr Carey confirmed that to fully realise the capture and sequestration of carbon from the Proposed Development it would require another DCO application (as the pipeline would be over 10 miles long) but it was technically possible.
	The ExA asked the Applicant to explain how requirement 22 and 23 of the DCO will work in practice.	Ms Brodrick explained that Requirement 22 in the **draft DCO [REP3- 007]** secures the carbon capture and export readiness reserve space required to deliver future environmental requirements relating to CCS. A **Carbon Capture and Export Readiness Reserve Space Plan [REP2-024]** details the location of this space. The requirement obliges the Applicant not to sell that area of the land and not to do anything that would prevent CCS export equipment coming forward. This is therefore a restriction on the usage of the site to ensure the development is decarbonisation ready. Requirement 23 of the **draft DCO [REP3-007]** secures the production of a carbon capture readiness monitoring report to be submitted to the Secretary of State, which will set out how the undertaker is monitoring the ongoing feasibility of carbon capture and exploring technology. This provides evidence that the Applicant has complied with Requirement 22. It also requires the Applicant to confirm the ability to retrofit the

Item	ExA Question/ Context for Discussion	Applicant's Response
		development with the technology and provide explanations as to whether there are additional consents required to ensure the development is decarbonisation ready.
	The ExA queried why the Applicant is proposing to submit the report to the SoS as opposed to the LPA.	Ms Brodrick, for the Applicant, explained that the Applicant based the drafting on similar requirements in made DCOs (such as the Drax Power (Generating Stations) Order 2019). It is the Applicant's understanding that the SoS's preference is that the report is submitted to the SoS. The Applicant confirmed that it is content with sending a copy to the LPA if required.
	The ExA wanted to clarify its understanding that the Applicant is committing to exploring the feasibility of CCS and not making a commitment to provide CCS.	Mr Carey confirmed that the ExA's understanding was correct. The Government has requested expressions of interest in Bacton Thames Net Zero consortium, and it is hoped that the Proposed Development will get Government support. The Applicant is not in a position to commit to providing CCS until Government support is known.
	The ExA noted that it is clear that when considering the extent of the benefits being offered, at present CCS is not included as an element of the Proposed Development	Mr Carey responded that, unlike the position regarding confidential discussions with potential heat customers, the Applicant is in a position to confirm that it is part of the Bacton Thames Net Zero consortium. The Applicant could explore the option of providing a copy of the agreement to the ExA, but this may need to be redacted as there are 12 parties.
	The ExA invited CCC and FDC if they would like to make any comments.	In response to comments made by Mr Fraser-Urquhart on behalf of CCC regarding the deliverability of CCS, Ms Brodrick explained that the Applicant is policy compliant in terms of being decarbonisation ready both in terms of the adopted NPS EN-1 and emerging policy in the Revised Draft NPS EN-1. Mr Carey explained that the Applicant would be content to demonstrate that the plant is being designed to allow for CCS and that the Applicant is ensuring that the design can accommodate various elements either immediately or following retrofitting. The Applicant proposed that it would modify Requirement 22 to incorporate design commitments in the next version of the draft DCO submitted at Deadline 5. Mr Carey added that the Applicant will also be governed by the EA in the Environmental Permit and will need to comply with the EP conditions.

Item	ExA Question/ Context for Discussion	Applicant's Response
	The ExA asked if any other interested parties would like to comment in relation to CCS.	In response to comments from Councillor Michael de Whalley regarding the parasitic load of the amine based solution and the rotary packed solution and how this would impact the net capacity of the plant, Mr Carey explained that there would be a reduction in the net output of the facility as the amount of power into the grid will be reduced as a result of electricity needed to operate the CCS. However, the gross output will remain the same at almost 60 megawatts and therefore the Proposed Development would still remain a DCO project even with CCS. In response to comments from Councillor de Whalley relating to the alternative options being considered to minimise carbon emissions until CCS is deployed, Mr Carey responded that the best solution in absence of CCS would be for FDC and CCC to encourage local businesses to cut off gas boilers and take steam from the Applicant, which would reduce overall carbon emissions. In response to comments from Mr J Dowen on behalf of UKWIN, Mr Carey reiterated that the Applicant will ensure that the facility is decarbonisation ready and will demonstrate that it has the means to transport the carbon dioxide to Bacton. The Applicant will do this regardless of the Environmental Permit requirements. In response to comments from Mr Little regarding the location of the pipeline for transporting carbon, Mr Carey explained that there are two pipelines from Bacton to King's Lynn and there is the potential to either use one of the existing pipelines or to lay a new pipeline to take carbon dioxide to Bacton. Bacton Thames Net Zero Project are developing this project. At this current stage, the Applicant does not believe there are any firm timescales for that project.
	The ExA asked the Applicant to set out their approach to the assessment of GHG emissions of the Proposed Development during construction, operation, and decommissioning. The ExA asked the Applicant to set out their methodology for assessing the net GHG emissions when comparing the effects of the Proposed Development with the effects of no development.	Mr Ösund-Ireland explained that the **ES Chapter 14: Climate [APP-041]** sets out the legislation and national, regional and local policies relevant to the Greenhouse Gas (GHG) emissions associated with the Proposed Development. Chapter 14 of the ES then lists the technical guidance used to undertake the assessment of GHGs (Table 14.8) and the sources of data used for the desktop assessment (Table 14.10). The technical guidance documents are all peer reviewed

Item	ExA Question/ Context for Discussion	Applicant's Response
	The ExA asked the Applicant about the level of confidence it has in its calculations given the challenges raised against the GHG figures.	or Government approved publications that are commonly applied to carbon assessments of infrastructure projects in the UK. The activity data for the Proposed Development are provided in the ES. The calculation of indicative carbon content and calorific values of main waste types found in residual waste was undertaken by the Applicant using their Greenhouse Gas Calculator for Municipal Waste (WRATE v2). These calculations were compared to the indicative carbon content and breakdown of residual waste used in EfW facilities from a Zero Waste Scotland study, the Carbon Trust Report for Cory Riverside EfW Facility and the Defra Carbon Modelling of UK Waste Streams (APP-041, para 14.8.19). All the information used in the assessment was government approved, a public source or verified by comparing to other studies. Mr Ösund-Ireland continued by explaining Table 14.31 on page 63 of Chapter 14 shows each stage of the Proposed Development from construction to operation and provides a side by side comparison without the Proposed Development and with the Proposed Development for the disposal of the residual waste. In respect of the Applicant's confidence, the Applicant has carried out a robust assessment by using published data, considered the sensitivity of the conclusions to variations and has taken a conservative approach in assuming no local CHP supply and assuming no CCS. In conclusion, the core assessment demonstrates the Proposed Development would have a net benefit compared to landfill of residual waste.
	The ExA read paragraph 14.9.1.2 and paragraph 14.9.51 from the ES. The ExA then asked for reassurance from the Applicant given the number of assumptions that have been made in arriving at those conclusions and the Applicant's confidence in these.	Mr Ösund-Ireland explained that the calculation on landfill is based on UK Government methodologies and it is therefore acceptable to assume that they are the best available. *[Post hearing note: Data and methodologies used can be found within **ES Chapter 14: Climate Table 14.10 [APP-041]** and include Residual Waste Composition Data from, Zero Waste Scotland and from WRAP]*

Item	ExA Question/ Context for Discussion	Applicant's Response
	The ExA then noted ES Chapter 14 **[APP-041]** section 14.9.49 and asked the Applicant to confirm how they reached this conclusion. The ExA noted that in paragraph 14.9.51 it concludes 'beneficial significant effect', the ExA queried where that word has come from since IEMA only references beneficial and not significant.	Mr Ösund-Ireland for the Applicant made reference to section 6 IEMA guidance paragraph 6.1 of the IEMA guidance states that: *"When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its life time, which may be positive, negative or negligible".* The Proposed Development will replace existing development or baseline activity in the form of the landfill of residual waste, so the Applicant is looking at it in terms of net impact. Moreover, highlighted in para 6.2 of the IEMA guidance: *"The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050".* Waste to energy as a means of waste disposal is something that is aligned to net zero. The GHG assessment undertaken and reported in the ES compares emissions from the Proposed Development with emissions from the existing case of landfilling residual waste. The change in GHG emissions associated with the Proposed Development is assessed against the UK carbon budgets and GHG emissions policy objectives at the national level, and are further contextualised at the regional and local scales. Table 14.19 of the **ES Chapter 14: Climate [APP-041],** provides definitions of significance used in the assessment which are taken from Box 3 of the IEMA guidance: *Beneficial: the project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-*

Item	ExA Question/ Context for Discussion	Applicant's Response
		project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact. Mr Ösund-Ireland explained that IEMA guidance makes reference to the receptor being the global climate, so all emissions are deemed significant regardless of whether positive or negative. The Proposed Development, by disposing of residual waste rather than landfilling, would have a positive effect in actively reducing emissions.
	The ExA asked the Applicant to explain how the development is compliant with the net zero pathway	Mr Ösund-Ireland, for the Applicant, explained that the assessment considers the impact of the Proposed Development on the achievement of the 2050 net zero target, to which future carbon budgets will be aligned. Net zero is about recognising that we have to move forward and take into account the fact that some technologies are not currently available. The opportunities of waste to energy to either provide heat or electricity locally and CCS are options that allow developments to remain on the net zero pathway. The net zero pathway requires government leadership and the Proposed Development cannot be considered in isolation. Ms Brodrick drew the ExA's attention to paragraph 3.7.89 of the revised draft NPS EN-3 which cross references to NPS EN-1 which clearly states the proposed policy is that the Secretary of State does not need to assess individual applications against the international climate position or carbon budgets or net zero pathways.
	The ExA asked CCC and FDC to comment on this issue specifically on the joint local impact report and REP2-033 and relevant reps RR-002.	Ms Sarah Wilkinson introduced herself as the Carbon Energy Manager from CCC. The overall scale of GHG emissions estimated in Table 14.27 and 14.31 is about 11 million tonnes over 40 years. This a very large scale of GHG emission. GHG emission from EfW plants vary depending on the composition of the waste. The Applicant's sensitivity analysis in **Appendix 14C [APP-088]** considered alternative cases, however, both reduce food waste and plastic waste by the same percentage and fail to consider the separate impacts. Ms Wilson explained that she has carried out a number of alternative analysis and in some circumstances landfill has better GHG emissions than EfW. Ms Wilkinson explained that she would challenge the description and the baseline of the without Proposed Development scenario as it cannot be assumed that the waste would go to landfill for the entire 40 years. The Proposed Development cannot be regarded

Item	ExA Question/ Context for Discussion	Applicant's Response
		as replacing an existing development. We have to think carefully about the baseline and look at emissions in its own right. Ms Wilkson explained another concern is the figure for avoided emissions is incorrect and the benefit is much smaller than claimed. Avoided emissions will gradually reduce each year as the UK grid decarbonises over time. At **Appendix 9.2C [REP1-036]** the Applicant has produced a revised calculation of the benefits of avoided emissions, which reduced 2.8 million tonnes, which is about 10% of the original benefit claimed. Ms Wilkinson concluded that combining these concerns, the overall uncertainty is such that we cannot know if the GHG emissions will be higher or lower. In response to comments from Sarah Wilkinson, Carbon Energy Manager at CCC, on alternative analysis carried out by CCC, Mr McGovern, for the Applicant, asked whether full details of the analysis undertaken has been submitted into the Examination so that the Applicant can scrutinise the data (as opposed to just a summary of the conclusions). Mr Fraser-Urquhart confirmed that the summary of the analysis is available at **REP2-031** and a full analysis will be attached to CCC and FDC's oral submissions. Mr McGovern confirmed that the Applicant would respond to the full analysis in writing. However, from a policy perspective it is clear from the revised draft NPS EN-1 and NPS EN-3 that EfW is supported in the future government energy strategy. It is explicitly set out in paragraph 3.3.41 that energy from waste has lower GHG impact than landfill.
	The ExA then invited UKWIN to comment and make particular focus on areas where they are in disagreement	In response to comments from Mr S Dowen on the Applicant providing copies of the spreadsheets used for the sensitivity analysis, Mr McGovern confirmed that the Applicant will provide the spreadsheets with the formulas for Deadline 4. In response to comments from Mr S Dowen on the composition of waste, Mr McGovern explained that reasonable scenarios have already been modelled and the Applicant is not proposing to submit any further analysis. However, UKWIN could do their own further modelling if they wish to do so using the spreadsheet provided.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Mr S Dowen explained UKWIN's concerns of the handling of biogenic carbon sequestration. The Applicant failed to properly account for biogenic carbon sequestration in landfill. When the calculation is done properly then the GHG impact of the landfill is reduced by 184,600 tonnes of carbon dioxide and it shows that it would be significantly worse than landfill with respect of GHG performance. Mr S Dowen asked the Applicant to confirm that they do not dispute if one follows the method set out in [**REP2-064]** and kept all other assumptions that this would reduce the GHG benefits of the development by 171,846 tonnes of carbon dioxide per annum, which would tip the balance to adverse significant effect. In response to a number of technical questions posed by Mr S Dowen, Mr Ösund-Ireland explained that given the technical nature of the questions it would be easier to receive that question in writing to ensure that Applicant can accurately respond. Mr Ösund-Ireland added that the composition of waste can vary and that the Applicant has used the best available information to undertake the assessment.
Agenda item 6 - Review of issues and actions arising		
	The ExA stated that he does not intend to review the issues and actions from this hearing now, however they will be written into a note and published as soon as practicable.	N/A
Agenda item 7 - Any other business		
	The ExA asked if there were any other business.	Mr Marks stated that in relation to the **Outline Local Air Quality Monitoring Strategy (LAQMS) [REP3-035]**, the Applicant will add in further commitments on the exceedance points following the concerns raised by stakeholders during ISH4. Mr Marks confirmed this would be updated and will be submitted at Deadline 4.

Item	ExA Question/ Context for Discussion	Applicant's Response
		Post hearing note: the updated Outline LAQMS (Rev 3) has been submitted at Deadline 4.
	The ExA acknowledged the notification of the Applicant's intention to submit a change application. The ExA asked that the Applicant to highlight the changes that they have proposed and the reasoning behind those changes. The ExA asked the Applicant to also confirm when those changes will be submitted to the ExA. The ExA requested that the Applicant confirm that is has considered the Planning Inspectorates advice note regarding change requests and that the change request will be developed in accordance with that guidance.	Mr Marks explained that the proposed non-material changes application is the result of discussions with CCC. Specifically reviewing how junction arrangements at Cromwell Road will work with signalisation. Therefore, the Applicant would like to include additional land to accommodate for a filter lane and signalising. The second change is in relation to a drop kerb crossing that the Applicant wishes to include in the DCO Order limits. Ms Brodrick explained that the Applicant intends to submit the changes application on 5 June 2023. The notification letter submitted to the ExA sets out suggested timing and how the changes application could be accommodated within the existing timeline based on the assumption that the changes application is accepted on 9 June 2023 (if considered appropriate by the ExA). The proposed timescales are based on the acceptance of changes applications of a similar nature on other DCO projects. Ms Brodrick explained that there were only minor changes proposed, that do not involve additional compulsory acquisition of land only highways powers. The Applicant has set out the reasons why it considers that the changes application does not necessitate a separate form of statutory consultation. However, should the ExA consider that non statutory consultation is necessary then the Applicant has set out how that could be accommodated within the Examination timetable within the notification letter. Ms Brodrick confirmed that the Applicant is aware of the PINS Advice Note and the Application will contain the information set out in that Advice Note. In response to concerns raised by Mr Fraser-Urquhart over whether the land to be included was highway land, Ms Brodrick explained that the Applicant had based the changes on information and mapping provided by CCC. Ms Brodrick requested that CCC confirm its position as soon as possible to enable the change application to be accommodated within the ExA timetable. Ms Brodrick reiterated that the purpose of the change application is to increase the Order limits to accommodate the signalisation

Item	ExA Question/ Context for Discussion	Applicant's Response
		works, the Applicant is not suggesting that the full detailed design of the signalisation has been agreed or fixed at this stage. Ms Brodrick confirmed that the Applicant has had significant discussions with CCC and that the Applicant will continue to work with CCC on this matter.
Agenda Item 8 - Closure of Hearing		
	The ExA thanked the parties for their contributions and closed the hearing.	N/A

Table 1.2 ISH 4 Action Points: Applicant's response

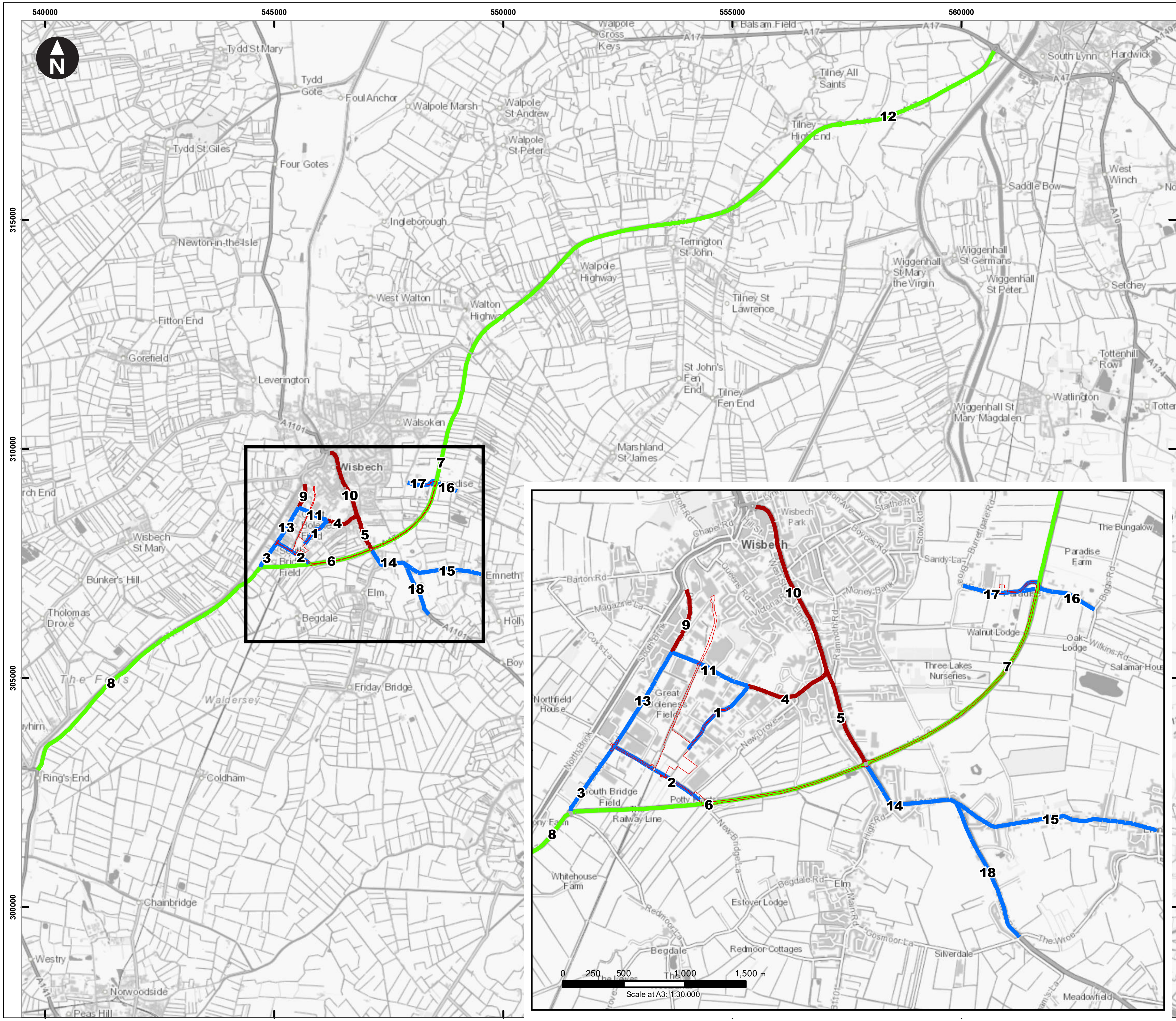
Ref	Party	Action Point	Deadline	Applicant's Response
ISH4-1	Applicant	Applicant to map out the information included in Table 6.24 Receptors potentially requiring assessment, namely Link No	Deadline 4	A figure identifying the Table 6.24 Receptors (Link No) has been created and is provided as Appendix A.
ISH4-2	Applicant/ Cambs CC	Applicant and Cambs CC to engage on outstanding issues in relation to Highways issues including Protective Provisions, particularly payments for highway damage, and to update the ExA and Statement of common ground to reflect this.	Deadline 5	Action noted.
ISH4-3	Applicant/ Cambs CC	Applicant to work with CCC on negotiations of the Section 278 Agreement, particularly financial contributions to the maintenance of roads.	Deadline 5	Action noted.
ISH4-4	Applicant/ Network Rail/ Cambs DC/ Fenland DC	Applicant to involve Fenland District Council (Fenland DC) and Cambs CC in its discussions with Network Rail to secure permissive rights Non-Motorised Users access via New Bridge Lane during construction and operation and for the Applicant to update ExA accordingly.	Deadline 5	Action noted.

Ref	Party	Action Point	Deadline	Applicant's Response
ISH4-5	Applicant	Applicant to review the latest update of the Air Quality Monitoring Strategy in relation to reporting times for exceedances of established thresholds to the Local Authority.	Deadline 4	Submitted at Deadline 4, the **Outline Local Air Quality Monitoring Strategy Revision 3 (Volume 9.21)** (clean and tracked versions) are updated to accommodate the reporting of exceedances and within a timeframe to be agreed for the detailed LAQMS that is secured by a draft DCO Requirement.
ISH4-6	Applicant	Applicant to provide information on the design features of the equipment to show that the plant is being designed and specified to allow carbon capture and modify requirement 22.	Deadline 5	Action noted.
ISH4-7	Applicant	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.	Deadline 5	Action noted.
ISH4-8	Applicant	Applicant to provide unlocked carbon calculation functional spreadsheets with formulae to enable other users to carry out sensitivity analysis, as per UKWIN request.	Deadline 4	A pdf version is submitted into the Examination as Appendix B to this document and the Applicant will issue the corresponding Excel spreadsheets to UKWIN and CCC.

Ref	Party	Action Point	Deadline	Applicant's Response
ISH4-9	UKWIN/ Applicant	UKWIN to provide in writing question presented at ISH4 for the Applicant relating to the Applicant's handling of biogenic carbon sequestration in landfill. Applicant to respond to this question by the earliest deadline.	Deadline 4	On receipt of the written questions from UKWIN, the Applicant shall provide a written response.

Appendix A Traffic and Transport Figure: Receptors Potentially Requiring Assessment

H:\Projects\41310 Wisbech\Design_Technical - GI\Drawings\ArcGIS\Workspaces\41310-WOOD-XX-XX-FG-OT-0006_S2_P01.1.mxd Originator: jacqui.parkin



Key

Order limits

Receptor sensitivity

High

Medium

Negligible

0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 m

Scale at A3: 1:80,000

Client

Medworth CHP Limited
Medworth Energy from Waste Combined Heat and Power Facility DCO

Receptors potentially requiring assessment

May 2023

41310-WOOD-XX-XX-FG-OT-0006_S2_P01.1

Appendix B Climate Change and Carbon: Greenhouse Gas Emissions Spreadsheets

GHG Assessment page 1 of 6 Embodied carbon

Based on assumptions from the Waste and Resources Action Programme (WRAP), Net Waste Tool (2008), wastage rates used to assess the material quantities based on the amount of waste, and the Waste Benchmark Calculator data from Query submitted on BRE Smartwaste 21/03/2019, this calculates the estimated material resource required for the project over the construction period. The calculation uses a 15,000 m2 estimate of the gross internal area (GIA) of the Proposed Development and categorises this as civil engineering under BRE Smartwaste's defined component categories. Material quantities for concrete and metals are based upon information available from the Applicant from similar facilities. Using the total materials required for the Proposed Development (inclusive of waste) and the Inventory of Carbon and Energy (ICE) Database carbon factors / BEIS 2021 emission factors the embodied carbon GHG emissions over the construction phase is determined.

Floor Area (m2)	15,000
Category	Civil Engineering
GHG Emissions (kt CO2e)	35.55

GHG Assessment page 2 of 6

Process emissions

Scope: The carbon emissions arising from any on- or off-site construction-related activities must be considered in [A5]. This includes any energy consumption for site accommodation, plant use and the impacts associated with any waste generated through the construction process, its treatment and disposal.

KPI: 1400kgCO2e/£100k

Source: https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/building-surveying-standards/whole-life-carbon-assessment-for-the-built-environment

Construction Cost (£)	350,000,000
Construction KPI (at 1400kgCO2e/ £100k)	1,400
Estimated Process emissions during construction (kgCO2e)	4,900,000.00
Estimated Process emissions during construction (tCO2e)	4,900.00
Estimated Process emissions during construction (ktCO2e)	4.90

Note: construction costs excluding consultancy fees

GHG Assessment page 3 of 6

Maintenance

MVV provided data - diesel 1,939,360 l per annum including 5d (4b would be 10% of it)

BEIS emissions factors - liquid fuels - gas oil - 0.63253 kg CO2e per litre

Total diesel use per annum (litres)	1,939,360
Maintenance diesel use per annum (litres)	193,936
Years of operation	40
Lifetime biodiesel use (litres)	7,757,440
Emissions conversion factor gas oil (kg CO2e per litre)	0.63253
Lifetime diesel use emissions (kg CO2e)	4,906,813.52
Lifetime diesel use emissions (t CO2e)	4,906.81
Lifetime diesel use emissions (kt CO2e)	**4.91**

GHG Assessment page 4 of 6

Operational water use

MVV provided data - 40,000 tpa

BEIS emissions factors - water supply - 0.149 kg CO_2e per m3

One metric tonne of water converted into cubic meter of water equals = 1.00 m3 - cu m

Water use per annum (tonnes)	40,000
Water use per annum (m3)	40,000
Years of operation	40
Lifetime water use (m3)	1,600,000
Emissions conversion factor (CO2e per m3)	0.149
Lifetime operational water use emissions (kg CO2e)	238,400.00
Lifetime operational water use emissions (t CO2e)	238.40
Lifetime operational water use emissions (kt CO2e)	**0.24**

GHG Assessment page 5 of 6

IBA and APCr

The IBA remaining after combustion equates to approximately 26.5% by weight of the input waste, this equates to approximately 165,600tpa assuming a maximum waste throughput of 625,600tpa

The IBA would be sent to a suitably licenced facility and in the UK where possible, for recycling

BEIS emissions factors - waste disposal - refuse - commercial and industrial waste - open-loop recycling (note factor greyed out assumed the same as closed-loop) - 21.294 kg CO2e per tonne

The APC residues amount to approximately 5% of the total waste by volume, this equates to approximately 31,280tpa assuming a maximum waste throughput of 625,600tpa

The APC residues are not dissimilar to powdered cement

The APC residues would be sent to a suitable licenced facility and in the UK where possible, for disposal

BEIS emissions factors - waste disposal - construction - aggregates - landfill - 1.239 kg CO2e per tonne

IBA per annum (tonnes)	165,600
Years of operation	40
Lifetime IBA (tonnes)	6,624,000
Emissions conversion factor (CO2e per tonne)	21.294
Lifetime IBA emissions (kg CO2e)	141,051,456.00
Lifetime IBA emissions (t CO2e)	141,051.46
Lifetime IBA emissions (kt CO2e)	**141.05**

APCr per annum (tonnes)	31,280
Years of operation	40
Lifetime APCr (tonnes)	1,251,200
Emissions conversion factor (CO2e per tonne)	1.239
Lifetime APCr emissions (kg CO2e)	1,550,236.80
Lifetime APCr emissions (t CO2e)	1,550.24
Lifetime APCr emissions (kt CO2e)	**1.55**

Total lifetime IBA and APCr emisisons (kt CO2e)	**142.60**

Summary

GHG Assessment page 6 of 6

kt	No Development					With Development											Difference	UKCB (kt)			
	Operation			Avoided		Construction			Operation					Decom	Avoided						
	Landfill	Road Traffic	Energy		Total	Materials	Process	Transport	Maintenance	Combustion	Op Water Use	IBA and APCr	Road Traffic			Total					
2023					0.00	11.85	1.63	2.67								16.15	16.15	4th UKCB	-83.41	1,950,000	-0.0043%
2024					0.00	11.85	1.63	2.65								16.13	16.13				
2025					0.00	11.85	1.63	2.62								16.10	16.10				
2026	287.23	3.10	0.63	-20.04	270.92				0.12	273.33	0.006	3.57	8.11		-80.08	205.05	-65.87				
2027	287.23	3.07	0.63	-20.04	270.89				0.12	273.33	0.006	3.57	8.04		-80.08	204.98	-65.92				
2028	287.23	3.04	0.63	-20.04	270.87				0.12	273.33	0.006	3.57	7.97		-80.08	204.91	-65.96	5th UKCB	-330.55	1,725,000	-0.0192%
2029	287.23	3.02	0.63	-20.04	270.84				0.12	273.33	0.006	3.57	7.90		-80.08	204.84	-66.00				
2030	287.23	2.96	0.63	-20.04	270.78				0.12	273.33	0.006	3.57	7.74		-80.08	204.68	-66.10				
2031	287.23	2.90	0.63	-20.04	270.72				0.12	273.33	0.006	3.57	7.59		-80.08	204.53	-66.20				
2032	287.23	2.85	0.63	-20.04	270.67				0.12	273.33	0.006	3.57	7.45		-80.08	204.39	-66.28				
2033	287.23	2.80	0.63	-20.04	270.62				0.12	273.33	0.006	3.57	7.32		-80.08	204.26	-66.36	6th UKCB	-332.47	965,000	-0.0345%
2034	287.23	2.75	0.63	-20.04	270.58				0.12	273.33	0.006	3.57	7.20		-80.08	204.14	-66.43				
2035	287.23	2.71	0.63	-20.04	270.54				0.12	273.33	0.006	3.57	7.10		-80.08	204.04	-66.50				
2036	287.23	2.68	0.63	-20.04	270.50				0.12	273.33	0.006	3.57	7.00		-80.08	203.94	-66.56				
2037	287.23	2.64	0.63	-20.04	270.47				0.12	273.33	0.006	3.57	6.91		-80.08	203.85	-66.62				
2038	287.23	2.61	0.63	-20.04	270.43				0.12	273.33	0.006	3.57	6.83		-80.08	203.77	-66.67				
2039	287.23	2.58	0.63	-20.04	270.41				0.12	273.33	0.006	3.57	6.76		-80.08	203.70	-66.71				
2040	287.23	2.56	0.63	-20.04	270.38				0.12	273.33	0.006	3.57	6.70		-80.08	203.64	-66.75				
2041	287.23	2.53	0.63	-20.04	270.36				0.12	273.33	0.006	3.57	6.62		-80.08	203.56	-66.80				
2042	287.23	2.51	0.63	-20.04	270.34				0.12	273.33	0.006	3.57	6.57		-80.08	203.51	-66.83				
2043	287.23	2.50	0.63	-20.04	270.32				0.12	273.33	0.006	3.57	6.53		-80.08	203.47	-66.85				
2044	287.23	2.49	0.63	-20.04	270.31				0.12	273.33	0.006	3.57	6.50		-80.08	203.44	-66.87				
2045	287.23	2.48	0.63	-20.04	270.30				0.12	273.33	0.006	3.57	6.48		-80.08	203.42	-66.88				
2046	287.23	2.47	0.63	-20.04	270.29				0.12	273.33	0.006	3.57	6.45		-80.08	203.39	-66.90				
2047	287.23	2.46	0.63	-20.04	270.29				0.12	273.33	0.006	3.57	6.44		-80.08	203.38	-66.91				
2048	287.23	2.46	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.43		-80.08	203.37	-66.92				
2049	287.23	2.46	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.42		-80.08	203.36	-66.92				
2050	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92	Net Zero			
2051	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2052	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2053	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2054	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2055	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2056	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2057	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2058	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2059	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2060	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2061	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2062	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2063	287.23	2.45	0.63	-20.04	270.27				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2064	287.23	2.45	0.63	-20.04	270.27				0.12	273.33	0.006	3.57	6.41		-80.08	203.36	-66.91				
2065	287.23	2.45	0.63	-20.04	270.27				0.12	273.33	0.006	3.57	6.41		-80.08	203.36	-66.91				
2066					0.00									16.15		16.15	16.15				
2067					0.00									16.13		16.13	16.13				
2068					0.00									16.10		16.10	16.10				
Total	11,489.35	103.85	25.04	-801.42	10,816.83	35.55	4.90	7.93	4.91	10,933.05	0.24	142.60	271.68	48.38	- 3,203.20	8,246.03	- 2,570.80				
	See waste spreadsheet	See transport spreadsheet		See waste spreadsheet				See transport spreadsheet		See waste spreadsheet			See transport spreadsheet		See waste spreadsheet						

Transport GHG Calculations page 1 of 6

	Data Sources					
	Description	**Value**	**Unit**	**Source**	**Further info**	**Website**
Construction	Average freight haul of glass cement metal	99.7	km	DfT Freight statistic (TSGB04)		https://www.gov.uk/government/statistical-data-sets/tsgb04-freight
Construction and Operation	Average commuting distance	14.6	km	DfT: NTS0403: Average number of trips, miles and time spent travelling by trip purpose: England	9.11 miles = 14.58 km	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/905985/nts0403.ods

Transport GHG Calculations page 2 of 6

Construction data

	2023 to 2026 (36 months)
Total HGV movements	90,934
Total LGV movements	298,031

Table RFS0105

https://www.gov.uk/government/statistical-data-sets/tsgb04-freight

Goods lifted[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonnes

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
Metal, mineral and chemical products									
Glass, cement and other non-metallic mineral products		34	25	23	10	6	8	4	111
Metal products		6	4	5	3	3	4	1	25

Table RFS0105

Goods moved[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonne kilometres

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
Metal, mineral and chemical products									
Glass, cement and other non-metallic mineral products		484	932	1,654	1,235	1,013	1,965	1,685	**8,967**
Metal products		75	136	330	369	593	922	541	**2,965**

Glass, cement and other non-metallic mineral products	Average distance:	80.8
Metal products	Average distance:	118.6
	Total average:	99.7

Transport GHG Calculations page 3 of 6

Operational data

	Weekly	Annual
Total HGV movements	1,548	80,496
Total LDV movements	96	4,992
Total car movements	358	18,616

Number of weeks per year
52

2011 Census: Usual resident population and population density, local authorities in the United Kingdom

https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/2011censuspopulationandhouseholdestimatesfortheunitedkingdom

	Administrative centre	Source	Centre postcode	Miles Distance to PE13 2TQ (Google maps)	km
Essex	Basildon	2011 Census	SS14 1LD	99.7	160.5
Hertfordshire	Watford	https://www.citypop	WD17 2PA	99.4	160.0
Leicester City	Leicester	2011 Census	LE1 5BD	61.7	99.3
Leicestershire	Loughborough	https://www.citypop	LE11 2QG	70.2	113.0
Lincolnshire	Lincoln	https://citypopulatic	LN2 1HL	58.7	94.5
Luton	Luton	2011 Census	LU1 2NB	78.1	125.7
Norfolk	Norwich	https://www.citypop	NR1 3RU	57.1	91.9
Northamptonshire	Northampton	2011 Census	NN1 2SQ	63.6	102.4
Rutland	Oakham	2011 Census	LE15 6AL	44.4	71.5
Thurrock	Thurrock	2012 Census		102.0	164.2

1.60934 km in 1 mile

Origin WPA	Shortfall (tonnes)	% share of overall shortfall after 2030	Largest settlement	Distance to Proposed Development (km)	HDV Movements (annual)	HDV km	LDV Movements (annual)	LDV km
Central Bedfordshire, Bedford City Council and Luton Borough Council	229,000	11	Luton	125.7	8,854.56	1,112,924.81	549.12	69,018.59
Essex (including Southend on Sea)	209,000	10	Basildon	160.5	8,049.60	1,291,567.96	499.20	80,097.24
Hertfordshire	507,363	24	Watford	160.0	19,319.04	3,090,435.84	1,198.08	191,654.94
Norfolk	703,000	33	Norwich	91.9	26,563.68	2,441,024.59	1,647.36	151,381.37
Thurrock	71,200	3	Thurrock	164.2	2,414.88	396,409.02	149.76	24,583.51
Leicester City	*unquantified*	*unquantified*	Leicester	99.3	*unquantified*	*unquantified*	*unquantified*	*unquantified*
Leicestershire	23,448	1	Loughborough	113.0	804.96	90,940.89	49.92	5,639.75
Lincolnshire	101,604	5	Lincoln	94.5	4,024.80	380,215.84	249.60	23,579.28
Northamptonshire	250,000	12	Northampton	102.4	9,659.52	988,690.74	599.04	61,314.15
Rutland	27,000	1	Oakham	71.5	804.96	57,518.17	49.92	3,567.02
TOTAL	2,121,615	100	**Average:**	118.3	80,496.00	9,849,727.88	4,992.00	610,835.84

Transport GHG Calculations page 4 of 6 Baseline landfill

Total HGV movements	80,496
Total LDV movements	4,992
Total car movements	18,616

Table RFS0105

https://www.gov.uk/government/statistical-data-sets/tsgb04-freight

Goods lifted[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonnes

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
	Waste related products	43	40	42	10	7	7	2	151

1. Goods lifted: the weight of goods carried, measured in tonnes.

Table RFS0105

Goods moved[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonne kilometres

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
	Waste related products	648	1,431	3,005	1,245	1,215	1,673	960	**10,177**

Average distance:	67.4
Average distance up to 150km (approx the 2 hours catchment)	46.9

Transport GHG Calculations page 5 of 6

Without development

Detailed Option 1, Rural (Not London), 48 kph

	100% HGV			100% LGV			100% Car	
	CO2 (g/km)	HGV km	kT CO2	CO2 (g/km)			CO2 (g/km)	Total
2023	828			186			113	
2024	823			184			110	
2025	816			181			107	
2026	809	3,773,772	3.1	178	234032	0.04	104	3.10
2027	802	3,773,772	3.0	176	234032	0.04	100	3.07
2028	795	3,773,772	3.0	173	234032	0.04	97	3.04
2029	789	3,773,772	3.0	170	234032	0.04	94	3.02
2030	773	3,773,772	2.9	164	234032	0.04	89	2.96
2031	758	3,773,772	2.9	159	234032	0.04	85	2.90
2032	744	3,773,772	2.8	155	234032	0.04	81	2.85
2033	732	3,773,772	2.8	150	234032	0.04	78	2.80
2034	720	3,773,772	2.7	146	234032	0.03	75	2.75
2035	710	3,773,772	2.7	142	234032	0.03	72	2.71
2036	700	3,773,772	2.6	139	234032	0.03	69	2.68
2037	691	3,773,772	2.6	136	234032	0.03	66	2.64
2038	683	3,773,772	2.6	134	234032	0.03	63	2.61
2039	677	3,773,772	2.6	132	234032	0.03	61	2.58
2040	670	3,773,772	2.5	129	234032	0.03	58	2.56
2041	663	3,773,772	2.5	127	234032	0.03	56	2.53
2042	658	3,773,772	2.5	125	234032	0.03	53	2.51
2043	654	3,773,772	2.5	124	234032	0.03	51	2.50
2044	651	3,773,772	2.5	122	234032	0.03	49	2.49
2045	649	3,773,772	2.4	121	234032	0.03	47	2.48
2046	646	3,773,772	2.4	120	234032	0.03	45	2.47
2047	645	3,773,772	2.4	118	234032	0.03	44	2.46
2048	644	3,773,772	2.4	117	234032	0.03	43	2.46
2049	644	3,773,772	2.4	116	234032	0.03	42	2.46
2050	643	3,773,772	2.4	114	234032	0.03	41	2.45
2051	643	3,773,772	2.4	114	234032	0.03	41	2.45
2052	643	3,773,772	2.4	114	234032	0.03	41	2.45
2053	643	3,773,772	2.4	114	234032	0.03	41	2.45
2054	643	3,773,772	2.4	114	234032	0.03	41	2.45
2055	643	3,773,772	2.4	114	234032	0.03	41	2.45
2056	643	3,773,772	2.4	114	234032	0.03	41	2.45
2057	643	3,773,772	2.4	114	234032	0.03	41	2.45
2058	643	3,773,772	2.4	114	234032	0.03	41	2.45
2059	643	3,773,772	2.4	114	234032	0.03	41	2.45
2060	643	3,773,772	2.4	114	234032	0.03	41	2.45
2061	643	3,773,772	2.4	114	234032	0.03	41	2.45
2062	643	3,773,772	2.4	114	234032	0.03	41	2.45
2063	643	3,773,772	2.4	114	234032	0.03	41	2.45
2064	643	3,773,772	2.4	114	234032	0.03	41	2.45
2065	643	3,773,772	2.4	114	234032	0.03	41	2.45

With development

Transport GHG Calculations page 6 of 6

Detailed Option 1, Rural (Not London), 48 kph

	100% HGV			100% LGV			100% Car			
	CO2 (g/km)	HGV km	kT CO2	CO2 (g/km)			CO2 (g/km)			Total
2023	828	3,021,787	2.50	186			113	1,448,429	0.16	2.67
2024	823	3,021,787	2.49	184			110	1,448,429	0.16	2.65
2025	816	3,021,787	2.46	181			107	1,448,429	0.15	2.62
2026	809	9,849,728	7.97	178	610,836	0.11	104	271,421	0.03	8.11
2027	802	9,849,728	7.90	176	610,836	0.11	100	271,421	0.03	8.04
2028	795	9,849,728	7.83	173	610,836	0.11	97	271,421	0.03	7.97
2029	789	9,849,728	7.77	170	610,836	0.10	94	271,421	0.03	7.90
2030	773	9,849,728	7.61	164	610,836	0.10	89	271,421	0.02	7.74
2031	758	9,849,728	7.47	159	610,836	0.10	85	271,421	0.02	7.59
2032	744	9,849,728	7.33	155	610,836	0.09	81	271,421	0.02	7.45
2033	732	9,849,728	7.21	150	610,836	0.09	78	271,421	0.02	7.32
2034	720	9,849,728	7.10	146	610,836	0.09	75	271,421	0.02	7.20
2035	710	9,849,728	6.99	142	610,836	0.09	72	271,421	0.02	7.10
2036	700	9,849,728	6.90	139	610,836	0.09	69	271,421	0.02	7.00
2037	691	9,849,728	6.81	136	610,836	0.08	66	271,421	0.02	6.91
2038	683	9,849,728	6.73	134	610,836	0.08	63	271,421	0.02	6.83
2039	677	9,849,728	6.66	132	610,836	0.08	61	271,421	0.02	6.76
2040	670	9,849,728	6.60	129	610,836	0.08	58	271,421	0.02	6.70
2041	663	9,849,728	6.53	127	610,836	0.08	56	271,421	0.02	6.62
2042	658	9,849,728	6.48	125	610,836	0.08	53	271,421	0.01	6.57
2043	654	9,849,728	6.44	124	610,836	0.08	51	271,421	0.01	6.53
2044	651	9,849,728	6.41	122	610,836	0.07	49	271,421	0.01	6.50
2045	649	9,849,728	6.39	121	610,836	0.07	47	271,421	0.01	6.48
2046	646	9,849,728	6.37	120	610,836	0.07	45	271,421	0.01	6.45
2047	645	9,849,728	6.35	118	610,836	0.07	44	271,421	0.01	6.44
2048	644	9,849,728	6.35	117	610,836	0.07	43	271,421	0.01	6.43
2049	644	9,849,728	6.34	116	610,836	0.07	42	271,421	0.01	6.42
2050	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2051	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2052	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2053	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2054	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2055	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2056	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2057	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2058	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2059	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2060	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2061	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2062	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2063	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2064	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2065	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41

Waste Composition (incl. sensitivity cases) page 1 of 6

	Assumptions	**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.coryenergy.com/wp-content/uploads/2018/01/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 municpial 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_%20England%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	WRAP 2020, National Municipal Waste Composition, England 2017, Table 3 https://wrap.org.uk/sites/default/files/2020-11/WRAP-National%20municipal%20waste%20composition_%20England%202017.pdf WRATE (2011), Greenhouse Gas Calculator for Municipal Waste. WRATE v2. (provided by MVV) 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
4	The Proposed Development 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 esimate of N_2O and CH_4 emissions associated with Stationary Combustion Processes, based on IPCC Guidelines for Greenhouse Gas Inventories and factors for Global Warming Potential (GWP): - N_2O default emissions factor for Stationary Combustion, municipal wastes (non-biomass fraction) = 4 kg N_2O/TJ - N_2O to CO_2 GWP = 265 kg CO_{2e} /kg N_2O - CH_4 default emissions factor for Stationary Combustion, municipal wastes (non-biomass fraction) = 30 kg CH_4/TJ - CH_4 to CO_2 GWP = 28 kg CO_{2e} /kg CH_4	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_Ch2_Stationary_Combustion.pdf IPCC 2014. IPCC 5th Assessment Report (AR5) https://www.ipcc.ch/pdf/assessmentreport/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf
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 auxilliary 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/greenhouse-gas-reporting-conversion-factors-2021
7	The GHG assement includes an estimate of GHG emissions offset by electricty 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 miniumum of 8,000 hrs per year (not stated in the PEIR) - 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 electricty 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 utliisation 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=12439_WR1908ReviewofMethaneEmissionsModelling.pdf
9	The GHG assement includes an estimate of GHG emissions offset by electricty 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 - electricity generated by the EfW Facility would displace the use of Natural Gas with an equivalent CO2 emissions factor of 371 g/kWh (BEIS 2019-2020)	DEFRA 2014. DEFRA Review of Landfill Methane Emissions Modelling http://randd.defra.gov.uk/Document.aspx?Document=12439_WR1908ReviewofMethaneEmissionsModelling.pdf
	For the sensitivity analysis: ***- Waste composition:*** two additional waste compostion scenarios are assumed: Reduced Recyclables - assuming a 20% increase in recyclables, and Reducedfood/plastics - assuming a further 90% increase in recycling of food/plastics. ***- UK grid decarbonisation:*** Current CO2 emissions factors for: UK Grid average electricity =182 g/kWh; and Natural Gas =380 g/kWh (BEIS 2020-2021). Future forecast CO2 emissions factors UK Grid average electricity = 23 g/kWh in 2035; and 6 g/kWh in 2050 (BEIS 2021: Treasury Green Book – Data Tables 1-19) - ***CHP - steam generation:*** information provided by MVV for the CHP design for exporting steam assumes export of 48.8MWe (allowing for 5MWe parasitic load) and 23.6 MWth of steam. Avoided emissions from steam generation are assumed to replace the use of Natural Gas up to 2035, with a CO2 emissions factor for Natural Gas = 202.97 g/kWh (BEIS: GHG reporting conversion factors 2021), and assumed to replace electricity in 2050, with a CO2 emissions factor for UK grid electricity in 2050 = 6 g/kWh (BEIS 2021: Treasury Green Book – Data Tables 1-19).	BEIS Fuel Mix Disclosure Data Table 2020-2021 https://www.gov.uk/government/publications/fuel-mix-disclosure-data-table BEIS (2021). Treasury Green Book – Data Tables 1-19 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1024043/data-tables-1-19.xlsx. Based on design information confirmed for steam generation by MVV 02Feb22 (Medworth ES - questions for MVV_SG.docx) BEIS (2021). Greenhouse gas reporting: conversion factors 2021 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

Waste Composition (incl. sensitivity cases) page 2 of 6 Core case

Waste Material GHG Assessment

1) Residual Waste Composition Data

Waste Stream	**WRAP 2017 Residual Waste (UK Grid - Emissions Factor)**
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%
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	**WRAP 2017 Residual Waste (UK Grid - Emissions Factor)**
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	70,142
Fossil derived CO2 emissions (tCO2)	257,187
N2O emissions from residual waste combustion (tonnes)	24
Equivalent CO2 emissions (tCO2e)	6,318
CH4 emissions from residual waste combustion (tonnes)	179
Equivalent CO2 emissions (tCO2e)	5,007
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424
Auxilliary Burners - emissions for use of fuel (tCO2e)	*4,815*
EfW Total emissions (tCO2e)	**273,326**
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)	**80,080**
EfW Net emissions (tCO2e)	**193,246**
Annual difference versus LFG	-73,952

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	**WRAP 2017 Residual Waste (UK Grid - Emissions Factor)**
Mass of biogenic carbon in residual waste (tonnes carbon)	93,735
Total carbon converted to LFG (tonnes carbon)	46,867
Methane in LFG released from residual waste (tCH4)	35,619
Methane in LFG captured for use in gas engines (tCH4)	24,221
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	1,140
Uncaptured LFG released to atmosphere as methane (tCH4)	10,258
LFG Equivalent CO2 emissions released to atmosphere (tCO2e)	**287,234**
Methane in LFG captured for use in gas engines (tCH4)	24,221
Methane used in gas engines (tCH4)	22,017
Fuel input to LFG engines (GJ)	396,306
Power generated by LFG engines (MWh)	110,085
UK grid CO2 emissions factor for electricity generation (g/kWh)	182
LFG Equivalent CO2 offset for electricity generation from combustion (tCO2e)	**20,035**
LFG Net emissions (tCO2e)	**267,198**

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
EfW Total themal capacity (MW)	200
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%

Waste Composition (incl. sensitivity cases) page 3 of 6

Core case - sensitivity

Waste Material GHG Assessment

1) Residual Waste Composition Data

Waste Stream	**Case 1: Core WRAP 2017**
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%
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%

1) Core Waste Composition	**UK Grid Emissions Factor (gCO2e/kWh)**			
	Current: gas	Current: ave	2035	2050
	380	182	23	6
Electricity only	139,275	73,952	21,496	15,887
CHP	158,748	103,246	58,675	16,722
	Core Case: % change	73,952		
Electricity only	88%	0%	-71%	-79%
CHP	115%	40%	-21%	-77%
	Core Case: relative change		>100%: +++/----	
			>50%: ++/---	
			>0%: +/-	
Electricity only	++		--	--
CHP	+++	+	-	--

Additional sensitivity parameters:

CO2 emissions factor for electricity generation - UK grid (g/kWh)	380	182	23	6	380	182	23	6
CO2 emissions factor for heat generation - natural gas (g/kWh)	202.97	202.97	202.97	6	202.97	202.97	202.97	6
CHP (MWe)	60	60	60	60	53.8	53.8	53.8	53.8
CHP (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
EfW vs Landfill difference (tCO2e)	139,275	73,952	21,496	15,887	158,748	103,246	58,675	16,722
EfW vs Landfill difference (tCO2e/tonne of waste)	0.22	0.12	0.03	0.03	0.25	0.17	0.09	0.03

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**
Total waste input (tonnes/yr)	625,600	625,600	625,600	625,600	625,600	625,600	625,600	625,600
Total Carbon (% by weight)	26.20%	26.20%	26.20%	26.20%	26.20%	26.20%	26.20%	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%	42.80%	42.80%	42.80%	42.80%	42.80%	42.80%	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	70,142	70,142	70,142	70,142	70,142	70,142	70,142	70,142
Fossil derived CO_2 emissions (tCO_2)	257,187	257,187	257,187	257,187	257,187	257,187	257,187	257,187
N_2O emissions from residual waste combustion	24	24	24	24	24	24	24	24
Equivalent CO_2 emissions (tCO_{2e})	6,318	6,318	6,318	6,318	6,318	6,318	6,318	6,318
CH_4 emissions from residual waste combustion	179	179	179	179	179	179	179	179
Equivalent CO_2 emissions (tCO_{2e})	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424
Auxilliary Burners (MWh)								
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*
EfW Total emissions (tCO_{2e})	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**
EfW Facility operations (hrs/yr)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
EfW Facility net electricity generation (MWe)	55	55	55	55	49	49	48.8	48.8
Electricity generated by EfW Facility (MWh)	440,000	440,000	440,000	440,000	390,400	390,400	390,400	390,400
CO2 emissions factor for electricity generation (g/kWh)	380	182	23	6	380	182	23	6
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	*167,200*	*80,080*	*10,120*	*2,640*	*148,352*	*71,053*	*8,979*	*2,342*
EfW Facility heat generation (MWth)	0	0	0	0	24	24	23.6	23.6
Heat exported by EfW facility (MWh)	0	0	0	0	188,800	188,800	188,800	188,800
CO2 emissions factor for heat generation (g/kWh) - gas: current/2035, elec: 2050	203	203	203	6	203	203	203	6
EfW Equivalent CO_2 offset for heat generation by Facility (tCO_{2e})	*0*	*0*	*0*	*0*	*38,321*	*38,321*	*38,321*	*1,133*
EfW Equivalent CO_2 offset for energy generation by Facility (tCO_{2e})	**167,200**	**80,080**	**10,120**	**2,640**	**186,673**	**109,374**	**47,300**	**3,475**
EfW Net emissions (tCO_{2e})	**106,126**	**193,246**	**263,206**	**270,686**	**86,654**	**163,953**	**226,026**	**269,851**

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**	**Case 1: Core WRAP 2017**
Mass of biogenic carbon in residual waste (tonnes carbon)	93,735	93,735	93,735	93,735	93,735	93,735	93,735	93,735
Total carbon converted to LFG (tonnes carbon)	46,867	46,867	46,867	46,867	46,867	46,867	46,867	46,867
Methane in LFG released from residual waste (tCH_4)	35,619	35,619	35,619	35,619	35,619	35,619	35,619	35,619
Methane in LFG captured for use in gas engines (tCH_4)	24,221	24,221	24,221	24,221	24,221	24,221	24,221	24,221
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Uncaptured LFG released to atmosphere as methane (tCH_4)	10,258	10,258	10,258	10,258	10,258	10,258	10,258	10,258
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**
Methane in LFG captured for use in gas engines (tCH_4)	24,221	24,221	24,221	24,221	24,221	24,221	24,221	24,221
Methane used in gas engines (tCH_4)	22,017	22,017	22,017	22,017	22,017	22,017	22,017	22,017
Fuel input to LFG engines (GJ)	396,306	396,306	396,306	396,306	396,306	396,306	396,306	396,306
Power generated by LFG engines (MWh)	110,085	110,085	110,085	110,085	110,085	110,085	110,085	110,085
CO2 emissions factor for energy generation (g/kWh)	380	182	23	6	380	182	23	6
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**41,832**	**20,035**	**2,532**	**661**	**41,832**	**20,035**	**2,532**	**661**
LFG Net emissions (tCO_{2e})	**245,402**	**267,198**	**284,702**	**286,573**	**245,402**	**267,198**	**284,702**	**286,573**

EfW Parameters:

N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	4	4	4	4	4	4	4	4
N_20 Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	265	265	265	265	265	265	265	265
CH_4 Emissions Factor 4 $kgCH_4$/TJ (IPCC)	30	30	30	30	30	30	30	30
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	28	28	28	28	28	28	28	28
Total Gas Oil (diesel) consumption (litres)	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%	90%	90%	90%	90%	90%	90%	90%
Fuel (Gas Oil) emissions factor ($kgCO_2e$/kWh)	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e$/litre)	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857

LFG Parameters:

Calorific value of methane (MJ/kg)	50	50	50	50	50	50	50	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%	50%	50%	50%	50%	50%	50%	50%
Proprtion of methane in LFG	57%	57%	57%	57%	57%	57%	57%	57%
Proportion of LFG recovered from residual waste	68%	68%	68%	68%	68%	68%	68%	68%
Oxidation of LFG released from residual waste to CO_2 in landfill cap	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Proportion of LFG used in gas engines	91%	91%	91%	91%	91%	91%	91%	91%
LFG engine efficiency: 36%	36%	36%	36%	36%	36%	36%	36%	36%

Reduced recyclables - sensitivity

Waste Composition (incl. sensitivity cases) page 4 of 6

Waste Material GHG Assessment

1) Residual Waste Composition Data

Waste Stream	Case 2: 20% Recyclables
Recyclable Paper	5.5%
Card	5.9%
Non-recyclable Paper	10.4%
Dense Plastic	7.3%
Plastic film	7.7%
Textiles	5.1%
Misc. Combustible	10.9%
Misc. Non-Combustible	4.2%
Other Wastes	0.4%
Glass	2.4%
Ferrous Metals	2.2%
Non-Ferrous Metals	1.0%
Food Waste	25.2%
Garden Waste	2.5%
Other Organic	2.7%
Wood	2.1%
WEEE	1.3%
Hazardous	0.6%
Fines	2.6%
Net Calorific Value (MJ/kg)	9.50
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.21%
Biogenic Carbon (% of Total Carbon)	58.35%
Non-Biogenic Carbon (% of Total Carbon)	41.65%

2) 20% recyclables reduction

UK Grid Emissions Factor (gCO2e/kWh)

	Current: gas	Current: ave	2035	2050
	380	182	23	6
Electricity only	151,217	86,351	34,261	28,692
CHP	170,689	115,644	71,441	29,527
Core Case: % change		73,952		
Electricity only	104%	17%	-54%	-61%
CHP	131%	56%	-3%	-60%
Core Case: relative change			>100%: +++/---- >50%: ++/--- >0%: +/-	
Electricity only	+++	+	--	--
CHP	+++	++	-	--

Additional sensitivity parameters:

CO2 emissions factor for electricity generation - UK grid (g/kWh)	380	182	23	6	380	182	23	6
CO2 emissions factor for heat generation - natural gas (g/kWh)	202.97	202.97	202.97	6	202.97	202.97	202.97	6
CHP (MWe)	60	60	60	60	53.8	53.8	53.8	53.8
CHP (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
EfW vs Landfill difference (tCO2e)	151,217	86,351	34,261	28,692	170,689	115,644	71,441	29,527
EfW vs Landfill difference (tCO2e/tonne of waste)	0.24	0.14	0.05	0.05	0.27	0.18	0.11	0.05

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables
Total waste input (tonnes/yr)	625,600	625,600	625,600	625,600	625,600	625,600	625,600	625,600
Total Carbon (% by weight)	26.21%	26.21%	26.21%	26.21%	26.21%	26.21%	26.21%	26.21%
Non-Biogenic Carbon (% of Total Carbon)	41.65%	41.65%	41.65%	41.65%	41.65%	41.65%	41.65%	41.65%
Mass of fossil carbon in residual waste (tonnes carbon)	68,298	68,298	68,298	68,298	68,298	68,298	68,298	68,298
Fossil derived CO_2 emissions (tCO_2)	250,425	250,425	250,425	250,425	250,425	250,425	250,425	250,425
N_2O emissions from residual waste combustion	24	24	24	24	24	24	24	24
Equivalent CO_2 emissions (tCO_{2e})	6,301	6,301	6,301	6,301	6,301	6,301	6,301	6,301
CH_4 emissions from residual waste combustion	178	178	178	178	178	178	178	178
Equivalent CO_2 emissions (tCO_{2e})	4,993	4,993	4,993	4,993	4,993	4,993	4,993	4,993
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424
Auxilliary Burners (MWh)								
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*
EfW Total emissions (tCO_{2e})	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**
EfW Facility operations (hrs/yr)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
EfW Facility net electricity generation (MWe)	55	55	55	55	48.8	48.8	48.8	48.8
Electricity generated by EfW Facility (MWh)	440,000	440,000	440,000	440,000	390,400	390,400	390,400	390,400
CO2 emissions factor for electricity generation (g/kWh)	380	182	23	6	380	182	23	6
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	*167,200*	*80,080*	*10,120*	*2,640*	*148,352*	*71,053*	*8,979*	*2,342*
EfW Facility heat generation (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
Heat exported by EfW facility (MWh)	0	0	0	0	188,800	188,800	188,800	188,800
CO2 emissions factor for heat generation (g/kWh) - gas: current/2035, elec: 2050	203	203	203	6	203	203	203	6
EfW Equivalent CO_2 offset for heat generation by Facility (tCO_{2e})	*0*	*0*	*0*	*0*	*38,321*	*38,321*	*38,321*	*1,133*
EfW Equivalent CO_2 offset for energy generation by Facility (tCO_{2e})	**167,200**	**80,080**	**10,120**	**2,640**	**186,673**	**109,374**	**47,300**	**3,475**
EfW Net emissions (tCO_{2e})	**99,334**	**186,454**	**256,414**	**263,894**	**79,861**	**157,160**	**219,234**	**263,059**

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables	Case 2: 20% Recyclables
Mass of biogenic carbon in residual waste (tonnes carbon)	95,702	95,702	95,702	95,702	95,702	95,702	95,702	95,702
Total carbon converted to LFG (tonnes carbon)	47,851	47,851	47,851	47,851	47,851	47,851	47,851	47,851
Methane in LFG released from residual waste (tCH_4)	36,367	36,367	36,367	36,367	36,367	36,367	36,367	36,367
Methane in LFG captured for use in gas engines (tCH_4)	24,729	24,729	24,729	24,729	24,729	24,729	24,729	24,729
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	1,164	1,164	1,164	1,164	1,164	1,164	1,164	1,164
Uncaptured LFG released to atmosphere as methane (tCH_4)	10,474	10,474	10,474	10,474	10,474	10,474	10,474	10,474
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**
Methane in LFG captured for use in gas engines (tCH_4)	24,729	24,729	24,729	24,729	24,729	24,729	24,729	24,729
Methane used in gas engines (tCH_4)	22,479	22,479	22,479	22,479	22,479	22,479	22,479	22,479
Fuel input to LFG engines (GJ)	404,621	404,621	404,621	404,621	404,621	404,621	404,621	404,621
Power generated by LFG engines (MWh)	112,395	112,395	112,395	112,395	112,395	112,395	112,395	112,395
CO2 emissions factor for energy generation (g/kWh)	380	182	23	6	380	182	23	6
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**42,710**	**20,456**	**2,585**	**674**	**42,710**	**20,456**	**2,585**	**674**
LFG Net emissions (tCO_{2e})	**250,550**	**272,804**	**290,675**	**292,586**	**250,550**	**272,804**	**290,675**	**292,586**

EfW Parameters:

N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	4	4	4	4	4	4	4	4
N_2O Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	265	265	265	265	265	265	265	265
CH_4 Emissions Factor 4 $kgCH_4/TJ$ (IPCC)	30	30	30	30	30	30	30	30
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	28	28	28	28	28	28	28	28
Total Gas Oil (diesel) consumption (litres)	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%	90%	90%	90%	90%	90%	90%	90%
Fuel (Gas Oil) emissions factor ($kgCO_2e/kWh$)	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e$/litre)	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857

LFG Parameters:

Calorific value of methane (MJ/kg)	50	50	50	50	50	50	50	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%	50%	50%	50%	50%	50%	50%	50%
Proprtion of methane in LFG	57%	57%	57%	57%	57%	57%	57%	57%
Proportion of LFG recovered from residual waste	68%	68%	68%	68%	68%	68%	68%	68%
Oxidation of LFG released from residual waste to CO_2 in landfill cap	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Proportion of LFG used in gas engines	91%	91%	91%	91%	91%	91%	91%	91%
LFG engine efficiency: 36%	36%	36%	36%	36%	36%	36%	36%	36%

Waste Composition (incl. sensitivity cases) page 5 of 6

Waste Material GHG Assessment

Reduced food and plastic - sensitivity

1) Residual Waste Composition Data

Waste Stream	Case 3: 90% Food/Plastic
Recyclable Paper	8.5%
Card	9.1%
Non-recyclable Paper	16.0%
Dense Plastic	1.4%
Plastic film	1.5%
Textiles	7.9%
Misc. Combustible	16.7%
Misc. Non-Combustible	6.5%
Other Wastes	0.5%
Glass	3.7%
Ferrous Metals	3.5%
Non-Ferrous Metals	1.6%
Food Waste	4.9%
Garden Waste	3.9%
Other Organic	4.1%
Wood	3.3%
WEEE	2.0%
Hazardous	0.9%
Fines	4.0%
Net Calorific Value (MJ/kg)	8.85
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	25.49%
Biogenic Carbon (% of Total Carbon)	74.58%
Non-Biogenic Carbon (% of Total Carbon)	25.42%

3) 90% of food & plastics	**UK Grid Emissions Factor (gCO2e/kWh)**			
	Current: gas	Current: ave	2035	2050
	380	182	23	6
Electricity only	314,582	255,113	207,358	202,253
CHP	334,055	284,407	244,538	203,088
Core Case: % change		73,952		
Electricity only	325%	245%	180%	173%
CHP	352%	285%	231%	175%
Core Case: relative change			>100%: +++/----	
			>50%: ++/---	
			>0%: +/-	
Electricity only	+++	+++	+++	+++
CHP	+++	+++	+++	+++

Additional sensitivity parameters:

CO2 emissions factor for electricity generation - UK grid (g/kWh)	380	182	23	6	380	182	23	6
CO2 emissions factor for heat generation - natural gas (g/kWh)	202.97	202.97	202.97	6	202.97	202.97	202.97	6
Methane capture rate (%)	68%	68%	68%	68%	68%	68%	68%	68%
CHP (MWe)	60	60	60	60	53.8	53.8	53.8	53.8
CHP (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
EfW vs Landfill difference (tCO2e)	314,582	255,113	207,358	202,253	334,055	284,407	244,538	203,088
EfW vs Landfill difference (tCO2e/tonne of waste)	0.50	0.41	0.33	0.32	0.53	0.45	0.39	0.32

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic
Total waste input (tonnes/yr)	625,600	625,600	625,600	625,600	625,600	625,600	625,600	625,600
Total Carbon (% by weight)	25.49%	25.49%	25.49%	25.49%	25.49%	25.49%	25.49%	25.49%
Non-Biogenic Carbon (% of Total Carbon)	25.42%	25.42%	25.42%	25.42%	25.42%	25.42%	25.42%	25.42%
Mass of fossil carbon in residual waste (tonnes carbon)	40,528	40,528	40,528	40,528	40,528	40,528	40,528	40,528
Fossil derived CO_2 emissions (tCO_2)	148,603	148,603	148,603	148,603	148,603	148,603	148,603	148,603
N_2O emissions from residual waste combustion	22	22	22	22	22	22	22	22
Equivalent CO_2 emissions (tCO_{2e})	5,868	5,868	5,868	5,868	5,868	5,868	5,868	5,868
CH_4 emissions from residual waste combustion	166	166	166	166	166	166	166	166
Equivalent CO_2 emissions (tCO_{2e})	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424
Auxilliary Burners (MWh)								
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*
EfW Total emissions (tCO_{2e})	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**
EfW Facility operations (hrs/yr)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
EfW Facility net electricity generation (MWe)	55	55	55	55	48.8	48.8	48.8	48.8
Electricity generated by EfW Facility (MWh)	440,000	440,000	440,000	440,000	390,400	390,400	390,400	390,400
CO2 emissions factor for electricity generation (g/kWh)	380	182	23	6	380	182	23	6
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	*167,200*	*80,080*	*10,120*	*2,640*	*148,352*	*71,053*	*8,979*	*2,342*
EfW Facility heat generation (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
Heat exported by EfW facility (MWh)	0	0	0	0	188,800	188,800	188,800	188,800
CO2 emissions factor for heat generation (g/kWh) - gas: current/2035, elec: 2050	203	203	203	6	203	203	203	6
EfW Equivalent CO_2 offset for heat generation by Facility (tCO_{2e})	*0*	*0*	*0*	*0*	*38,321*	*38,321*	*38,321*	*1,133*
EfW Equivalent CO_2 offset for energy generation by Facility (tCO_{2e})	**167,200**	**80,080**	**10,120**	**2,640**	**186,673**	**109,374**	**47,300**	**3,475**
EfW Net emissions (tCO_{2e})	**-3,265**	**83,855**	**153,815**	**161,295**	**-22,738**	**54,562**	**116,635**	**160,460**

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic	Case 3: 90% Food/Plastic
Mass of biogenic carbon in residual waste (tonnes carbon)	118,912	118,912	118,912	118,912	118,912	118,912	118,912	118,912
Total carbon converted to LFG (tonnes carbon)	59,456	59,456	59,456	59,456	59,456	59,456	59,456	59,456
Methane in LFG released from residual waste (tCH_4)	45,187	45,187	45,187	45,187	45,187	45,187	45,187	45,187
Methane in LFG captured for use in gas engines (tCH_4)	30,727	30,727	30,727	30,727	30,727	30,727	30,727	30,727
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446
Uncaptured LFG released to atmosphere as methane (tCH_4)	13,014	13,014	13,014	13,014	13,014	13,014	13,014	13,014
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**
Methane in LFG captured for use in gas engines (tCH_4)	30,727	30,727	30,727	30,727	30,727	30,727	30,727	30,727
Methane used in gas engines (tCH_4)	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931
Fuel input to LFG engines (GJ)	502,755	502,755	502,755	502,755	502,755	502,755	502,755	502,755
Power generated by LFG engines (MWh)	139,654	139,654	139,654	139,654	139,654	139,654	139,654	139,654
CO2 emissions factor for energy generation (g/kWh)	380	182	23	6	380	182	23	6
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**53,069**	**25,417**	**3,212**	**838**	**53,069**	**25,417**	**3,212**	**838**
LFG Net emissions (tCO_{2e})	**311,317**	**338,969**	**361,174**	**363,548**	**311,317**	**338,969**	**361,174**	**363,548**

EfW Parameters:

N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	4	4	4	4	4	4	4	4
N_2O Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	265	265	265	265	265	265	265	265
CH_4 Emissions Factor 4 $kgCH_4$/TJ (IPCC)	30	30	30	30	30	30	30	30
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	28	28	28	28	28	28	28	28
Total Gas Oil (diesel) consumption (litres)	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%	90%	90%	90%	90%	90%	90%	90%
Fuel (Gas Oil) emissions factor ($kgCO_2e$/kWh)	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e$/litre)	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857

LFG Parameters:

Calorific value of methane (MJ/kg)	50	50	50	50	50	50	50	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%	50%	50%	50%	50%	50%	50%	50%
Proprtion of methane in LFG	57%	57%	57%	57%	57%	57%	57%	57%
Proportion of LFG recovered from residual waste	68%	68%	68%	68%	68%	68%	68%	68%
Oxidation of LFG released from residual waste to CO_2 in landfill cap	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Proportion of LFG used in gas engines	91%	91%	91%	91%	91%	91%	91%	91%
LFG engine efficiency: 36%	36%	36%	36%	36%	36%	36%	36%	36%

Waste composition - sensitivity

Waste Composition (incl. sensitivity cases) page 6 of 6

Case 1: Core Case - Current Residual Waste (WRAP survey, 2017)

Waste Stream	Municipal Residual Waste: Commercial and Household (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	31.27%		10.749	1.84%		1.84%	0.63
Card	6.3%	31.27%		10.749	1.97%		1.97%	0.68
Non-recyclable Paper	8.9%	28.69%		9.735	2.55%		2.55%	0.87
Dense Plastic	7.8%		54.76%	24.682		4.27%	4.27%	1.93
Plastic film	8.2%		48.11%	21.279		3.95%	3.95%	1.74
Textiles	5.5%	19.93%	19.93%	14.327	1.10%	1.10%	2.19%	0.79
Misc. Combustible	9.3%	23.69%	15.79%	14.612	2.20%	1.47%	3.67%	1.36
Misc. Non-Combustible	3.6%	2.94%	4.05%	2.573	0.11%	0.15%	0.25%	0.09
Other Wastes	0.3%	2.94%	4.05%	2.573	0.01%	0.01%	0.02%	0.01
Glass	2.6%	0.31%		1.414	0.01%		0.01%	0.04
Ferrous Metals	2.4%							0.00
Non-Ferrous Metals	1.1%							0.00
Food Waste	27.0%	13.46%		3.460	3.63%		3.63%	0.93
Garden Waste	2.7%	17.17%		4.210	0.46%		0.46%	0.11
Other Organic	2.3%	17.17%		4.210	0.39%		0.39%	0.10
Wood	2.3%	17.17%		4.210	0.39%		0.39%	0.10
WEEE	1.1%		15.81%	7.060		0.17%	0.17%	0.08
Hazardous	0.5%	0.61%	19.76%	0.000	0.00%	0.10%	0.10%	0.00
Fines	2.2%	13.75%		3.479	0.30%	0.00%	0.30%	0.08
Total	100.0%				15.0%	11.2%	26.2%	9.53
					57.20%	42.80%		

Case 2: Waste Composition Sensitivity Analysis - Future Residual Waste (65% of municipal waste is recycled by 2035, with 44.5% already recycled in 2019)

Waste Stream	Current Residual Waste: Commercial and Household (% by weight)	Future Waste: 20% reduction in paper, card, food, plastics, glass, metals, garden and wood in residual waste	Equivalent weight of residual waste (tonnes)	Future Residual Waste: (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	20.0%	0.047	5.5%	31.27%		10.749	1.72%		1.72%	0.59
Card	6.3%	20.0%	0.050	5.9%	31.27%		10.749	1.84%		1.84%	0.63
Non-recyclable Paper	8.9%		0.089	10.4%	28.69%		9.735	2.98%		2.98%	1.01
Dense Plastic	7.8%	20.0%	0.062	7.3%		54.76%	24.682		3.99%	3.99%	1.80
Plastic film	8.2%	20.0%	0.066	7.7%		48.11%	21.279		3.69%	3.69%	1.63
Textiles	5.5%	20.0%	0.044	5.1%	19.93%	19.93%	14.327	1.02%	1.02%	2.05%	0.74
Misc. Combustible	9.3%		0.093	10.9%	23.69%	15.79%	14.612	2.57%	1.71%	4.29%	1.59
Misc. Non-Combustible	3.6%		0.036	4.2%	2.94%	4.05%	2.573	0.12%	0.17%	0.29%	0.11
Other Wastes	0.3%		0.003	0.4%	2.94%	4.05%	2.573	0.01%	0.01%	0.02%	0.01
Glass	2.6%	20.0%	0.021	2.4%	0.31%		1.414	0.008%		0.008%	0.03
Ferrous Metals	2.4%	20.0%	0.019	2.2%							
Non-Ferrous Metals	1.1%	20.0%	0.009	1.0%							
Food Waste	27.0%	20.0%	0.216	25.2%	13.46%		3.460	3.39%		3.39%	0.87
Garden Waste	2.7%	20.0%	0.022	2.5%	17.17%		4.210	0.43%		0.43%	0.11
Other Organic	2.3%		0.023	2.7%	17.17%		4.210	0.46%		0.46%	0.11
Wood	2.3%	20.0%	0.018	2.1%	17.17%		4.210	0.37%		0.37%	0.09
WEEE	1.1%		0.011	1.3%		15.81%	7.060		0.20%	0.20%	0.09
Hazardous	0.5%		0.005	0.6%	0.61%	19.76%	0.000	0.00%	0.12%	0.12%	0.00
Fines	2.2%		0.022	2.6%	13.75%		3.479	0.35%	0.00%	0.35%	0.09
Total	100.0%		0.856	100%				15.3%	10.9%	26.2%	9.50
								58.35%	41.65%		

Case 3: Sensitivity Analysis - Future Residual Waste (90% reduction in food and plastics, in addition to 20% reduction in other recyclables)

Waste Stream	Current Residual Waste: Commercial and Household (% by weight)	Future Waste: 90% reduction in plastics and food and 19.5% reduction in other recyclables in residual waste	Equivalent weight of residual waste (tonnes)	Future Residual Waste: (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	20.0%	0.047	8.5%	31.27%		10.749	2.66%		2.66%	0.91
Card	6.3%	20.0%	0.050	9.1%	31.27%		10.749	2.84%		2.84%	0.98
Non-recyclable Paper	8.9%		0.089	16.0%	28.69%		9.735	4.60%		4.60%	1.56
Dense Plastic	7.8%	90.0%	0.008	1.4%		54.76%	24.682		0.77%	0.77%	0.35
Plastic film	8.2%	90.0%	0.008	1.5%		48.11%	21.279		0.71%	0.71%	0.31
Textiles	5.5%	20.0%	0.044	7.9%	19.93%	19.93%	14.327	1.58%	1.58%	3.16%	1.14
Misc. Combustible	9.3%		0.093	16.7%	23.69%	15.79%	14.612	3.97%	2.64%	6.61%	2.45
Misc. Non-Combustible	3.6%		0.036	6.5%	2.94%	4.05%	2.573	0.19%	0.26%	0.45%	0.17
Other Wastes	0.3%		0.003	0.5%	2.94%	4.05%	2.573	0.02%	0.02%	0.04%	0.01
Glass	2.6%	20.0%	0.021	3.7%	0.31%		1.414	0.012%		0.012%	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%	0.17
Garden Waste	2.7%	20.0%	0.022	3.9%	17.17%		4.210	0.67%		0.67%	0.16
Other Organic	2.3%		0.023	4.1%	17.17%		4.210	0.71%		0.71%	0.17
Wood	2.3%	20.0%	0.018	3.3%	17.17%		4.210	0.57%		0.57%	0.14
WEEE	1.1%		0.011	2.0%		15.81%	7.060		0.31%	0.31%	0.14
Hazardous	0.5%		0.005	0.9%	0.61%	19.76%	0.000	0.01%	0.18%	0.18%	0.00
Fines	2.2%		0.022	4.0%	13.75%		3.479	0.54%	0.00%	0.54%	0.14
Total	100.0%		0.555	100%				19.0%	6.5%	25.5%	8.85
								74.58%	25.42%		

Uncontrolled copy

	Assumptions	**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.coryenergy.com/wp-content/uploads/2018/01/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 municpial 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_%20England%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.	WRAP 2020, National Municipal Waste Composition, England 2017, Table 3 https://wrap.org.uk/sites/default/files/2020-11/WRAP-National%20municipal%20waste%20composition_%20England%202017.pdf WRATE (2011), Greenhouse Gas Calculator for Municipal Waste. WRATE v2. (provided by MVV) 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
4	The Proposed Development is based on receiving up to 625,600 tonnes of residual (non-recyclable) waste per annum. 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 thermal 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 and NCV value calculated from WRAP and WRATE info
5	The GHG assessment includes an esimate of N_2O and CH_4 emissions associated with Stationary Combustion Processes, based on IPCC Guidelines for Greenhouse Gas Inventories and factors for Global Warming Potential (GWP): - N_2O default emissions factor for Stationary Combustion, municipal wastes (non-biomass fraction) = 4 kg N_2O/TJ - N_2O to CO_2 GWP = 265 kg CO_{2e} /kg N_2O - CH_4 default emissions factor for Stationary Combustion, municipal wastes (non-biomass fraction) = 30 kg CH_4/TJ - CH_4 to CO_2 GWP = 28 kg CO_{2e} /kg CH_4	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_Ch2_Stationary_Combustion.pdf IPCC 2014. IPCC 5th Assessment Report (AR5) https://www.ipcc.ch/pdf/assessmentreport/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf
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. If Hydrotreated Vegetable Oil (HVO) is used, emissions from fuel use would be reduced. - 'Gas Oil' represents the type of fuel that would be used in the auxilliary burners, with an equivalent CO2 emissions factor of 2.75857 kgCO2e/litre (BEIS 2021)	Based on design information confirmed by MVV BEIS UK Government GHG Conversion Factors for Company Reporting 2021 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021
7	The GHG assement includes an estimate of GHG emissions offset by electricty 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 miniumum of 8,000 hrs per year - electricity generated by the EfW Facility would displace the use of UK grid average electricity with an equivalent CO2 emissions factor of 182 g/kWh (BEIS 2020-2021)	Based on design information confirmed by MVV 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 electricty 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 utliisation 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 landfill operations in the UK is 68% - 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=12439_WR1908ReviewofMethaneEmissionsModelling.pdf
9	The GHG assement includes an estimate of GHG emissions offset by electricty 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 - electricity generated by LFG would displace the use of UK grid 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=12439_WR1908ReviewofMethaneEmissionsModelling.pdf
	For the sensitivity analysis: ***- Waste composition:*** two additional waste compostion scenarios are assumed: Reduced Recyclables - assuming a 20% increase in recyclables, and Reducedfood/plastics - assuming a further 90% increase in recycling of food/plastics. ***- UK grid decarbonisation:*** Current CO2 emissions factors for: UK Grid average electricity =182 g/kWh; and Natural Gas =380 g/kWh (BEIS 2020-2021). Future forecast CO2 emissions factors UK Grid average electricity = 23 g/kWh in 2035; and 6 g/kWh in 2050 (BEIS 2021: Treasury Green Book – Data Tables 1-19) - ***CHP - steam generation:*** information provided by MVV for the CHP design for exporting steam assumes export of 48.8MWe (allowing for 5MWe parasitic load) and 23.6 MWth of steam. Avoided emissions from steam generation are assumed to replace the use of Natural Gas up to 2035, with a CO2 emissions factor for Natural Gas = 202.97 g/kWh (BEIS: GHG reporting conversion factors 2021), and assumed to replace electricity in 2050, with a CO2 emissions factor for UK grid electricity in 2050 = 6 g/kWh (BEIS 2021: Treasury Green Book – Data Tables 1-19).	BEIS Fuel Mix Disclosure Data Table 2020-2021 https://www.gov.uk/government/publications/fuel-mix-disclosure-data-table BEIS (2021). Treasury Green Book – Data Tables 1-19 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1024043/data-tables-1-19.xlsx. Based on design information confirmed for steam generation by MVV 02Feb22 (Medworth ES - questions for MVV_SG.docx) BEIS (2021). Greenhouse gas reporting: conversion factors 2021 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

1) Residual Waste Composition Data

Waste Stream	WRAP 2017 Residual Waste (UK Grid - Emissions Factor)
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%
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	WRAP 2017 Residual Waste (UK Grid - Emissions Factor)
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	70,142
Fossil derived CO2 emissions (tCO2)	257,187
N2O emissions from residual waste combustion (tonnes)	24
Equivalent CO2 emissions (tCO2e)	6,318
CH4 emissions from residual waste combustion (tonnes)	179
Equivalent CO2 emissions (tCO2e)	5,007
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424
Auxilliary Burners - emissions for use of fuel (tCO2e)	*4,815*
EfW Total emissions (tCO2e)	**273,326**
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)	**80,080**
EfW Net emissions (tCO2e)	**193,246**
Annual difference versus LFG	-73,952

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	WRAP 2017 Residual Waste (UK Grid - Emissions Factor)
Mass of biogenic carbon in residual waste (tonnes carbon)	93,735
Total carbon converted to LFG (tonnes carbon)	46,867
Methane in LFG released from residual waste (tCH4)	35,619
Methane in LFG captured for use in gas engines (tCH4)	24,221
Uncaptured LFG oxidised to CO2 in landfill cap (tCH4)	1,140
Uncaptured LFG released to atmosphere as methane (tCH4)	10,258
LFG Equivalent CO2 emissions released to atmosphere (tCO2e)	**287,234**
Methane in LFG captured for use in gas engines (tCH4)	24,221
Methane used in gas engines (tCH4)	22,017
Fuel input to LFG engines (GJ)	396,306
Power generated by LFG engines (MWh)	110,085
UK grid CO2 emissions factor for electricity generation (g/kWh)	182
LFG Equivalent CO2 offset for electricity generation from combustion (tCO2e)	**20,035**
LFG Net emissions (tCO2e)	**267,198**

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
EfW Total themal capacity (MW)	200
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%

1) Residual Waste Composition Data

Waste Stream	Case 1: Core WRAP 2017
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%
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%

1) Core Waste Composition	UK Grid Emissions Factor (gCO2e/kWh) Current: gas 380	Current: ave 182	2035 23	2050 6
Electricity only	139,275	73,952	21,496	15,887
CHP	158,748	103,246	58,675	16,722
	Core Case: % change	73,952		
Electricity only	88%	0%	-71%	-79%
CHP	115%	40%	-21%	-77%
	Core Case: relative change		>100%: +++/---- >50%: ++/--- >0%: +/-	
Electricity only	++		--	--
CHP	+++	+	-	--

Additional sensitivity parameters:

CO2 emissions factor for electricity generation - UK grid (g/kWh)	380	182	23	6	380	182	23	6
CO2 emissions factor for heat generation - natural gas (g/kWh)	202.97	202.97	202.97	6	202.97	202.97	202.97	6
CHP (MWe)	60	60	60	60	53.8	53.8	53.8	53.8
CHP (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
EfW vs Landfill difference (tCO2e)	139,275	73,952	21,496	15,887	158,748	103,246	58,675	16,722
EfW vs Landfill difference (tCO2e/tonne of waste)	0.22	0.12	0.03	0.03	0.25	0.17	0.09	0.03

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017
Total waste input (tonnes/yr)	625,600	625,600	625,600	625,600	625,600	625,600	625,600	625,600
Total Carbon (% by weight)	26.20%	26.20%	26.20%	26.20%	26.20%	26.20%	26.20%	26.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%	42.80%	42.80%	42.80%	42.80%	42.80%	42.80%	42.80%
Mass of fossil carbon in residual waste (tonnes carbon)	70,142	70,142	70,142	70,142	70,142	70,142	70,142	70,142
Fossil derived CO_2 emissions (tCO_2)	257,187	257,187	257,187	257,187	257,187	257,187	257,187	257,187
N_2O emissions from residual waste combustion	24	24	24	24	24	24	24	24
Equivalent CO_2 emissions (tCO_{2e})	6,318	6,318	6,318	6,318	6,318	6,318	6,318	6,318
CH_4 emissions from residual waste combustion	179	179	179	179	179	179	179	179
Equivalent CO_2 emissions (tCO_{2e})	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424
Auxilliary Burners (MWh)								
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*
EfW Total emissions (tCO_{2e})	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**	**273,326**
EfW Facility operations (hrs/yr)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
EfW Facility net electricity generation (MWe)	55	55	55	55	49	49	48.8	48.8
Electricity generated by EfW Facility (MWh)	440,000	440,000	440,000	440,000	390,400	390,400	390,400	390,400
CO2 emissions factor for electricity generation (g/kWh)	380	182	23	6	380	182	23	6
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	*167,200*	*80,080*	*10,120*	*2,640*	*148,352*	*71,053*	*8,979*	*2,342*
EfW Facility heat generation (MWth)	0	0	0	0	24	24	23.6	23.6
Heat exported by EfW facility (MWh)	0	0	0	0	188,800	188,800	188,800	188,800
CO2 emissions factor for heat generation (g/kWh) - gas: current/2035, elec: 2050	380	182	23	6	203	203	203	6
EfW Equivalent CO_2 offset for heat generation by Facility (tCO_{2e})	*0*	*0*	*0*	*0*	*38,321*	*38,321*	*38,321*	*1,133*
EfW Equivalent CO_2 offset for energy generation by Facility (tCO_{2e})	**167,200**	**80,080**	**10,120**	**2,640**	**186,673**	**109,374**	**47,300**	**3,475**
EfW Net emissions (tCO_{2e})	**106,126**	**193,246**	**263,206**	**270,686**	**86,654**	**163,953**	**226,026**	**269,851**

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017
Mass of biogenic carbon in residual waste (tonnes carbon)	93,735	93,735	93,735	93,735	93,735	93,735	93,735	93,735
Total carbon converted to LFG (tonnes carbon)	46,867	46,867	46,867	46,867	46,867	46,867	46,867	46,867
Methane in LFG released from residual waste (tCH_4)	35,619	35,619	35,619	35,619	35,619	35,619	35,619	35,619
Methane in LFG captured for use in gas engines (tCH_4)	24,221	24,221	24,221	24,221	24,221	24,221	24,221	24,221
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Uncaptured LFG released to atmosphere as methane (tCH_4)	10,258	10,258	10,258	10,258	10,258	10,258	10,258	10,258
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**	**287,234**
Methane in LFG captured for use in gas engines (tCH_4)	24,221	24,221	24,221	24,221	24,221	24,221	24,221	24,221
Methane used in gas engines (tCH_4)	22,017	22,017	22,017	22,017	22,017	22,017	22,017	22,017
Fuel input to LFG engines (GJ)	396,306	396,306	396,306	396,306	396,306	396,306	396,306	396,306
Power generated by LFG engines (MWh)	110,085	110,085	110,085	110,085	110,085	110,085	110,085	110,085
CO2 emissions factor for energy generation (g/kWh)	380	182	23	6	380	182	23	6
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**41,832**	**20,035**	**2,532**	**661**	**41,832**	**20,035**	**2,532**	**661**
LFG Net emissions (tCO_{2e})	**245,402**	**267,198**	**284,702**	**286,573**	**245,402**	**267,198**	**284,702**	**286,573**

EfW Parameters:								
N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	4	4	4	4	4	4	4	4
N_2O Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	265	265	265	265	265	265	265	265
CH_4 Emissions Factor 4 $kgCH_4$/TJ (IPCC)	30	30	30	30	30	30	30	30
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	28	28	28	28	28	28	28	28
Total Gas Oil (diesel) consumption (litres)	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360
Auxillary burners - % of annual Gas Oil consumption	90%	90%	90%	90%	90%	90%	90%	90%
Fuel (Gas Oil) emissions factor ($kgCO_2e$/kWh)	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e$/litre)	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857
LFG Parameters:								
Calorific value of methane (MJ/kg)	50	50	50	50	50	50	50	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%	50%	50%	50%	50%	50%	50%	50%
Proprtion of methane in LFG	57%	57%	57%	57%	57%	57%	57%	57%
Proportion of LFG recovered from residual waste	68%	68%	68%	68%	68%	68%	68%	68%
Oxidation of LFG released from residual waste to CO_2 in landfill cap	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Proportion of LFG used in gas engines	91%	91%	91%	91%	91%	91%	91%	91%
LFG engine efficiency: 36%	36%	36%	36%	36%	36%	36%	36%	36%

Waste Material GHG Assessment **Uncontrolled copy**

1) Residual Waste Composition Data

Waste Stream	Case 2: 20% Recyclables
Recyclable Paper	5.5%
Card	5.9%
Non-recyclable Paper	10.4%
Dense Plastic	7.3%
Plastic film	7.7%
Textiles	5.1%
Misc. Combustible	10.9%
Misc. Non-Combustible	4.2%
Other Wastes	0.4%
Glass	2.4%
Ferrous Metals	2.2%
Non-Ferrous Metals	1.0%
Food Waste	25.2%
Garden Waste	2.5%
Other Organic	2.7%
Wood	2.1%
WEEE	1.3%
Hazardous	0.6%
Fines	2.6%
Net Calorific Value (MJ/kg)	9.50
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.21%
Biogenic Carbon (% of Total Carbon)	58.35%
Non-Biogenic Carbon (% of Total Carbon)	41.65%

2) 20% recyclables reduction	UK Grid Emissions Factor (gCO2e/kWh)			
	Current: gas	Current: ave	2035	2050
	380	182	23	6
Electricity only	151,217	86,351	34,261	28,692
CHP	170,689	115,644	71,441	29,527
	Core Case: % change	73,952		
Electricity only	104%	17%	-54%	-61%
CHP	131%	56%	-3%	-60%
	Core Case: relative change		>100%: +++/----	
			>50%: ++/---	
			>0%: +/-	
Electricity only	+++	+	--	--
CHP	+++	++	-	--

Additional sensitivity parameters:

CO2 emissions factor for electricity generation - UK grid (g/kWh)	380	182	23	6	380	182	23	6
CO2 emissions factor for heat generation - natural gas (g/kWh)	202.97	202.97	202.97	6	202.97	202.97	202.97	6
CHP (MWe)	60	60	60	60	53.8	53.8	53.8	53.8
CHP (MWth)	0	0	0	0	23.6	23.6	23.6	23.6
EfW vs Landfill difference (tCO2e)	151,217	86,351	34,261	28,692	170,689	115,644	71,441	29,527
EfW vs Landfill difference (tCO2e/tonne of waste)	0.24	0.14	0.05	0.05	0.27	0.18	0.11	0.05

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017
Total waste input (tonnes/yr)	625,600	625,600	625,600	625,600	625,600	625,600	625,600	625,600
Total Carbon (% by weight)	26.21%	26.21%	26.21%	26.21%	26.21%	26.21%	26.21%	26.21%
Non-Biogenic Carbon (% of Total Carbon)	41.65%	41.65%	41.65%	41.65%	41.65%	41.65%	41.65%	41.65%
Mass of fossil carbon in residual waste (tonnes carbon)	68,298	68,298	68,298	68,298	68,298	68,298	68,298	68,298
Fossil derived CO_2 emissions (tCO_2)	250,425	250,425	250,425	250,425	250,425	250,425	250,425	250,425
N_2O emissions from residual waste combustion	24	24	24	24	24	24	24	24
Equivalent CO_2 emissions (tCO_{2e})	6,301	6,301	6,301	6,301	6,301	6,301	6,301	6,301
CH_4 emissions from residual waste combustion	178	178	178	178	178	178	178	178
Equivalent CO_2 emissions (tCO_{2e})	4,993	4,993	4,993	4,993	4,993	4,993	4,993	4,993
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424
Auxilliary Burners (MWh)								
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	4,815	4,815	4,815	4,815	4,815	4,815	4,815	4,815
EfW Total emissions (tCO_{2e})	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**	**266,534**
EfW Facility operations (hrs/yr)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
EfW Facility net electricity generation (MWe)	55	55	55	55	49	49	48.8	48.8
Electricity generated by EfW Facility (MWh)	440,000	440,000	440,000	440,000	390,400	390,400	390,400	390,400
CO2 emissions factor for electricity generation (g/kWh)	380	182	23	6	380	182	23	6
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	167,200	80,080	10,120	2,640	148,352	71,053	8,979	2,342
EfW Facility heat generation (MWth)	0	0	0	0	24	24	23.6	23.6
Heat exported by EfW facility (MWh)	0	0	0	0	188,800	188,800	188,800	188,800
CO2 emissions factor for heat generation (g/kWh) - gas: current/2035, elec: 2050	380	182	23	6	203	203	203	6
EfW Equivalent CO_2 offset for heat generation by Facility (tCO_{2e})	0	0	0	0	38,321	38,321	38,321	1,133
EfW Equivalent CO_2 offset for energy generation by Facility (tCO_{2e})	**167,200**	**80,080**	**10,120**	**2,640**	**186,673**	**109,374**	**47,300**	**3,475**
EfW Net emissions (tCO_{2e})	**99,334**	**186,454**	**256,414**	**263,894**	**79,861**	**157,160**	**219,234**	**263,059**

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017
Mass of biogenic carbon in residual waste (tonnes carbon)	95,702	95,702	95,702	95,702	95,702	95,702	95,702	95,702
Total carbon converted to LFG (tonnes carbon)	47,851	47,851	47,851	47,851	47,851	47,851	47,851	47,851
Methane in LFG released from residual waste (tCH_4)	36,367	36,367	36,367	36,367	36,367	36,367	36,367	36,367
Methane in LFG captured for use in gas engines (tCH_4)	24,729	24,729	24,729	24,729	24,729	24,729	24,729	24,729
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	1,164	1,164	1,164	1,164	1,164	1,164	1,164	1,164
Uncaptured LFG released to atmosphere as methane (tCH_4)	10,474	10,474	10,474	10,474	10,474	10,474	10,474	10,474
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**	**293,260**
Methane in LFG captured for use in gas engines (tCH_4)	24,729	24,729	24,729	24,729	24,729	24,729	24,729	24,729
Methane used in gas engines (tCH_4)	22,479	22,479	22,479	22,479	22,479	22,479	22,479	22,479
Fuel input to LFG engines (GJ)	404,621	404,621	404,621	404,621	404,621	404,621	404,621	404,621
Power generated by LFG engines (MWh)	112,395	112,395	112,395	112,395	112,395	112,395	112,395	112,395
CO2 emissions factor for energy generation (g/kWh)	380	182	23	6	380	182	23	6
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**42,710**	**20,456**	**2,585**	**674**	**42,710**	**20,456**	**2,585**	**674**
LFG Net emissions (tCO_{2e})	**250,550**	**272,804**	**290,675**	**292,586**	**250,550**	**272,804**	**290,675**	**292,586**

EfW Parameters:								
N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	4	4	4	4	4	4	4	4
N_2O Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	265	265	265	265	265	265	265	265
CH_4 Emissions Factor 4 $kgCH_4/TJ$ (IPCC)	30	30	30	30	30	30	30	30
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	28	28	28	28	28	28	28	28
Total Gas Oil (diesel) consumption (litres)	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%	90%	90%	90%	90%	90%	90%	90%
Fuel (Gas Oil) emissions factor ($kgCO_2e/kWh$)	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e/litre$)	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857
LFG Parameters:								
Calorific value of methane (MJ/kg)	50	50	50	50	50	50	50	50
Biogenic carbon in resdual waste converted to landfill gas (LFG)	50%	50%	50%	50%	50%	50%	50%	50%
Proprtion of methane in LFG	57%	57%	57%	57%	57%	57%	57%	57%
Proportion of LFG recovered from residual waste	68%	68%	68%	68%	68%	68%	68%	68%
Oxidation of LFG released from residual waste to CO_2 in landfill cap	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Proportion of LFG used in gas engines	91%	91%	91%	91%	91%	91%	91%	91%
LFG engine efficiency: 36%	36%	36%	36%	36%	36%	36%	36%	36%

1) Residual Waste Composition Data

Waste Stream	Case 3: 90% Food/Plastic
Recyclable Paper	8.5%
Card	9.1%
Non-recyclable Paper	16.0%
Dense Plastic	1.4%
Plastic film	1.5%
Textiles	7.9%
Misc. Combustible	16.7%
Misc. Non-Combustible	6.5%
Other Wastes	0.5%
Glass	3.7%
Ferrous Metals	3.5%
Non-Ferrous Metals	1.6%
Food Waste	4.9%
Garden Waste	3.9%
Other Organic	4.1%
Wood	3.3%
WEEE	2.0%
Hazardous	0.9%
Fines	4.0%
Net Calorific Value (MJ/kg)	8.85
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	25.49%
Biogenic Carbon (% of Total Carbon)	74.58%
Non-Biogenic Carbon (% of Total Carbon)	25.42%

3) 90% of food & plastics

UK Grid Emissions Factor (gCO2e/kWh)	Current: gas	Current: ave	2035	2050
	380	182	23	6
Electricity only	314,582	255,113	207,358	202,253
CHP	334,055	284,407	244,538	203,088
Core Case: % change		73,952		
Electricity only	325%	245%	180%	173%
CHP	352%	285%	231%	175%
Core Case: relative change			>100%: +++/--- >50%: ++/--- >0%: +/-	
Electricity only	+++	+++	+++	+++
CHP	+++	+++	+++	+++

Additional sensitivity parameters:

CO_2 emissions factor for electricity generation - UK grid (g/kWh)	380	182	23	6	380	182	23	6
CO_2 emissions factor for heat generation - natural gas (g/kWh)	202.97	202.97	202.97	6	202.97	202.97	202.97	6
Methane capture rate (%)	60	60	60	60	53.8	53.8	53.8	53.8
CHP (MWe)	0	0	0	0	23.6	23.6	23.6	23.6
CHP (MWth)								
	314,582	255,113	207,358	202,253	334,055	284,407	244,538	203,088
EfW vs Landfill difference (tCO_2e)	0.50	0.41	0.33	0.32	0.53	0.45	0.39	0.32
EfW vs Landfill difference (tCO_2e/tonne of waste)								

2) Net carbon emissions from residual waste combustion in EfW Facility	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017
Parameter	625,600	625,600	625,600	625,600	625,600	625,600	625,600	625,600
Total waste input (tonnes/yr)	25.49%	25.49%	25.49%	25.49%	25.49%	25.49%	25.49%	25.49%
Total Carbon (% by weight)	25.42%	25.42%	25.42%	25.42%	25.42%	25.42%	25.42%	25.42%
Non-Biogenic Carbon (% of Total Carbon)	40,528	40,528	40,528	40,528	40,528	40,528	40,528	40,528
Mass of fossil carbon in residual waste (tonnes carbon)	148,603	148,603	148,603	148,603	148,603	148,603	148,603	148,603
Fossil derived CO_2 emissions (tCO_2)	22	22	22	22	22	22	22	22
N_2O emissions from residual waste combustion	5,868	5,868	5,868	5,868	5,868	5,868	5,868	5,868
Equivalent CO_2 emissions (tCO_{2e})	166	166	166	166	166	166	166	166
CH_4 emissions from residual waste combustion	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650
Equivalent CO_2 emissions (tCO_{2e})	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424	1,745,424
Auxilliary Burners - Fuel: Gas Oil (litres)								
Auxilliary Burners (MWh)	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*	*4,815*
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**	**163,935**
EfW Total emissions (tCO_{2e})								
	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
EfW Facility operations (hrs/yr)	55	55	55	55	49	49	48.8	48.8
EfW Facility net electricity generation (MWe)	440,000	440,000	440,000	440,000	390,400	390,400	390,400	390,400
Electricity generated by EfW Facility (MWh)	380	182	23	6	380	182	23	6
CO_2 emissions factor for electricity generation (g/kWh)	*167,200*	*80,080*	*10,120*	*2,640*	*148,352*	*71,053*	*8,979*	*2,342*
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	0	0	0	0	24	24	23.6	23.6
EfW Facility heat generation (MWth)	0	0	0	0	188,800	188,800	188,800	188,800
Heat exported by EfW facility (MWh)	380	182	23	6	203	203	203	6
CO_2 emissions factor for heat generation (g/kWh) - gas: current/2035, elec: 2050	*0*	*0*	*0*	*0*	*38,321*	*38,321*	*38,321*	*1,133*
EfW Equivalent CO_2 offset for heat generation by Facility (tCO_{2e})	**167,200**	**80,080**	**10,120**	**2,640**	**186,673**	**109,374**	**47,300**	**3,475**
EfW Equivalent CO_2 offset for energy generation by Facility (tCO_{2e})								
	-3,265	**83,855**	**153,815**	**161,295**	**-22,738**	**54,562**	**116,635**	**160,460**
EfW Net emissions (tCO_{2e})								

3) Net carbon emissions from landfilling residual waste and LFG combustion	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017	Case 1: Core WRAP 2017
Parameter	118,912	118,912	118,912	118,912	118,912	118,912	118,912	118,912
Mass of biogenic carbon in residual waste (tonnes carbon)	59,456	59,456	59,456	59,456	59,456	59,456	59,456	59,456
Total carbon converted to LFG (tonnes carbon)	45,187	45,187	45,187	45,187	45,187	45,187	45,187	45,187
Methane in LFG released from residual waste (tCH_4)	30,727	30,727	30,727	30,727	30,727	30,727	30,727	30,727
Methane in LFG captured for use in gas engines (tCH_4)	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	13,014	13,014	13,014	13,014	13,014	13,014	13,014	13,014
Uncaptured LFG released to atmosphere as methane (tCH_4)	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**	**364,386**
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})								
	30,727	30,727	30,727	30,727	30,727	30,727	30,727	30,727
Methane in LFG captured for use in gas engines (tCH_4)	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931
Methane used in gas engines (tCH_4)	502,755	502,755	502,755	502,755	502,755	502,755	502,755	502,755
Fuel input to LFG engines (GJ)	139,654	139,654	139,654	139,654	139,654	139,654	139,654	139,654
Power generated by LFG engines (MWh)	380	182	23	6	380	182	23	6
CO_2 emissions factor for energy generation (g/kWh)	**53,069**	**25,417**	**3,212**	**838**	**53,069**	**25,417**	**3,212**	**838**
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})								
	311,317	**338,969**	**361,174**	**363,548**	**311,317**	**338,969**	**361,174**	**363,548**
LFG Net emissions (tCO_{2e})								

EfW Parameters:	4	4	4	4	4	4	4	4
N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	265	265	265	265	265	265	265	265
N_20 Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	30	30	30	30	30	30	30	30
CH_4 Emissions Factor 4 $kgCH_4$/TJ (IPCC)	28	28	28	28	28	28	28	28
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360	1,939,360
Total Gas Oil (diesel) consumption (litres)	90%	90%	90%	90%	90%	90%	90%	90%
Auxilliary burners - % of annual Gas Oil consumption	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e$/kWh)	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857	2.75857
Fuel (Gas Oil) emissions factor ($kgCO_2e$/litre)								
LFG Parameters:	50	50	50	50	50	50	50	50
Calorific value of methane (MJ/kg)	50%	50%	50%	50%	50%	50%	50%	50%
Biogenic carbon in resdual waste converted to landfill gas (LFG)	57%	57%	57%	57%	57%	57%	57%	57%
Proprtion of methane in LFG	68%	68%	68%	68%	68%	68%	68%	68%
Proportion of LFG recovered from residual waste	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Oxidation of LFG released from residual waste to CO_2 in landfill cap	91%	91%	91%	91%	91%	91%	91%	91%
Proportion of LFG used in gas engines	36%	36%	36%	36%	36%	36%	36%	36%
LFG engine efficiency: 36%	36%	36%	36%	36%	36%	36%	36%	36%

Case 1: Core Case - Current Residual Waste (WRAP survey, 2017)

Uncontrolled copy

Waste Stream	Municipal Residual Waste: Commercial and Household (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	31.27%		10.749	1.84%		1.84%	0.63
Card	6.3%	31.27%		10.749	1.97%		1.97%	0.68
Non-recyclable Paper	8.9%	28.69%		9.735	2.55%		2.55%	0.87
Dense Plastic	7.8%		54.76%	24.682		4.27%	4.27%	1.93
Plastic film	8.2%		48.11%	21.279		3.95%	3.95%	1.74
Textiles	5.5%	19.93%	19.93%	14.327	1.10%	1.10%	2.19%	0.79
Misc. Combustible	9.3%	23.69%	15.79%	14.612	2.20%	1.47%	3.67%	1.36
Misc. Non-Combustible	3.6%	2.94%	4.05%	2.573	0.11%	0.15%	0.25%	0.09
Other Wastes	0.3%	2.94%	4.05%	2.573	0.01%	0.01%	0.02%	0.01
Glass	2.6%	0.31%		1.414	0.01%		0.01%	0.04
Ferrous Metals	2.4%							0.00
Non-Ferrous Metals	1.1%							0.00
Food Waste	27.0%	13.46%		3.460	3.63%		3.63%	0.93
Garden Waste	2.7%	17.17%		4.210	0.46%		0.46%	0.11
Other Organic	2.3%	17.17%		4.210	0.39%		0.39%	0.10
Wood	2.3%	17.17%		4.210	0.39%		0.39%	0.10
WEEE	1.1%		15.81%	7.060		0.17%	0.17%	0.08
Hazardous	0.5%	0.61%	19.76%	0.000	0.00%	0.10%	0.10%	0.00
Fines	2.2%	13.75%		3.479	0.30%	0.00%	0.30%	0.08
Total	100.0%				15.0%	11.2%	26.2%	9.53
					57.20%	42.80%		

Case 2: Waste Composition Sensitivity Analysis - Future Residual Waste (65% of municipal waste is recycled by 2035, with 44.5% already recycled in 2019)

Waste Stream	Current Residual Waste: Commercial and Household (% by weight)	Future Waste: 20% reduction in paper, card, food, plastics, glass, metals, garden and wood in residual waste	Equivalent weight of residual waste (tonnes)	Future Residual Waste: (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	20.0%	0.047	5.5%	31.27%		10.749	1.72%		1.72%	0.59
Card	6.3%	20.0%	0.050	5.9%	31.27%		10.749	1.84%		1.84%	0.63
Non-recyclable Paper	8.9%		0.089	10.4%	28.69%		9.735	2.98%		2.98%	1.01
Dense Plastic	7.8%	20.0%	0.062	7.3%		54.76%	24.682		3.99%	3.99%	1.80
Plastic film	8.2%	20.0%	0.066	7.7%		48.11%	21.279		3.69%	3.69%	1.63
Textiles	5.5%	20.0%	0.044	5.1%	19.93%	19.93%	14.327	1.02%	1.02%	2.05%	0.74
Misc. Combustible	9.3%		0.093	10.9%	23.69%	15.79%	14.612	2.57%	1.71%	4.29%	1.59
Misc. Non-Combustible	3.6%		0.036	4.2%	2.94%	4.05%	2.573	0.12%	0.17%	0.29%	0.11
Other Wastes	0.3%		0.003	0.4%	2.94%	4.05%	2.573	0.01%	0.01%	0.02%	0.01
Glass	2.6%	20.0%	0.021	2.4%	0.31%		1.414	0.008%		0.008%	0.03
Ferrous Metals	2.4%	20.0%	0.019	2.2%							
Non-Ferrous Metals	1.1%	20.0%	0.009	1.0%							
Food Waste	27.0%	20.0%	0.216	25.2%	13.46%		3.460	3.39%		3.39%	0.87
Garden Waste	2.7%	20.0%	0.022	2.5%	17.17%		4.210	0.43%		0.43%	0.11
Other Organic	2.3%		0.023	2.7%	17.17%		4.210	0.46%		0.46%	0.11
Wood	2.3%	20.0%	0.018	2.1%	17.17%		4.210	0.37%		0.37%	0.09
WEEE	1.1%		0.011	1.3%		15.81%	7.060		0.20%	0.20%	0.09
Hazardous	0.5%		0.005	0.6%	0.61%	19.76%	0.000	0.00%	0.12%	0.12%	0.00
Fines	2.2%		0.022	2.6%	13.75%		3.479	0.35%	0.00%	0.35%	0.09
Total	100.0%		0.856	100%				15.3%	10.9%	26.2%	9.50
								58.35%	41.65%		

Case 3: Sensitivity Analysis - Future Residual Waste (90% reduction in food and plastics, in addition to 20% reduction in other recyclables)

Waste Stream	Current Residual Waste: Commercial and Household (% by weight)	Future Waste: 90% reduction in plastics and food and 19.5% reduction in other recyclables in residual waste	Equivalent weight of residual waste (tonnes)	Future Residual Waste: (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	20.0%	0.047	8.5%	31.27%		10.749	2.66%		2.66%	0.91
Card	6.3%	20.0%	0.050	9.1%	31.27%		10.749	2.84%		2.84%	0.98
Non-recyclable Paper	8.9%		0.089	16.0%	28.69%		9.735	4.60%		4.60%	1.56
Dense Plastic	7.8%	90.0%	0.008	1.4%		54.76%	24.682		0.77%	0.77%	0.35
Plastic film	8.2%	90.0%	0.008	1.5%		48.11%	21.279		0.71%	0.71%	0.31
Textiles	5.5%	20.0%	0.044	7.9%	19.93%	19.93%	14.327	1.58%	1.58%	3.16%	1.14
Misc. Combustible	9.3%		0.093	16.7%	23.69%	15.79%	14.612	3.97%	2.64%	6.61%	2.45
Misc. Non-Combustible	3.6%		0.036	6.5%	2.94%	4.05%	2.573	0.19%	0.26%	0.45%	0.17
Other Wastes	0.3%		0.003	0.5%	2.94%	4.05%	2.573	0.02%	0.02%	0.04%	0.01
Glass	2.6%	20.0%	0.021	3.7%	0.31%		1.414	0.012%		0.012%	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%	0.17
Garden Waste	2.7%	20.0%	0.022	3.9%	17.17%		4.210	0.67%		0.67%	0.16
Other Organic	2.3%		0.023	4.1%	17.17%		4.210	0.71%		0.71%	0.17
Wood	2.3%	20.0%	0.018	3.3%	17.17%		4.210	0.57%		0.57%	0.14
WEEE	1.1%		0.011	2.0%		15.81%	7.060		0.31%	0.31%	0.14
Hazardous	0.5%		0.005	0.9%	0.61%	19.76%	0.000	0.01%	0.18%	0.18%	0.00
Fines	2.2%		0.022	4.0%	13.75%		3.479	0.54%	0.00%	0.54%	0.14
Total	100.0%		0.555	100%				19.0%	6.5%	25.5%	8.85
								74.58%	25.42%		

Waste Material GHG Assessment | **Uncontrolled copy**

1) Residual Waste Composition Data

Waste Stream	WRAP 2017 Residual Waste (UK Grid - Emissions Factor)
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%
Net Calorific Value (MJ/kg)	9.53
Total waste input (tonnes/yr)	625,600
Total Carbon (% by weight)	26.20%
Biogenic Carbon (% of Total Carbon)	57.20%
Non-Biogenic Carbon (% of Total Carbon)	42.80%

2) Net carbon emissions from residual waste combustion in EfW Facility

Parameter	WRAP 2017 Residual Waste (UK Grid - Emissions Factor)	Over 40 years (ktCO2e) *Original*
Total waste input (tonnes/yr)	625,600	
Total Carbon (% by weight)	26.20%	
Non-Biogenic Carbon (% of Total Carbon)	42.80%	
Mass of fossil carbon in residual waste (tonnes carbon)	70,142	
Fossil derived CO_2 emissions (tCO_2)	257,187	
N_2O emissions from residual waste combustion (tonnes)	24	
Equivalent CO_2 emissions (tCO_{2e})	6,318	
CH_4 emissions from residual waste combustion (tonnes)	179	
Equivalent CO_2 emissions (tCO_{2e})	5,007	
Auxilliary Burners - Fuel: Gas Oil (litres)	1,745,424	
Auxilliary Burners - emissions for use of fuel (tCO_{2e})	4,815	
EfW Total emissions (tCO_{2e})	**273,326**	**10933.05**
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 CO_2 offset for electricity generation by Facility (tCO_{2e})	**80,080**	**3203.20**
Annual EfW Net emissions (tCO_{2e})	**193,246**	**7729.85**
Annual difference versus LFG	-73,952	

	Over 40 years (ktCO2e) *Revised*
EfW Total emissions (tCO_{2e})	**10933.05**
UK grid CO_2 emissions factor for electricity generation (g/kWh)	
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	**326.37**
Annual EfW Net emissions (tCO_{2e})	**10606.69**

	Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Year 12*	*Year 13*	*Year 14*	*Year 15*	*Year 16*	*Year 17*	*Year 18*	*Year 19*	*Year 20*
	2026	*2027*	*2028*	*2029*	*2030*	*2031*	*2032*	*2033*	*2034*	*2035*	*2036*	*2037*	*2038*	*2039*	*2040*	*2041*	*2042*	*2043*	*2044*	*2045*
UK grid CO_2 emissions factor for electricity generation (g/kWh)	84.3277232	69.789	64.53309	60.42248	47.95517	37.97718	32.82444	28.50573	25.87792	23.08556	19.09694	16.98601	16.59213	15.71003	14.23579	11.81768	11.21516	10.98618	10.3259	8.769083
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	37,104	30,707	28,395	26,586	21,100	16,710	14,443	12,543	11,386	10,158	8,403	7,474	7,301	6,912	6,264	5,200	4,935	4,834	4,543	3,858

	Year 21	*Year 22*	*Year 23*	*Year 24*	*Year 25*	*Year 26*	*Year 27*	*Year 28*	*Year 29*	*Year 30*	*Year 31*	*Year 32*	*Year 33*	*Year 34*	*Year 35*	*Year 36*	*Year 37*	*Year 38*	*Year 39*	*Year 40*
	2046	*2047*	*2048*	*2049*	*2050*	*2051*	*2052*	*2053*	*2054*	*2055*	*2056*	*2057*	*2058*	*2059*	*2060*	*2061*	*2062*	*2063*	*2064*	*2065*
UK grid CO_2 emissions factor for electricity generation (g/kWh)	7.961591	7.340922	6.967297	6.483356	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048
EfW Equivalent CO_2 offset for electricity generation by Facility (tCO_{2e})	3,503	3,230	3,066	2,853	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804	2,804

3) Net carbon emissions from landfilling residual waste and LFG combustion

Parameter	WRAP 2017 Residual Waste (UK Grid - Emissions Factor)	Over 40 years (ktCO2e) *Original*
Mass of biogenic carbon in residual waste (tonnes carbon)	93,735	
Total carbon converted to LFG (tonnes carbon)	46,867	
Methane in LFG released from residual waste (tCH_4)	35,619	
Methane in LFG captured for use in gas engines (tCH_4)	24,221	
Uncaptured LFG oxidised to CO_2 in landfill cap (tCH_4)	1,140	
Uncaptured LFG released to atmosphere as methane (tCH_4)	10,258	
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**287,234**	**11,489.35**
Methane in LFG captured for use in gas engines (tCH_4)	24,221	
Methane used in gas engines (tCH_4)	22,017	
Fuel input to LFG engines (GJ)	396,306	
Power generated by LFG engines (MWh)	110,085	
UK grid CO_2 emissions factor for electricity generation (g/kWh)	182	
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**20,035**	**801.42**
Annual LFG Net emissions (tCO_{2e})	**267,198**	**10,687.94**

	Over 40 years (ktCO2e) *Revised*
LFG Equivalent CO_2 emissions released to atmosphere (tCO_{2e})	**11489.35**
UK grid CO2 emissions factor for electricity generation (g/kWh)	
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	**81.65**
Annual LFG Net emissions (tCO_{2e})	**11407.70**

	Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Year 12*	*Year 13*	*Year 14*	*Year 15*	*Year 16*	*Year 17*	*Year 18*	*Year 19*	*Year 20*
	2026	*2027*	*2028*	*2029*	*2030*	*2031*	*2032*	*2033*	*2034*	*2035*	*2036*	*2037*	*2038*	*2039*	*2040*	*2041*	*2042*	*2043*	*2044*	*2045*
UK grid CO2 emissions factor for electricity generation (g/kWh)	84.3277232	69.789	64.53309	60.42248	47.95517	37.97718	32.82444	28.50573	25.87792	23.08556	19.09694	16.98601	16.59213	15.71003	14.23579	11.81768	11.21516	10.98618	10.3259	8.769083
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	9,283	7,683	7,104	6,652	5,279	4,181	3,613	3,138	2,849	2,541	2,102	1,870	1,827	1,729	1,567	1,301	1,235	1,209	1,137	965

	Year 21	*Year 22*	*Year 23*	*Year 24*	*Year 25*	*Year 26*	*Year 27*	*Year 28*	*Year 29*	*Year 30*	*Year 31*	*Year 32*	*Year 33*	*Year 34*	*Year 35*	*Year 36*	*Year 37*	*Year 38*	*Year 39*	*Year 40*
	2046	*2047*	*2048*	*2049*	*2050*	*2051*	*2052*	*2053*	*2054*	*2055*	*2056*	*2057*	*2058*	*2059*	*2060*	*2061*	*2062*	*2063*	*2064*	*2065*
UK grid CO2 emissions factor for electricity generation (g/kWh)	7.961591	7.340922	6.967297	6.483356	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048	6.372048
LFG Equivalent CO_2 offset for electricity generation from combustion (tCO_{2e})	876	808	767	714	701	701	701	701	701	701	701	701	701	701	701	701	701	701	701	701

EfW Parameters:

N_2O Emissions Factor 4 kgN_2O/TJ (IPCC)	4
N_20 Global Warming Potential ($kgCO_{2e}$ / kgN_2O)	265
CH_4 Emissions Factor 4 $kgCH_4$/TJ (IPCC)	30
CH_4 Global Warming Potential ($kgCO_{2e}$ / $kgCH_4$)	28
EfW Total themal capacity (MW)	200
Total Gas Oil (diesel) consumption (litres)	1,939,360
Auxilliary burners - % of annual Gas Oil consumption	90%
Fuel (Gas Oil) emissions factor ($kgCO_2e$/kWh)	0.2731
Fuel (Gas Oil) emissions factor ($kgCO_2e$/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 CO_2 in landfill cap	10.0%
Proportion of LFG used in gas engines	91%
LFG engine efficiency: 36%	36%

		Over 40yrs (original) LFG ($ktCO_2e$)	Over 40yrs (original) EfW ($ktCO_2e$)	Over 40yrs (revised) LFG ($ktCO_2e$)	Over 40yrs (revised) EfW ($ktCO_2e$)
Constru	A1 – A2 – A3 - Raw materials supply, transport and manufacture		35.55		35.55
	A5 – Construction process stage		4.90		4.90
	A4 – Construction Transport		7.93		7.93
Operati	B2 – B5 – Maintenance, repair, replacement and refurbishment		4.91		4.91
	B6 – Operational energy	25.04	10,933.05	25.04	10,933.05
	B7 – Operational water		0.24		0.24
	B8 – Other operational processes: Landfill	11,489.35		11,489.35	
	B8 – Other operational processes: Operational transport	103.85	271.68	103.85	271.68
	B8 – Other operational processes: IBA and APCr		142.60		142.60
Decomr	C1 – C2 -C3 -C4 – End of life, including deconstruction, transport, waste processing for recovery and disposal *		48.38		48.38
General	D – Avoided emissions	-801.42	-3,203.20	-81.65	-326.37
TOTAL		10,816.82	8,246.04	11,536.59	11,122.88
	Net change in GHG emissions resulting from the Proposed Development (ktCO2e)		**-2,570.78**		**-413.71**

Case 1: Core Case - Current Residual Waste (WRAP survey, 2017) **Uncontrolled copy**

Waste Stream	Municipal Residual Waste: Commercial and Household (% by weight)	Biogenic Carbon (% of waste stream)	Non-Biogenic Carbon (% of waste stream)	Net Calorific Value (MJ/kg)	Biogenic Carbon (% by weight)	Non-Biogenic Carbon (% by weight)	Total Carbon (% by weight)	Total NCV (MJ/kg)
Recyclable Paper	5.9%	31.27%		10.749	1.84%		1.84%	0.63
Card	6.3%	31.27%		10.749	1.97%		1.97%	0.68
Non-recyclable Paper	8.9%	28.69%		9.735	2.55%		2.55%	0.87
Dense Plastic	7.8%		54.76%	24.682		4.27%	4.27%	1.93
Plastic film	8.2%		48.11%	21.279		3.95%	3.95%	1.74
Textiles	5.5%	19.93%	19.93%	14.327	1.10%	1.10%	2.19%	0.79
Misc. Combustible	9.3%	23.69%	15.79%	14.612	2.20%	1.47%	3.67%	1.36
Misc. Non-Combustible	3.6%	2.94%	4.05%	2.573	0.11%	0.15%	0.25%	0.09
Other Wastes	0.3%	2.94%	4.05%	2.573	0.01%	0.01%	0.02%	0.01
Glass	2.6%	0.31%		1.414	0.01%		0.01%	0.04
Ferrous Metals	2.4%							0.00
Non-Ferrous Metals	1.1%							0.00
Food Waste	27.0%	13.46%		3.460	3.63%		3.63%	0.93
Garden Waste	2.7%	17.17%		4.210	0.46%		0.46%	0.11
Other Organic	2.3%	17.17%		4.210	0.39%		0.39%	0.10
Wood	2.3%	17.17%		4.210	0.39%		0.39%	0.10
WEEE	1.1%		15.81%	7.060		0.17%	0.17%	0.08
Hazardous	0.5%	0.61%	19.76%	0.000	0.00%	0.10%	0.10%	0.00
Fines	2.2%	13.75%		3.479	0.30%	0.00%	0.30%	0.08
Total	100.0%				15.0%	11.2%	26.2%	9.53
					57.20%	42.80%		

	Data Sources					
	Description	**Value**	**Unit**	**Source**	**Further info**	**Website**
Construction	Average freight haul of glass cement metal	99.7	km	DfT Freight statistic (TSGB04)		https://www.gov.uk/government/statistical-data-sets/tsgb04-freight
Construction and Operation	Average commuting distance	14.6	km	DfT: NTS0403: Average number of trips, miles and time spent travelling by trip purpose: England	9.11 miles = 14.58 km	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/905985/nts0403.ods

	2023 to 2026 (36 months)
Total HGV movements	90,934
Total LGV movements	298,031

Table RFS0105

https://www.gov.uk/government/statistical-data-sets/tsgb04-freight

Goods lifted[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonnes

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
Metal, mineral and chemical products									
Glass, cement and other non-metallic mineral products		34	25	23	10	6	8	4	111
Metal products		6	4	5	3	3	4	1	25

Table RFS0105

Goods moved[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonne kilometres

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
Metal, mineral and chemical products									
Glass, cement and other non-metallic mineral products		484	932	1,654	1,235	1,013	1,965	1,685	**8,967**
Metal products		75	136	330	369	593	922	541	**2,965**

Glass, cement and other non-metallic mineral products	Average distance:	80.8
Metal products	Average distance:	118.6
	Total average:	99.7

	Weekly	Annual
Total HGV movements	1,548	80,496
Total LDV movements	96	4,992
Total car movements	358	18,616

Number of weeks per year
52

2011 Census: Usual resident population and population density, local authorities in the United Kingdom
https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/2011censuspopulationandhouseholdestimatesfortheunitedkingdom

	Administrative centre	**Source**	**Centre postcode**	**Miles Distance to PE13 2TQ (Google maps)**	**km**
Essex	Basildon	2011 Census	SS14 1LD	99.7	160.5
Hertfordshire	Watford	https://www.citypo	WD17 2PA	99.4	160.0
Leicester City	Leicester	2011 Census	LE1 5BD	61.7	99.3
Leicestershire	Loughborough	https://www.citypo	LE11 2QG	70.2	113.0
Lincolnshire	Lincoln	https://citypopulati	LN2 1HL	58.7	94.5
Luton	Luton	2011 Census	LU1 2NB	78.1	125.7
Norfolk	Norwich	https://www.citypo	NR1 3RU	57.1	91.9
Northamptonshire	Northampton	2011 Census	NN1 2SQ	63.6	102.4
Rutland	Oakham	2011 Census	LE15 6AL	44.4	71.5
Thurrock	Thurrock	2012 Census		102.0	164.2

1.60934 km in 1 mile

Origin WPA	**Shortfall (tonnes)**	**% share of overall shortfall after 2030**	**Largest settlement**	**Distance to Proposed Development (km)**	**HDV Movements (annual)**	**HDV km**	**LDV Movements (annual)**	**LDV km**
Central Bedfordshire, Bedford City Council and Luton Borough Council	229,000	11	Luton	125.7	8,854.56	1,112,924.81	549.12	69,018.59
Essex (including Southend on Sea)	209,000	10	Basildon	160.5	8,049.60	1,291,567.96	499.20	80,097.24
Hertfordshire	507,363	24	Watford	160.0	19,319.04	3,090,435.84	1,198.08	191,654.94
Norfolk	703,000	33	Norwich	91.9	26,563.68	2,441,024.59	1,647.36	151,381.37
Thurrock	71,200	3	Thurrock	164.2	2,414.88	396,409.02	149.76	24,583.51
Leicester City	*unquantified*	*unquantified*	Leicester	99.3	*unquantified*	*unquantified*	*unquantified*	*unquantified*
Leicestershire	23,448	1	Loughborough	113.0	804.96	90,940.89	49.92	5,639.75
Lincolnshire	101,604	5	Lincoln	94.5	4,024.80	380,215.84	249.60	23,579.28
Northamptonshire	250,000	12	Northampton	102.4	9,659.52	988,690.74	599.04	61,314.15
Rutland	27,000	1	Oakham	71.5	804.96	57,518.17	49.92	3,567.02
TOTAL	2,121,615	100	**Average:**	118.3	80,496.00	9,849,727.88	4,992.00	610,835.84

Total HGV movements	80,496
Total LDV movements	4,992
Total car movements	18,616

Table RFS0105

https://www.gov.uk/government/statistical-data-sets/tsgb04-freight

Goods lifted[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonnes

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
	Waste related products	43	40	42	10	7	7	2	151

1. Goods lifted: the weight of goods carried, measured in tonnes.

Table RFS0105

Goods moved[1] by commodity[2] and length of haul[3]: 2020

UK activity of GB-registered heavy goods vehicles

Million tonne kilometres

		Length of haul							
Commodity		**Up to 25km**	**Over 25km to 50km**	**Over 50km to 100km**	**Over 100km to 150km**	**Over 150km to 200km**	**Over 200km to 300km**	**Over 300km**	**All lengths**
	Waste related products	648	1,431	3,005	1,245	1,215	1,673	960	**10,177**

Average distance:	67.4
Average distance up to 150km (approx the 2 hours catchment)	46.9

Detailed Option 1, Rural (Not London), 48 kph

Uncontrolled copy

	100% HGV CO2 (g/km)	HGV km	kT CO2	100% LGV CO2 (g/km)			100% Car CO2 (g/km)	Total
2023	828			186			113	
2024	823			184			110	
2025	816			181			107	
2026	809	3,773,772	3.1	178	234032	0.04	104	3.10
2027	802	3,773,772	3.0	176	234032	0.04	100	3.07
2028	795	3,773,772	3.0	173	234032	0.04	97	3.04
2029	789	3,773,772	3.0	170	234032	0.04	94	3.02
2030	773	3,773,772	2.9	164	234032	0.04	89	2.96
2031	758	3,773,772	2.9	159	234032	0.04	85	2.90
2032	744	3,773,772	2.8	155	234032	0.04	81	2.85
2033	732	3,773,772	2.8	150	234032	0.04	78	2.80
2034	720	3,773,772	2.7	146	234032	0.03	75	2.75
2035	710	3,773,772	2.7	142	234032	0.03	72	2.71
2036	700	3,773,772	2.6	139	234032	0.03	69	2.68
2037	691	3,773,772	2.6	136	234032	0.03	66	2.64
2038	683	3,773,772	2.6	134	234032	0.03	63	2.61
2039	677	3,773,772	2.6	132	234032	0.03	61	2.58
2040	670	3,773,772	2.5	129	234032	0.03	58	2.56
2041	663	3,773,772	2.5	127	234032	0.03	56	2.53
2042	658	3,773,772	2.5	125	234032	0.03	53	2.51
2043	654	3,773,772	2.5	124	234032	0.03	51	2.50
2044	651	3,773,772	2.5	122	234032	0.03	49	2.49
2045	649	3,773,772	2.4	121	234032	0.03	47	2.48
2046	646	3,773,772	2.4	120	234032	0.03	45	2.47
2047	645	3,773,772	2.4	118	234032	0.03	44	2.46
2048	644	3,773,772	2.4	117	234032	0.03	43	2.46
2049	644	3,773,772	2.4	116	234032	0.03	42	2.46
2050	643	3,773,772	2.4	114	234032	0.03	41	2.45
2051	643	3,773,772	2.4	114	234032	0.03	41	2.45
2052	643	3,773,772	2.4	114	234032	0.03	41	2.45
2053	643	3,773,772	2.4	114	234032	0.03	41	2.45
2054	643	3,773,772	2.4	114	234032	0.03	41	2.45
2055	643	3,773,772	2.4	114	234032	0.03	41	2.45
2056	643	3,773,772	2.4	114	234032	0.03	41	2.45
2057	643	3,773,772	2.4	114	234032	0.03	41	2.45
2058	643	3,773,772	2.4	114	234032	0.03	41	2.45
2059	643	3,773,772	2.4	114	234032	0.03	41	2.45
2060	643	3,773,772	2.4	114	234032	0.03	41	2.45
2061	643	3,773,772	2.4	114	234032	0.03	41	2.45
2062	643	3,773,772	2.4	114	234032	0.03	41	2.45
2063	643	3,773,772	2.4	114	234032	0.03	41	2.45
2064	643	3,773,772	2.4	114	234032	0.03	41	2.45
2065	643	3,773,772	2.4	114	234032	0.03	41	2.45

Detailed Option 1, Rural (Not London), 48 kph

Uncontrolled copy

	100% HGV CO2 (g/km)	HGV km	kT CO2	100% LGV CO2 (g/km)			100% Car CO2 (g/km)			Total
2023	828	3,021,787	2.50	186			113	1,448,429	0.16	2.67
2024	823	3,021,787	2.49	184			110	1,448,429	0.16	2.65
2025	816	3,021,787	2.46	181			107	1,448,429	0.15	2.62
2026	809	9,849,728	7.97	178	610,836	0.11	104	271,421	0.03	8.11
2027	802	9,849,728	7.90	176	610,836	0.11	100	271,421	0.03	8.04
2028	795	9,849,728	7.83	173	610,836	0.11	97	271,421	0.03	7.97
2029	789	9,849,728	7.77	170	610,836	0.10	94	271,421	0.03	7.90
2030	773	9,849,728	7.61	164	610,836	0.10	89	271,421	0.02	7.74
2031	758	9,849,728	7.47	159	610,836	0.10	85	271,421	0.02	7.59
2032	744	9,849,728	7.33	155	610,836	0.09	81	271,421	0.02	7.45
2033	732	9,849,728	7.21	150	610,836	0.09	78	271,421	0.02	7.32
2034	720	9,849,728	7.10	146	610,836	0.09	75	271,421	0.02	7.20
2035	710	9,849,728	6.99	142	610,836	0.09	72	271,421	0.02	7.10
2036	700	9,849,728	6.90	139	610,836	0.09	69	271,421	0.02	7.00
2037	691	9,849,728	6.81	136	610,836	0.08	66	271,421	0.02	6.91
2038	683	9,849,728	6.73	134	610,836	0.08	63	271,421	0.02	6.83
2039	677	9,849,728	6.66	132	610,836	0.08	61	271,421	0.02	6.76
2040	670	9,849,728	6.60	129	610,836	0.08	58	271,421	0.02	6.70
2041	663	9,849,728	6.53	127	610,836	0.08	56	271,421	0.02	6.62
2042	658	9,849,728	6.48	125	610,836	0.08	53	271,421	0.01	6.57
2043	654	9,849,728	6.44	124	610,836	0.08	51	271,421	0.01	6.53
2044	651	9,849,728	6.41	122	610,836	0.07	49	271,421	0.01	6.50
2045	649	9,849,728	6.39	121	610,836	0.07	47	271,421	0.01	6.48
2046	646	9,849,728	6.37	120	610,836	0.07	45	271,421	0.01	6.45
2047	645	9,849,728	6.35	118	610,836	0.07	44	271,421	0.01	6.44
2048	644	9,849,728	6.35	117	610,836	0.07	43	271,421	0.01	6.43
2049	644	9,849,728	6.34	116	610,836	0.07	42	271,421	0.01	6.42
2050	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2051	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2052	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2053	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2054	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2055	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2056	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2057	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2058	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2059	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2060	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2061	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2062	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2063	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2064	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41
2065	643	9,849,728	6.33	114	610,836	0.07	41	271,421	0.01	6.41

Waste Benchmark Calculator

Uncontrolled copy

These figures are calculated based on your floor area of 1,000,000,000.00 (1.0E9 m2)

Project Type	Bricks (17 01 02)	Tiles and Ceramics (17 01 03)	Concrete (17 01 01)	Inert (17 01 07)	Insulation materials (non hazardous) (17 06 04)	Metals (17 04 07)	Packaging materials (15 01 06)	Plasterboard / Gypsum (17 08 02)	Binders (17 01 01)	Plastic (excluding packaging waste) (17 02 03)	Timber (17 02 01)	Floor coverings (soft) (20 01 11)	electronic equipment (non hazardous) (20 01	Furniture (20 03 07)	Canteen/Office/Ad hoc waste (20 03 01)	Liquids (16 10 02)	Oils (13 01 13*)	mixtures (non hazardous e.g. asphalt) (17 03 02)	Hazardous waste*	Other waste	Mixed construction and/or demolition waste (17 09 04)
EWC																					
Civil Engineering	2080286.25	832224.76	16677996.42	8854805.73	3858.7	10027700.83	1995082.35	160345.4	0	2027183.46	15756868.88	802.72	911.7	354.17	11014164.78	6751906.25	745104.17	1102678.57	72718.75	34153562.12	12119335.9
Commercial Offices	9667059.31	208146.92	36364378.96	13973567.86	893827.37	1734062.37	1659254.44	4647158.48	64709.56	1136902.68	10086494.5	233031.26	12244.35	193301.58	346786.92	524455.92	5227.02	884583.26	132864.46	2718047.07	38758617.45
Commercial Other	2020625	0	68142548.86	79780273.83	58641.98	2627105.13	1780485.48	1686583.96	0	1863912.41	9127774.82	0	0	0	1308912.04	0	0	4864197.53	0	6602771.79	30292545.57
Commercial Retail	4062437.21	274439.98	24715102.15	62232640.31	419885.38	5260265.44	1380644.73	2015664.99	103203.14	1206481.84	6715290.25	51023.85	9467.46	32041.22	2518687.47	258346.13	7100.23	839541.32	1638276.13	3446051.61	40127226.1
Education	14136464.36	1175890.09	8861510.76	35879076.78	1348850.62	3742635.01	5041402.95	6221499.84	128370.44	1613115.58	10159469.78	290181.16	75383.33	8159.84	3414060.5	29931.31	0	9713133.61	2955404.18	5482033.96	38521378.76
Healthcare	8676413.81	759293.19	11149844.07	26944944.84	2189969.12	2465983.66	6437829.73	5216710	113375.71	3635836.78	10151956.66	219373.14	141659.66	62429.95	2839820.4	2129.73	27575.76	1380965.22	14952069.35	5298995.03	27425870.91
Industrial Buildings	2308186.04	16261.15	12744498.71	19848894.71	159858.15	10698807.69	2033234.27	963905.62	142067.84	767458.86	14130033.29	6794.87	1301.05	0	1355590.83	129.37	110972.83	2264103.4	245594.66	9652648.6	46334982.01
Leisure	4864819.51	117204.08	10568989.19	41223603.68	489971.45	1759742.5	2399793.89	2267474.01	142467.16	952545.69	8896656.9	1445235.52	114944.52	13854.78	964666.42	191624.83	103.22	2780999.13	143487.73	9352493.6	59218101.37
Public Buildings	8874268.87	37656.25	12332023.01	43266294.62	1693665.46	2279941.74	2536010.49	3470024.18	28089.24	1774551.1	9224597.65	20976.54	31992.95	44185.22	7366918.54	1463.8	0	766.55	125979.56	2637958.33	41538891.29
Residential	11909808.96	843067.22	16841427.08	45690649.46	705063.53	2104926.13	4127919.09	4861059.99	175093.57	2844232.79	13022065.71	76365.33	63896.24	12105.1	1323882.22	79833.59	11654.78	929579.91	1035911.01	3987733.25	42163778.24
Manufacturing	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available
Mixed Use Developments	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available
Offsite Manufacturing	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available	*No data available

Query submitted on BRE Smartwaste 21/03/2019

Uncontrolled copy

Based on assumptions from the Waste and Resources Action Programme (WRAP), Net Waste Tool (2008), wastage rates used to assess the material quantities based on the amount of waste, and the Waste Benchmark Calculator data from Query submitted on BRE Smartwaste 21/03/2019, this calculates the estimated material resource required for the project over the construction period.

Component 1	
Floor Area (m2) GIA	15,000.00
Category	Civil Engineering
Start year of construction	2023
Total years of construction	3.00

Total	
Floor Area (m2)	15,000.00

Products	Wastage Rate (%)	European Waste Code (EWC)	EPI (per 1,000,000,000m2)	Estimated Waste Arisings from Development (tonnes)	Estimated Material Resources Required for Development (tonnes)	Estimated Waste Arisings from Development (tonnes)	Estimated Material Resources Required for Development (tonnes)
Bricks	20.00	17 01 02	2,080,286.25	31.20	156.02	31.20	156.02
Tiles and Ceramics	8.00	17 01 03	832,224.76	12.48	156.04	12.48	156.04
Concrete	4.00	17 01 01	16,677,996.42	250.17	6,254.25	250.17	6,254.25
Inert	10.00	17 01 07	8,854,805.73	132.82	1,328.22	132.82	1,328.22
Insulation materials	15.00	17 06 04	3,858.70	0.06	0.39	0.06	0.39
Metals	3.00	17 04 07	10,027,700.83	150.42	5,013.85	150.42	5,013.85
Packaging materials	100.00	15 01 06	1,995,082.35	29.93	29.93	29.93	29.93
Plasterboard / Gypsum	5.00	17 08 02	160,345.40	2.41	48.10	2.41	48.10
Binders	20.00	17 01 01	0.00	0.00	0.00	0.00	0.00
Plastic	5.00	17 02 03	2,027,183.46	30.41	608.16	30.41	608.16
Timber	8.00	17 02 01	15,756,868.88	236.35	2,954.41	236.35	2,954.41
Floor coverings (soft)	5.00	20 01 11	802.72	0.01	0.24	0.01	0.24
Electrical and electronic equipment	1.00	20 01 36 / 16 02 14	911.70	0.01	1.37	0.01	1.37
Furniture	1.00	20 03 07	354.17	0.01	0.53	0.01	0.53
Canteen/Office/Adhoc waste	100.00	20 03 01	11,014,164.78	165.21	165.21	165.21	165.21
Liquids	3.00	16 10 02	6,751,906.25	101.28	3,375.95	101.28	3,375.95
Oils	3.00	13 01 13*	745,104.17	11.18	372.55	11.18	372.55
Bituminous mixtures	5.00	17 03 02	1,102,678.57	16.54	330.80	16.54	330.80
Hazardous waste*	7.25		72,718.75	1.09	15.05	1.09	15.05
Other waste	7.25		34,153,562.12	512.30	7,066.25	512.30	7,066.25
Mixed construction and/or demolition waste	7.25	17 09 04	12,119,335.90	181.79	2,507.45	181.79	2,507.45

Uncontrolled copy

Based on the calculations of material quantity within the "Waste" tab, this uses the total materials required for the project (inclusive of waste) and the ICE carbon factors/BEIS emission factors to determine the embodied carbon GHG emissions over the course of the construction phase.
Note: hidden waste types marked in yellow have been grouped under "other materials". Replaced highlighted material amount values for concrete and metal based on information provided by MVV - see 'Emodied C v2' sheet.

Component 1		**Total**		
Floor Area (m2)	15,000.00	Floor Area (m2)	15,000.00	
Category	Civil Engineering			
Start year of construction	2023			
Total years of construction	3.00			

Products	**ICE Carbon Factor (tCO2e per tonne)**	**Estimated Material Resources Required for Development (tonnes)**	**GHG Emissions (tCO2e)**	**Estimated Material Resources Required for Development (tonnes)**	**QA Check**	**GHG Emissions (tCO2e)**	**QA Check**	**GHG Emissions (ktCO2e)**
Bricks	0.2130000	156.02	33.23	156.02	Pass	33.23	Pass	0.03
Tiles and Ceramics	0.7000000	156.04	109.23	156.04	Pass	109.23	Pass	0.11
Concrete	0.1030000	39,392.25	4,057.40	39,392.25	Fail	4,057.40	Pass	4.06
Inert	0.0052000	1,328.22	6.91	1,328.22	Pass	6.91	Pass	0.01
Insulation materials	2.3617643	0.39	0.91	0.39	Pass	0.91	Pass	0.00
Metals	2.3642036	3,046.17	7,201.77	3,046.17	Fail	7,201.77	Pass	7.20
Plasterboard / Gypsum	0.3900000	48.10	18.76	48.10	Pass	18.76	Pass	0.02
Binders	0.8321104	0.00	0.00	0.00	Pass	0.00	Pass	0.00
Plastic	3.3100000	608.16	2,012.99	608.16	Pass	2,012.99	Pass	2.01
Timber	0.4928261	2,954.41	1,456.01	2,954.41	Pass	1,456.01	Pass	1.46
Floor coverings (soft)	4.9520865	0.24	1.19	0.24	Pass	1.19	Pass	0.00
Oils	3.2302800	372.55	1,203.45	372.55	Pass	1,203.45	Pass	1.20
Bituminous mixtures	0.1908600	330.80	63.14	330.80	Pass	63.14	Pass	0.06
Other materials	1.4727178	13,161.74	19,383.53	13,161.74	Pass	19,383.53	Pass	19.38
			35,548.52	**61,555.10**		**35,548.52**		**35.55**

Uncontrolled copy

	Oxford	tonnes	**Avonmouth**	tonnes	**Kings Plot**	tonnes	**Average (t)**
Concrete (m3)	13,326.00	**32,115.66**	20,670.00	**49,814.70**	15,040.00	**36,246.40**	**39,392.25**
Steel hot rolled (t)	1,869.00	1,869.00	2,713.00	2,713.00	2,105.00	2,105.00	
Cold roll steel (t)	187.00	187.00	290.00	290.00	210.00	210.00	
Cladding (metal) (m2)	50,287.00	653.73	47,829.00	621.78	37,616.00	489.01	
All metal (t)		**2,709.73**		**3,624.78**		**2,804.01**	**3,046.17**

Above civil construction data for concrete and steel provided by MVV for other similar facilities

The change of 1 m3 (cubic meter) unit of concrete measure equals = to 2.41 t (tonne (Metric)

Assumed steel cladding 13 kg (0.013 t) per m2

Scope: The carbon emissions arising from any on- or off-site construction-related activities must be considered in [A5]. This includes any energy consumption for site accommodation, plant use and the impacts associated with any waste generated through the construction process, its treatment and disposal.

KPI: 1400kgCO2e/£100k
Source: https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf

Construction Cost (£)	350,000,000
Construction KPI (at 1400kgCO2e/ £100k)	1,400
Estimated Process emissions during construction (kgCO2e)	4,900,000.00
Estimated Process emissions during construction (tCO2e)	4,900.00
Estimated Process emissions during construction (ktCO2e)	4.90

Note: construction costs excluding consultancy fees

MVV provided data - diesel 1,939,360 l per annum including 5d (4b would be 10% of it)
BEIS emissions factors - liquid fuels - gas oil - 0.63253 kg CO_2e per litre

Total diesel use per annum (litres)	1,939,360
Maintenance diesel use per annum (litres)	193,936
Years of operation	40
Lifetime biodiesel use (litres)	7,757,440
Emissions conversion factor gas oil (kg CO2e per litre)	0.63253
Lifetime diesel use emissions (kg CO2e)	4,906,813.52
Lifetime diesel use emissions (t CO2e)	4,906.81
Lifetime diesel use emissions (kt CO2e)	**4.91**

Uncontrolled copy

MVV provided data - 40,000 tpa

BEIS emissions factors - water supply - 0.149 kg CO_2e per m3

One metric tonne of water converted into cubic meter of water equals = 1.00 m3 - cu m

Water use per annum (tonnes)	40,000
Water use per annum (m3)	40,000
Years of operation	40
Lifetime water use (m3)	1,600,000
Emissions conversion factor (CO2e per m3)	0.149
Lifetime operational water use emissions (kg CO2e)	238,400.00
Lifetime operational water use emissions (t CO2e)	238.40
Lifetime operational water use emissions (kt CO2e)	**0.24**

The IBA remaining after combustion equates to approximately 26.5% by weight of the input waste, this equates to approximately 165,600tpa assuming a maximum waste throughput of 625,600tpa
The IBA would be sent to a suitably licenced facility and in the UK where possible, for recycling
BEIS emissions factors - waste disposal - refuse - commercial and industrial waste - open-loop recycling (note factor greyed out assumed the same as closed-loop) - 21.294 kg CO2e per tonne
The APC residues amount to approximately 5% of the total waste by volume, this equates to approximately 31,280tpa assuming a maximum waste throughput of 625,600tpa
The APC residues are not dissimilar to powdered cement
The APC residues would be sent to a suitable licenced facility and in the UK where possible, for disposal
BEIS emissions factors - waste disposal - construction - aggregates - landfill - 1.239 kg CO2e per tonne

IBA per annum (tonnes)	165,600
Years of operation	40
Lifetime IBA (tonnes)	6,624,000
Emissions conversion factor (CO2e per tonne)	21.294
Lifetime IBA emissions (kg CO2e)	141,051,456.00
Lifetime IBA emissions (t CO2e)	141,051.46
Lifetime IBA emissions (kt CO2e)	**141.05**

APCr per annum (tonnes)	31,280
Years of operation	40
Lifetime APCr (tonnes)	1,251,200
Emissions conversion factor (CO2e per tonne)	1.239
Lifetime APCr emissions (kg CO2e)	1,550,236.80
Lifetime APCr emissions (t CO2e)	1,550.24
Lifetime APCr emissions (kt CO2e)	**1.55**

Total lifetime IBA and APCr emisisons (kt CO2e)	**142.60**

Uncontrolled copy

kt	No Development					With Development											Difference			UKCB (kt)	
	Operation			Avoided		Construction			Operation					Decom	Avoided						
	Landfill	Road Traffic	Energy		Total	Materials	Process	Transport	Maintenance	Combustion	Op Water Use	IBA and APCr	Road Traffic			Total					
2023					0.00	11.85	1.63	2.67								16.15	16.15	4th UKCB	-83.41	1,950,000.00	-0.0043%
2024					0.00	11.85	1.63	2.65								16.13	16.13				
2025					0.00	11.85	1.63	2.62								16.10	16.10				
2026	287.23	3.10	0.63	-20.04	270.92				0.12	273.33	0.006	3.57	8.11		-80.08	205.05	-65.87				
2027	287.23	3.07	0.63	-20.04	270.89				0.12	273.33	0.006	3.57	8.04		-80.08	204.98	-65.92				
2028	287.23	3.04	0.63	-20.04	270.87				0.12	273.33	0.006	3.57	7.97		-80.08	204.91	-65.96	5th UKCB	-330.55	1,725,000.00	-0.0192%
2029	287.23	3.02	0.63	-20.04	270.84				0.12	273.33	0.006	3.57	7.90		-80.08	204.84	-66.00				
2030	287.23	2.96	0.63	-20.04	270.78				0.12	273.33	0.006	3.57	7.74		-80.08	204.68	-66.10				
2031	287.23	2.90	0.63	-20.04	270.72				0.12	273.33	0.006	3.57	7.59		-80.08	204.53	-66.20				
2032	287.23	2.85	0.63	-20.04	270.67				0.12	273.33	0.006	3.57	7.45		-80.08	204.39	-66.28				
2033	287.23	2.80	0.63	-20.04	270.62				0.12	273.33	0.006	3.57	7.32		-80.08	204.26	-66.36	6th UKCB	-332.47	965,000.00	-0.0345%
2034	287.23	2.75	0.63	-20.04	270.58				0.12	273.33	0.006	3.57	7.20		-80.08	204.14	-66.43				
2035	287.23	2.71	0.63	-20.04	270.54				0.12	273.33	0.006	3.57	7.10		-80.08	204.04	-66.50				
2036	287.23	2.68	0.63	-20.04	270.50				0.12	273.33	0.006	3.57	7.00		-80.08	203.94	-66.56				
2037	287.23	2.64	0.63	-20.04	270.47				0.12	273.33	0.006	3.57	6.91		-80.08	203.85	-66.62				
2038	287.23	2.61	0.63	-20.04	270.43				0.12	273.33	0.006	3.57	6.83		-80.08	203.77	-66.67				
2039	287.23	2.58	0.63	-20.04	270.41				0.12	273.33	0.006	3.57	6.76		-80.08	203.70	-66.71				
2040	287.23	2.56	0.63	-20.04	270.38				0.12	273.33	0.006	3.57	6.70		-80.08	203.64	-66.75				
2041	287.23	2.53	0.63	-20.04	270.36				0.12	273.33	0.006	3.57	6.62		-80.08	203.56	-66.80				
2042	287.23	2.51	0.63	-20.04	270.34				0.12	273.33	0.006	3.57	6.57		-80.08	203.51	-66.83				
2043	287.23	2.50	0.63	-20.04	270.32				0.12	273.33	0.006	3.57	6.53		-80.08	203.47	-66.85				
2044	287.23	2.49	0.63	-20.04	270.31				0.12	273.33	0.006	3.57	6.50		-80.08	203.44	-66.87				
2045	287.23	2.48	0.63	-20.04	270.30				0.12	273.33	0.006	3.57	6.48		-80.08	203.42	-66.88				
2046	287.23	2.47	0.63	-20.04	270.29				0.12	273.33	0.006	3.57	6.45		-80.08	203.39	-66.90				
2047	287.23	2.46	0.63	-20.04	270.29				0.12	273.33	0.006	3.57	6.44		-80.08	203.38	-66.91				
2048	287.23	2.46	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.43		-80.08	203.37	-66.92				
2049	287.23	2.46	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.42		-80.08	203.36	-66.92				
2050	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92	Net Zero			
2051	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2052	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2053	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2054	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2055	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2056	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2057	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2058	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2059	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2060	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2061	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2062	287.23	2.45	0.63	-20.04	270.28				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2063	287.23	2.45	0.63	-20.04	270.27				0.12	273.33	0.006	3.57	6.41		-80.08	203.35	-66.92				
2064	287.23	2.45	0.63	-20.04	270.27				0.12	273.33	0.006	3.57	6.41		-80.08	203.36	-66.91				
2065	287.23	2.45	0.63	-20.04	270.27				0.12	273.33	0.006	3.57	6.41		-80.08	203.36	-66.91				
2066					0.00									16.15		16.15	16.15				
2067					0.00									16.13		16.13	16.13				
2068					0.00									16.10		16.10	16.10				
Total	11,489.35	103.85	25.04	-801.42	10,816.83	35.55	4.90	7.93	4.91	10,933.05	0.24	142.60	271.68	48.38	- 3,203.20	8,246.03	- 2,570.80				
	See waste spreadsheet	See transport spreadsheet		See waste spreadsheet				See transport spreadsheet		See waste spreadsheet			See transport spreadsheet		See waste spreadsheet