Medworth Energy from Waste
Combined Heat and Power Facility

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Applicant's comments on the Deadline 5 Submissions: Part 1 Statutory Parties

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Contents

1. Introduction

1.1 Background

1.1.1 Medworth CHP Limited (the Applicant) submitted an application for development consent to the Secretary of State on 7 July 2022 (the Application). The Application was accepted for examination on 2 August 2022. The Examination of the Application commenced on 21 February 2023.

1.1.2 This document, submitted for Deadline 6 (12 July 2023) of the Examination contains the Applicant's comments on Deadline 5 submissions, other than responses to the Examining Authority's written questions ExQ2 which are addressed separately in **Volume 15.5.** Deadline 5 submissions were made by the following organisations:

- Statutory Parties:
  - Anglian Water **[REP5-041]**; and
  - Cambridgeshire County Council and Fenland District Council **[REP5-043 to REP5-044]**.
- Other Interested Parties:
  - United Kingdom Without Incineration Network (UKWIN) **[REP5-053]**; and
  - Kerys Jordan **[REP5-049]**.

1.1.3 This document (Part 1) contains the Applicant's response to Deadline 5 submissions from the Statutory Parties in the following tables:

- Table 2.1 Comments on Deadline 5 submissions from Anglian Water; and
- Table 3.1 Comments on Deadline 5 submissions from Cambridgeshire County Council (CCC) and Fenland District Council (FDC).

1.1.4 The Applicant's response to Deadline 5 submissions from Other Interested Parties is presented in a separate document (Part 2) in **Volume 15.6b** and the Applicant's comments on responses to ExQ2 are provided in **Volume 15.5**.

2. Comments on Deadline 5 submissions from Anglian Water

Table 2.1 Comments on Deadline 5 submissions from Anglian Water [REP5-041]

ID	Topic/Para	Anglian Water Representation	Applicant Comment
Water Resources			
AW1	First bullet point	The water demand for the existing use on the site (waste transfer depot) does not exceed 3m^3/day and therefore is negligible in terms of any offset against the proposed demand for non-domestic water.	Comments noted. The Applicant refers the ExA to **Table 3.1 Comments on the Deadline 4 Submission from Anglian Water [REP4-034]** in the **Applicant's comments on the Deadline 4 Submissions: Part 1 Statutory Parties – Revision 1.0 (Volume 14.4a) [REP5-034]**
AW2	Second bullet point	The requirement for the standard daily operational needs of the facility is 5m^3/hr or 0.12 megalitres/day (Ml/d) which is above our de minimis threshold for non-domestic water demand. As highlighted previously, to respond to the challenges of abstraction reductions to protect the environment, and a growing population, Anglian Water is building a new strategic pipeline to move water around our region. We have also developed plans to build two new reservoirs to increase water supply. These solutions will take time to deliver, and so it is more crucial than ever that all homes and businesses are water efficient,	See AW1, above.

ID	Topic/Para	Anglian Water Representation	Applicant Comment
		to reduce the overall demand for water, to meet government targets and to ensure there is enough water to go around.	
AW3	Third bullet point	The Technical Note setting out the approach to efficiently managing potable water use and utilising a water audit process is welcomed. The breakdown of water consumption in Appendix G of the Note demonstrates that of the 5 m^3/hr consumption, 0.72 m^3/hr is for domestic purposes (amenity and sanitary uses) of which 0.51 m^3/hr can be addressed by non-potable supply including on-site rainwater harvesting. The non-domestic supply therefore equates to 4.28 m^3/hr (0.1 Ml/d).	See AW1, above.
AW4	Fourth bullet point	The Anglian Water strategic interconnector from Peterborough to Bexwell (near Downham Market) will be constructed in 2025 and will bring more water into the Fenland water resource zone. Once other pressures for water demand have been addressed, Anglian Water can confirm the ability to offer 0.12 Ml/d from April 2026 to the facility. It is understood that the site will be commissioned from Q1 2027 and therefore the strategic interconnector will enable both domestic and non-domestic demands for water to be met.	See AW1, above.
AW5	Fifth bullet point	The 12m^3/hr of additional demand for occasional use (4 – 6 times a year) is less than 0.002 Ml/d on average and will be considered by our network modellers when a submission for a water supply	See AW1, above.

ID	Topic/Para	Anglian Water Representation	Applicant Comment
		connection is made by the Applicant through the Anglian Water InFlow process.	
AW6	Sixth bullet point	Anglian Water understands that the steam supply requirement of 63m^3/hr should not result in a net increase in terms of available water resources, as it will replace the water supply used by existing customers in the vicinity of the facility. Through the application to Anglian Water to upgrade to the water connection and increase supply to for steam generation, measures will be required to ensure a net 'neutral' position on water resources accounting for a corresponding reduction in demand from the 'steam customer'. Whilst a 'no condensate return' approach is outlined, Anglian Water would encourage condensate return to be utilised wherever possible whilst recognising that this is dependent on whether the customer's processing of the steam supplied can enable this to be secured.	See AW1, above.
AW7	Seventh bullet point	It is noted that water demands during the construction process should not be excessive as no temporary concrete batching plant is required on site, and therefore water will be generally required for amenity and sanitary uses for construction workers on site.	See AW1, above.
Foul drainage connections			
AW8	First bullet point	Anglian Water has no specific concerns with the proposed foul drainage strategy presented by the	Comment noted.

ID	Topic/Para	Anglian Water Representation	Applicant Comment
		Applicant and advise the Applicant to submit an application for the foul drainage connections as soon as reasonably practicable to enable the application process to progress and align with the construction and commissioning of the project.	
AW9	Second bullet point	A flow survey will be required for trade effluent and will confirm whether any network reinforcement will be needed. It is advised that any network upgrades, should they be required, will take 2-3 years to construct and at the cost of the developer	See AW1, above.
AW10	Third bullet point	Domestic foul flows will need to be confirmed at the point of submitting a pre-planning application through our Inflow platform and any upgrades will be the responsibility and at cost to Anglian Water.	See AW1, above.
Potential for efficiencies and alternative water supplies in the future			
AW11	First bullet point	Anglian Water notes that there is potential for further efficiencies and alternative water supplies in the future, should DCO consent be granted for the facility. Alternative water supply options for future consideration by the facility includes final effluent re-use from Water Recycling Centres following further investigation into feasibility by Anglian Water.	See AW1, above.

ID	Topic/Para	Anglian Water Representation	Applicant Comment
AW12	Second bullet point	The ability for the facility to secure condensate returns from potential steam customers that are currently in operation in the vicinity with an existing water supply, provides opportunities for greater water efficiencies by the facility. There is also the potential for closed-loop processes for future steam customers that may choose to locate in the vicinity of the facility, subject to securing a water supply from Anglian Water.	See AW1, above.

3. Comments on Deadline 5 submissions from Cambridgeshire County Council and Fenland District Council

Table 3.1 Comments on Deadline 5 submissions from Cambridgeshire County Council and Fenland District Council- CCC and FDC Comments on any further information/submissions received by Deadline 4 [REP5-043]

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
VOLUME 6.4 ENVIRONMENTAL STATEMENT – CHAPTER 6 – TRAFFIC AND TRANSPORT APPENDIX 6A – OUTLINE CTMP Rev 4[1] [REP4-007]			
1	Temporary Highway Closures 7.2.5	When explaining temporary rights of way closures, this paragraph refers to "*public footways*". This is incorrect as the closures actually affect Byways Open to All Traffic (Elm 6 and Wisbech 21), which connect Halfpenny Lane to the A47. The paragraph should refer to "*short term temporary public right of way closures*", and the correct term should be used throughout this paragraph and elsewhere in the document.	The **Outline Construction Traffic Management Plan (CTMP) Rev 5** [**REP5-011**] submitted at Deadline 5 was updated to respond to the comment made by CCC and FDC.
2	Signage on Network Rail land 7.4.8	CCC requests consultation on the wording of any sign erected on behalf of Network Rail and requests that such a requirement should be included within the outline CTMP. CCC wishes to ensure that such a sign is not inadvertently worded so as to discourage NMUs from passing across the former level crossing.	The **Outline CTMP Rev 5** [**REP5-011**] submitted at Deadline 5 was updated at paragraph 7.4.8 to respond to the comment made by CCC and FDC. The Applicant and CCC have met with Network Rail to discuss the provision of such signage.

[1] Rev 4 at Deadline 4

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
3	Highway Condition Surveys 7.4.21	CCC refers to its previous comments in relation to highway condition surveys, which still stand [**REP4-031, REP3-044** and **REP1-074**]. The Council notes that these provisions remain unaltered following such previous comments submitted by CCC	The **Outline CTMP Rev 5** [**REP5-011**] submitted at Deadline 5 was updated to respond to the comment made by CCC and FDC at paragraphs 7.4.21 to 7.4.27. CCC confirmed its agreement in emails dated 14 June 2023.
VOLUME 6.4 ENVIRONMENTAL STATEMENT – TECHNICAL APPENDIX – APPENDIX 7D OUTLINE OPERATIONAL NOISE MANAGEMENT PLAN – Rev 3 [REP4-005]			
4	Updates to LPA 1.4.3	The Councils note that their request [**REP4-031]** to amend paragraph 1.4.3 in order to keep the LPA updated on revised versions of the ONMP remains outstanding.	The requested amendment has been reflected in the revised **Outline Noise Management Plan (ONMP) [REP5-013 & REP5-014**] submitted as part of Deadline 5.
5	Chapters 5 and 6 additions 5.1.5, 5.1.6 6.1.1, 6.1.2	The Councils note and accept the additions to Chapters 5 and 6 of the ONMP.	Comment noted.
VOLUME 7.12 OUTLINE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (tracked) – Rev 4 [REP4-009]			
6	Noise and Vibration Monitoring	The Councils note and accept the additions to Appendix F, Chapters 3 and 4 to include details of vibration monitoring in line with relevant guidance.	Comment noted.
7	Landscape and Visual 5.8	The Councils welcome the proposed temporary fence to help mitigate impact of the development on NMUs using New Bridge Lane, although it	Agreed **Draft Heads of Terms (Volume 15.8)** have been submitted at Deadline 6 and the Applicant's and CCC's respective solicitors are negotiating the draft agreement.

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
		considers that this will have limited effect once construction traffic is using New Bridge Lane. The Councils are seeking a public access – ecological – community mitigation package to offset the impact of the development in the longer term, which is under negotiation.	The Applicant is confident that the agreement can be completed prior to the end of the Examination. CCC questions the level of mitigation provided by the proposed temporary fence which will be provided to screen the construction site (this is a fence to the construction site and not the acoustic fence intended for 10 New Bridge Lane). The Applicant considers that the fence will be effective in screening views to lower-level construction activities and it would also provide some attenuation of the noise that would otherwise be experienced by NMUs passing along the frontage of the site. The actual reduction in noise levels has not been assessed as the effects to users of the footway are not considered to have the potential to be significant.
12.2b WRITTEN SUMMARY OF THE APPLICANT'S ORAL SUBMISSIONS AT ISH4 – Rev 1 [REP4-020]			
8	Climate Change – GHG calculation spreadsheets Appendix B	CCC has been provided with the unlocked Excel spreadsheets that have been used by the Applicant to calculate the numbers in Appendix B. A number of queries arise from this: - • Does the biogenic and non-biogenic carbon fraction of each waste type take into account the dry matter content? Presumably the weight of waste as received would include water content; -	The weight of waste is assumed to be waste as received rather than dry weight. The biogenic carbon content, non-biogenic carbon content and NCV values used in the GHG calculation spreadsheets are based on the WRATE Greenhouse Gas Calculator for Municipal Waste model[3], which assigns carbon factors to 15 separate waste categories and aligns well with material categories for the WRAP 2017 residual waste composition data[4] used in the GHG assessment. The WRATE model was originally developed by the Environment Agency to enable those involved with waste management planning to model the potential effects of waste services on the environment.

[3] WRATE (2011), Greenhouse Gas Calculator for Municipal Waste. WRATE v2
[4] WRAP (2020). National Municipal Waste Composition, England 2017, Table 3.

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
		• It is unclear how the % of biogenic carbon and non-biogenic carbon given in the applicant's spreadsheet (e.g. cells D4 to E22 of 'Waste composition – Sens' tab of 'GHG Waste Composition (incl sensitivity cases).xlsx) have been arrived at. These %s differ from the values given in the 2006 IPCC guidelines for National Greenhouse Gas Inventories[2] – Vol 5 Ch 2, Table 2.4. For example, the IPCC guidelines for plastics state that the default total carbon content is 75% of the waste (by weight), however the Applicant's spreadsheet states 54.76% for dense plastics and 48.11% for plastic film; - • It is also unclear where the Applicant's Net Calorific Values for each waste type (cells F4 to F22) are drawn from; - The Applicant's 'Assumption 1' (methodology from Cory EfW plan) has a broken web link so this cannot be review at present; - For construction phase emissions, a high proportion of the Applicant's estimated GHG emissions is associated with "Other Materials", so this may not be accurate. It also seems odd to classify waste as a construction material (see cells C10 to D32 of 'Materials – Embodied C' tab in the 'GHG Assessment 1' spreadsheet); -	As identified in **Section 14.8 of the ES Chapter 14 Climate Change (Volume 6.2) [APP-041]**, a sense-check indicates that outputs on carbon content are comparable with the residual waste profiles for alternative studies. Please see Appendix A to this document which is relevant the relevant reference in Assumption 1: Carbon Trust 2017. Cory Riverside Energy: A Carbon Case, Carbon Trust Peer Review. With respect to construction phase emissions, the use of proxy information on construction waste arisings to estimate quantities of construction materials is considered to be an appropriate approach. Given the stage of the Proposed Development and level of detail available for the design at this stage (i.e. development footprint and type of development), this was considered to be the most suitable method for determining embodied carbon for the construction phase, as alternative information available for materials used in other developments may have underestimated the quantity of materials required. To clarify, waste is not being classified as construction material but typical wastage rates for construction waste arisings have been used as a means to determine quantities of construction materials for the Proposed Development. The method and calculations used for this approach are shown in the 'GHG Assessment 1' spreadsheet. It is unclear what CCC mean by 'classify waste as construction material' (where reference is made to cells C10 to D32 of

[2] Intergovernmental Panel on Climate Change (2006), *IPCC Guidelines for National Greenhouse Gas Inventories: Volume 5 (Waste)* [online] (Accessed 13 June 2023)

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
		- It is unclear what the Applicant's 'BRE Smartwaste' query was, but it appears it might be used to estimate waste generated from the construction process. However, it looks like this has also been used by the Applicant to estimate the quantity of construction materials required in the first place, by working backwards from typical wastage rate. It is unclear how this might be applicable to the 'Other Waste' category. It would be helpful to clarify this, and also whether more accurate materials data might be gained from design information instead; and – - The Applicant's assessment of construction 'process emissions' are based on construction spend, which is likely to be an inaccurate method of estimation.	'Materials – Embodied C' tab in the 'GHG Assessment 1'). The cells in this worksheet link back to the 'Waste – Embodied C' tab, which have been used as proxies to calculate equivalent quantities of construction materials. Once this step has been completed the relevant ICE carbon factors are applied to the construction material quantities to determine embodied carbon for construction of the Proposed Development. The construction materials calculated for the 'Other Waste Category' has been grouped together with additional materials in the 'Materials – Embodied C' tab under 'Other Materials'; however, this may not have been clear as some of the rows are hidden in the spreadsheet but can be displayed by using the 'unhide' function in excel. As for the construction process emissions, given the level of information available at this stage for the design, the use of proxy information for RICS construction spend benchmarks to estimate construction process quantities is considered to be an appropriate approach.
12.3 COMMENTS ON THE DEADLINE 3 SUBMISSIONS: PART 1 STATUTORY PARTIES – Rev 1 [REP4-022]			
6.4 Environmental Statement Appendix 8B Air Quality Technical Report (tracked changes) (Rev 3.0)			
9	Modelled road network 5.1.2	The Applicant's commitment to the imposition of HGV movement restrictions such that they would	Comment noted.

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
	Page 3	not travel through an AQMA, secured via Draft DCO [REP3-007] Requirements 11 (CTMP) and 12 (OTMP), is considered to be sufficient to address any outstanding queries with regards to the modelled road network	
10.2 Response to the ExA's Written Questions (ExQ1) (Rev 1.0)			
Biodiversity, Ecology and the Natural Environment			
10	810.1.4 Page 30 Page 14	The Councils' original comment still stands regarding the lack of compensation for water vole, as set out in the Local Impact Report [**REP1-074]** and its comments on the Applicant's D2 submissions [**REP3-044**]. However, the Councils consider this issue can be resolved through an update to the Outline Biodiversity Net Gain Strategy. Please refer to the Councils' response to "10.3 Applicant's Response to the CCC and FDC Local Impact Report (Rev 1.0)" below for more details.	The Applicant has been in discussion with the Councils concerning the potential for effects upon water vole and at the request of the CCC has made an additional amendment to **ES Chapter 11 - Biodiversity Appendix 11M Biodiversity Net Gain (Clean) Rev 4.0 [REP5-015**] to refer specifically to the issue of water voles in the Annex C (Outline BNG Strategy). This Rev 5.0 document is submitted at Deadline 6.
Climate Change			
11	Baseline 'without development' scenario 9.4.4 objection 3, and 9.4.17 and 9.4.18 Page 39	The Defra document the Applicant refers to, which assumes a landfill gas capture rate of 68%, is a research report, rather than guidance. The report is dated 2014 and is based on research from 2011, which may therefore be out of date. Nonetheless, this Defra document, which quotes 68% capture rate for "large, operational,	In response to **ISH 4 Action Point No.7 [EV-059]**, the Applicant has discussed further sensitivity analysis with Cambridgeshire County Council (CCC). Appropriate waste composition scenarios, Landfill Gas (LFG) capture rates (52% and 85%), and scenarios considering the decarbonisation of the UK electricity grid have been agreed. The Applicant has provided reasoning to clarify

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
		modern UK landfills", also states the range for current operational sites was 55-85% - indicating a large variance. The Councils therefore disagree with the Applicant's assertion that 68% is a "conservative approach". Indeed, landfill gas capture rates are variable (from site to site) and generally have improved over time.	which scenarios it considers to be most likely. This analysis is submitted at Deadline 6 **Applicant's Response to ISH4 Action Point 7 Technical Note Climate Additional Sensitivity Assessment (Volume 15.7).** It is also noted that in the Climate Change Committee's 6th Carbon Budget report for the waste sector[5], that although LFG capture rates increased significantly in the period up to the early 2010s, LFG capture rates have peaked and are now declining.
ELEC			
12	Impact on NMUs and local communities Page 16	The Councils disagree with the Applicant's assessment of degree of impact upon NMUs, and would reiterate that NMUs by necessity use local roads to access PROW, and in place of PROW where there are none. Therefore it is incorrect to assume that there would be limited impact on NMUs and local communities simply because the PROW network is limited. The Councils welcome the Applicant's draft Community Benefits Strategy and its commitment to engage in agreeing a community fund. It considers that this needs to be part of a wider NMU-ecological-community mitigation package. The Council has provided its suggestions and a meeting was held on 7 June, as outlined in its response to ExQ2 SCP 2.3 within document CLA.D5.EXQ2.R, to be	The Applicant maintains its position with regard to its assessment conclusions on the level of visual impact that will be sustained by users of the PROW network. However, agreed **Section 106 Heads of Terms (Volume 15.8)** are submitted at Deadline 6 and the Applicant's and CCC's respective solicitors are negotiating the draft agreement. The Section 106 Heads of Terms include the following: 1) Schedule 1: Secures the Public Rights of Way and Non-Motorised User Enhancement Contribution; and 2) Schedule 2: Secures the Public Access in Biodiversity Net Gain Land The Applicant is confident that the agreement can be completed prior to the end of the Examination.

[5] Climate Change Committee (2020). *The Sixth Carbon Budget, Waste*

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
		submitted at Deadline 5. Negotiations are ongoing. With regard to permissive access over the former level crossing, the Councils welcome the Applicant's commitment to continue to liaise with Network Rail to seek a grant of permissive rights. The Councils appreciate that such a grant is only in the gift of Network Rail, but given that the Applicant is having to secure rights for itself and for residents who currently access their properties via the highway, and as NMUs are affected by the Proposed Development, it seems more than reasonable that the rights sought should include permissive rights for NMUs. The Council would reiterate that this would not adversely impact in any way on Network Rail's control of rights over the crossings; rather it would clarify a use that has been occurring for decades. This may help the development to be accepted locally.	The Applicant's submission included an **Outline Community Benefits Strategy [APP-105]** which incorporated a commitment to a community fund. Since Deadline 5, the Applicant and the Council have agreed to update the Outline Community Benefits Strategy to include further information on community fund, including the general arrangements, scope, aims and objectives and the delivery mechanism. The Applicant and the Council have agreed to enter into a Section 111 Agreement (Local Government Act (1972)). Reflecting the latest position, the updated Outline Community Benefits Strategy Rev 2 (Volume 7.14) is submitted at Deadline 6. The Applicant is confident that the Agreement can be agreed prior to the end of the Examination. With regard to the matter of permissive access across the Disused March to Wisbech Railway, please see the Applicant's response to ID ref 2 and submitted at Deadline 6, SPC.2.3, page 44-45, **Applicant's comments on the responses to the ExA's Written Questions (ExQ2) (Volume 15.5**).
Noise and Vibration			
13	Impact on NMUs and local communities Pages 18 - 19	The Councils note the Applicant's response. The Councils remain of the view that NMUs will experience more noise and vibration during operation of the Proposed Development than is currently the case along New Bridge Lane, due to the additional level of HGV traffic that will be generated. The Councils point out that the limited mitigation possible along New Bridge Lane is one	It is agreed that NMUs will experience more noise and vibration on the stretch of New Bridge Lane between Salters Way and the EfW CHP Facility Site entrance during the operational phase. However, the Applicant's position remains that, regarding NMUs in this area, during both the construction and operational phases, as stated in Deadline 4 **Submission**

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
		of the reasons that the Councils seek the mitigation package set out in its response within document CLA.D5.EXQ2.R, to be submitted at Deadline 5.	**- 12.3 comments on the Deadline 3 Submissions: Part 1 Statutory Parties - Rev 1 [REP4-022]:** *"NMUs accessing the section of New Bridge Lane between the site entrance and Salters Way will experience transient noise from vehicle passbys. This will not be significant and will be similar to, or less than, the noise currently experienced on the section of road between Salters Way and Cromwell Road. No additional noise mitigation is required."* To provide further detail to the above, the segment of New Bridge Lane between Cromwell Road and Salters Way is approximately 250m in length and already experiences a relatively high number of vehicle movements. The segment of New Bridge Lane between Salters Way and the EfW CHP Facility Site entrance is approximately 150 m in length and will experience lower flows of vehicles than are currently existent on New Bridge Lane between Cromwell Road and Salters Way. It is noted that the improved segment of New Bridge Lane from Salters Way to the EfW CHP Facility Site entrance is significantly shorter than the existing segment from Salters Way to Cromwell Road. NMUs in this area are transient receptors that may be exposed to one or two vehicle pass-bys while transiting along the improved segment of New Bridge Lane between the EfW CHP Facility Site entrance and Salters Way. This is no different to the experience of the NMU currently which may pass through New Bridge Lane between Salters Way and Cromwell Road, where they may also experience one or two vehicle pass-bys, whilst they approach/ move away from the busy Cromwell Road where many vehicle pass-bys are likely to be

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
			experienced. It is also noted that the proposed EfW CHP Facility Site lies within an existing industrial area where NMUs would expect to be in close proximity to some vehicle movements. Based on the comments previously provided in **[REP4-022]**, and the additional considerations above, it is considered that there will be no significant noise or vibration effects to NMUs on New Bridge Lane due to the Proposed Development during the construction or operational phases.
Traffic and Transport			
14	Highways Asset Management Construction Phase Impact on NMUs and other rights of access Page 24	The Councils refer to their response within document CLA.D5.EXQ2.R, ExQ2 TT.2.3, to be submitted at Deadline 5. With regard to the bollard, the Councils note that there will be provision with the DCO for a TRO and that this matter is under discussion	Please see the **Applicant's comments on the responses to ExQ2 (Volume 15.5)** in respect of TT.2.2 and TT2.3 submitted at Deadline 6. Article 17 of the **draft DCO [REP5-005]** submitted at Deadline 5 includes provisions which would enable the installation of a bollard. This power requires the Applicant to obtain the prior consent of the traffic authority.
15	Highway Asset Management Decommissioning Phase Impacts 2.6.2 Pages 28 – 29	The Councils refer to their response within document CLA.D5.EXQ2.R, ExQ2 TT.2.3, to be submitted at Deadline 5.	Please see the **Applicant's comments on the responses to ExQ2 (Volume 15.5)** in respect of TT.2.2 and TT2.3 submitted at Deadline 6.
16	Public rights of way: Construction and Operational Phase Impacts on	The Councils welcome the amendments to the CTMP in respect of the crossings over the two	The **Outline CTMP Rev 5 [REP5-011]** paragraph 7.4.22 makes specific reference to the carrying out of condition

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
	NMUs and local communities 2.16 and 2.17 Page 31	byway accesses. However, the Councils still request that the CTMP includes provision for features that form the boundaries to the byway around the accesses to be protected from damage during construction, and for the highway condition surveys to include both the surfaces of these accesses for as far as any works may proceed (including any temporary storage of equipment or materials) and the boundary features.	surveys as requested. The wording was agreed with CCC via email correspondence on 14 June 2023.
17	Operational Traffic Management Plan: NMUs 32 - 34	The Councils refer to their response within document CLA.D5.EXQ2.R, ExQ2 TT.2.3, to be submitted at Deadline 5. In addition, the Councils would comment that, whilst there may be plans for employment use of the fields south of New Bridge Lane, it is unlikely that these would have the visual impact of the Proposed Development arising from its extreme height, or the same range of concerns about its environmental impacts. The Councils still seek amendment of the Outline Landscape and Ecology Management Plan to reflect the adverse impact on recreational use of PROWs and local communities within the wider landscape. This acknowledgment may help local communities feel that their concerns are being listened to.	Please see the **Applicant's comments on the responses to ExQ2 (Volume 15.5)** in respect of TT.2.2 and TT2.3 submitted at Deadline 6. In subsequent discussion with CCC it has been agreed that the submitted **Outline Landscape and Ecological Management Plan (LEMP) (Volume 7.7)** [**REP3-020**] is sufficient and does not require amendment.
10.23 Applicant's Response to the CCC and FDC Local Impact Report (Rev 1.0)			

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
18	Low Emissions Strategy 4.2.3 and 4.2.4 Page 34	The response only addresses emissions from the stack. However, the Traffic Management Plans secured via Draft DCO [REP3-007] Requirements 11 (CTMP) and 12 (OTMP) address emissions from traffic	Noted.
19	Construction Phase Impacts – Negative: Water Vole 7.3.13 Pages 35 and 36	The Councils' original comment still stands regarding the lack of compensation for water vole, as set out in the Local Impact Report [REP1-074] and its comments on the Applicant's D2 submissions [REP3-044]. However, the Councils met with the Applicant on 7 June 2023 to discuss this issue and have agreed off-site compensation habitat for water vole can be delivered as part of the Biodiversity Net Gain Strategy. The Applicant is expected to submit to the Examination a revised Biodiversity Net Gain Assessment [REP3-017] at Deadline 5 to confirm that the "off-site River BNG units will be targeted at enhancing local water vole habitats within the Host Authority areas" as part of the Outline Biodiversity Net Gain Strategy (Annex C). The Councils consider this habitat will adequately compensate for the loss of water vole habitat from the site and as such, is expected to fully resolve the Councils' concerns.	See ID ref: 10, above.
VOLUME 12.4 OUTLINE DECOMMISSIONING PLAN – Rev 1 [REP4-024]			

ID Ref	Topic/ Para	CCC/FDC Representation	Applicant Comment
20	Biodiversity General	The Councils welcome the submission of the Outline Decommissioning Plan from a biodiversity perspective and are satisfied that biodiversity features, including biodiversity net gain habitats, will be protected during the decommissioning phase. This is subject to further details being secured through the Decommissioning Plan under Requirement 28 – Decommissioning.	Comment noted.
21	Environmental Management Measures Chapter 6	However, the risk of not preparing a management plan in advance is that key elements may not be considered. For instance, the Councils note in Chapter 5 (Water Connections) that water would be decommissioned in Phase 6. It would be expected that a Dust Management Plan and Extreme Weather Management Plan would require access to water during periods of prolonged heat or no rainfall as part of a Dust Mitigation Strategy.	Comment noted. Specific management issues can be identified and addressed within the detailed Decommissioning Plan which will be submitted to the relevant planning authority.

Table 3.2 Comments on Deadline submissions from Cambridge County Council and Fenland District Council – CCC and FDC Response to ISH4 and ISH5 action points [REP5-044]

ID	Topic/Para	CCC/FDC Response	Applicant Comment
RESPONSE TO ISH4 ACTION POINTS			
1	Action Point 2 Applicant and CCC to engage on outstanding issues in relation to Highways issues – including Protective Provisions, particularly payments for highway damage, and to update ExA and SoCG to reflect this.	The Applicant has engaged CCC on the following matters: • • Draft Heads of Terms for a Section 278 agreement (Highways Act 1980) for works within the highway. CCC returned its comments to the Applicant on 31 May 2023. The Applicant provided CCC with an updated draft S106 heads of terms on 13 June 2023. CCC are currently reviewing the proposed head of terms and will provide feedback to the Applicant accordingly. • • Draft Protective Provisions proposed for inclusion in the DCO. CCC's consideration of the Applicant's first draft is ongoing. • Design of highway works affecting New Bridge Lane, and the proposed pipe bridge over Weasenham Lane. • Highway extents affected by the Applicant's proposed non-material amendment to the DCO. CCC has worked with the Applicant to clarify the effect that the location of the highway boundary may have on the Applicant's proposed changes to the DCO boundary, and has advised the Applicant of	The Applicant can confirm that it remains in negotiation with the Councils on the matters listed and that it is confident of reaching agreement during the examination. The Applicant met with CCC as relevant highway authority of 6 July to discuss the Cromwell Road/New Bridge Lane signalisation scheme. Both parties are confident that the scheme works technically. The Applicant is updating the signalisation model following feedback received from CCC and this model will be submitted to CCC as the relevant highway authority for its agreement.

ID	Topic/Para	CCC/FDC Response	Applicant Comment
		its position with regard to the content of the application for a non-material amendment. • Improvements to the Cromwell Road / New Bridge Lane Junction, specifically CCC's requirement that the junction design incorporates full signalisation. CCC is continuing its discussions regarding the above matters with the Applicant. Drawings and traffic modelling relating to the New Bridge Lane Cromwell Road Junction, New Bridge Lane widening and associated works, together with a Stage 1 Road Safety Audit were submitted to CCC on 25 May 2023 by the Applicant, and are continuing to be considered by the CCC at present.	
2	Action Point 3 Applicant to work with CCC on negotiations of Section 208 Agreement, particularly financial contributions to the maintenance of roads.	The Applicant provided CCC with a draft S106 heads of terms on 13 June 2023. CCC are currently reviewing the proposed head of terms and will provide feedback to the Applicant accordingly. Discussions are ongoing about the inclusion of further matters in the S106. In relation to a Section 278 Agreement, discussions are still ongoing.	Agreed **Draft Heads of Terms (Volume 15.8)** have been submitted at Deadline 6 and the Applicant's and CCC's respective solicitors are negotiating the draft Section 106 Agreement. The Applicant is confident that the agreements (being the Section 106 Agreement, Section 111 Agreement and Section 278 Agreement) can be completed prior to the end of the Examination.
3	Action Point 4 Applicant to involve FDC and CCC in its discussions with Network Rail to secure permissive rights NonMotorised Users access via New Bridge Lane during construction and	The Councils proactively wrote to the Applicant on 6 June 2023, setting out their suggestions for a public access-ecological mitigation package, which included the establishment of permissive rights over the former level crossing. The Councils Page 3 of 8 operation, and for the Applicant to update ExA accordingly. would	The **Outline CTMP Rev 5** [**REP5-011**] submitted at Deadline 5 was updated at paragraph 7.4.8 to respond to the comment made by CCC and FDC. The Applicant and CCC have met with Network Rail to discuss the provision of such signage.

ID	Topic/Para	CCC/FDC Response	Applicant Comment
	operation, and for the Applicant to update ExA accordingly.	comment that they consider this matter to be part of the NMU mitigation package sought. The Councils understand from a meeting held with the Applicant on 7 June 2023 that the Applicant is prepared to use reasonable endeavours to secure a permissive right of access for owners and occupiers of land adjacent to, and NMUs using, New Bridge Lane subject to the width restriction imposed by the agreed bollards, with appropriate signage to confirm such rights. CCC has provided suggested wording for the signage. The Councils appreciate that such permission is in the gift only of Network Rail, but considers that this is a simple request that would bestow a significant benefit for local communities, whilst still enabling Network Rail to retain control over rights over the crossing. The signage and any agreement should be in place upon completion of the proposed works to the crossing as part of the New Bridge Lane improvement works, prior to the commencement of operation. The Councils remain willing to attend a meeting with Network Rail and the Applicant to progress this matter.	
RESPONSE TO ISH5 ACTION POINTS			
4	Issue Action Point 5 To provide clarification on points of disagreement with the Applicant's landscape assessment as actioned	As noted in its LIR [**REP1-074],** the Council expressed concerns regarding the level of harm caused by the proposed development on both the landscape and visual resources. Taking each aspect in turn:	The Applicant has responded to each of these points in its Deadline 6 submission, '**Applicant's comments on their responses to the ExA's Written Questions (ExQ2) (Volume 15.5),** see the Applicant's comments on CCC and FDC's response to ExQ LV.2.2.

ID	Topic/Para	CCC/FDC Response	Applicant Comment
	in previous meeting with the applicant.	Visual: The conclusion (LVIA ES Chapter 9, para 9.12.3 [APP-036]) correctly confirms significant effects arise for Recreational Users of Nene Way, as does Table 9.172 Effects on recreational visual receptors (page 9-142); however, Table 9.14 Summary of Viewpoint Analysis (9-75-9-98) incorrectly states Not Significant for Viewpoint 13 on the same receptor. There are a huge number of visual effects of varying Magnitudes of Change (MoC) and therefore Significance, both Significant and Non-Significant Effects. Whilst the Council considers that the assessment largely demonstrates clear Significant Adverse Effects, it notes the following: The Council considers that the community of Wisbech St Mary will be affected by the development. Although the assessment for Viewpoint 15 (in page 9-33) states "representative of views available to residents", the viewpoint photography (Figure 9.31a and b) is taken behind the tallest row of trees. It is considered that there will be locations where the views are clearer in between tree cover and thus parts of the community will have Significant Effects (Table 9.14 currently shows non-significant, where a Moderate MoC results in Moderate (and Significant) Effects on the community.	

ID	Topic/Para	CCC/FDC Response	Applicant Comment
		In addition, the receptor covering Bevis Lane (Lords Lane/Bevis Lane (page 9-164) exaggerates the level of tree cover, which is not continuous or tall in all locations (as noted above for Wisbech St Mary). There are sections of road from where there will be more open views of the Proposed Development. This will result in a Medium MoC and Moderate (and Significant Effects). Page 5 of 8 The Council notes and agrees that, amongst others, Significant Effects have been identified for High Sensitivity receptors along the Nene Way, rights of way at Crooked Bank/ Narrow Drove/ Broad Drove (West of Begdale), as well as Sustrans NCR63, noting these are all located broadly south-west of the Proposed Development, within 5km of the Site. However, the Council is concerned that the likely effects in a similar radius to the south and south east has been under assessed or omitted from the assessment. These include: South east of the Site within 5km, users of Needham Bank, Bar Drove, Kirkham Lane, Gosmoor Lane are not included, suggesting no effects identified. The Council considers these will result in a range of Medium to Low MoC and Moderate (Significant) to Minor Significance Friday Bridge area (page 9-130) – Whilst it is acknowledged that for many receptors there may be no view, those residents living on the west side of the village (west edge of B1101, Fridaybridge	

ID	Topic/Para	CCC/FDC Response	Applicant Comment
		Rd), the Council disagrees with the assessment of "Very Low" and considers that part of the community (western edge) will experience at least a Low MoC, resulting in Moderate (and Significant Effects at both construction and Operation (Yr 1 and 15). This is particularly evident, given the open nature of PRoW Byway 72/9 which runs along Back Lane from Elm and adjoins the northern edge of Friday Bridge, but has not been assessed. The Council considers the effect on this Right of Way to be at least a Low MoC and therefore of Moderate (and Significant) Effects both during construction and operation (Yrs 1 and 15). Page 6 of 8 South of Friday Bridge – the assessment (para 9.5.48, page 9- 49) acknowledges as a location where settlement pattern is "particularly dispersed or almost absent". Accordingly, with an absence of tree cover, the landscape is relatively open in places, such that there are clear views across the landscape towards Wisbech and the Site. In this area there are roads (for example Laddus Drove) and footpaths along Laddus Bank (FP 72/14, 72/15 running between Longbeach Farm and Maltmas Farm with particularly open views towards the development that have not been assessed. The Council considers these receptors will experience at least a Low MoC with Moderate (and Significant) Effects for the PRoW and Minor (non-Significant) Effects for the roads. These are important receptors in understanding that effects including Significant effects remain	

ID	Topic/Para	CCC/FDC Response	Applicant Comment
		south of Begdale and Elm in the range of approximately 5km from the Site. In addition, the Council considers that the change on viewpoint 7 (Table 9.14 Summary of Viewpoint Analysis and recorded in wireframe photography, Figures 9.23 a and b) should be assessed as a Moderate MoC (not Low), resulting in Major (and Significant) Effects during operation (Y 1 and 15). Overall, it should be remembered that many roads, lanes and droves are not only vehicular routes, but they are also used by cyclists, runners and walkers too, and are fundamental to enable the public in accessing and connecting the rights of way and countryside access for health and wellbeing. <u>Landscape/Townscape Receptors</u>: *Table 9.15 Summary of Significance of Adverse Effects: Landscape and Townscape Receptors* Wisbech Settled Fen (Ref 9-99): Significant localised effects are acknowledged within the detailed rationale text; however, the table summary refers to 'Not Significant' on the basis it considers the whole LCA. This should be amended to confirm Moderate and Significant at both Construction and Operation (Yr1 and 15) to fully and correctly acknowledge the Significant effects of the proposed scheme on part of the local character, but the rationale should then	

ID	Topic/Para	CCC/FDC Response	Applicant Comment
		acknowledge the wider effects on character are more limited. The Fens LCA (Ref 9-100): The Council considers that a Medium Magnitude of Change (not Low) will occur locally on the landscape, as suggested in the Applicant's rationale this does not extend far enough. The Council suggest that the Medium MoC will change the character of the local landscape, given the extensive number and nature of views and experience of the proposed scheme that is imposed on the local area. TCA8: Wisbech Retail Development (Ref 9-114): As set out in the Councils' LIR [REP1-074] (at para 5.2.3, 5.3.8 and 5.3.9, 5.3.10), the Council disagrees with the assessment of Low Magnitude of Change and Negligible (Not Significant). The introduction of a highly prominent new building would be at a far greater scale/volume than almost every building in the local townscape (and surrounding landscape). The Council considers the MoC to be Medium, and of Minor Significance. Although the Applicant in their rationale (page 9-114) suggests the contrast would be "partly reduced by the detailed design including its cladding", the Council consider this is very difficult to achieve, as set out in 5.4.24 of the LIR report. <u>Summary</u>: In summary, considering the extent and nature of effects evident across the landscape (including views), the Council is of the opinion that the	

ID	Topic/Para	CCC/FDC Response	Applicant Comment
		landscape effects of Moderate Significance (considered to be Significant Effects) extend in an arc in the open landscape from the edge of Wisbech St Mary extending round to the A1101 at approximately 5km radius.	

Appendix A Cory Riverside Energy: A Carbon Case

Cory Riverside Energy:
A Carbon Case

CORY
RIVERSIDE ENERGY

Carbon Trust Peer Review

Cory Riverside Energy: A Carbon Case

The Carbon Trust has conducted a peer-review on the report Cory Riverside Energy: A Carbon Case.

The scope of this study was to run a comparison between two alternative scenarios for waste management and its goal being to demonstrate which has the lower impact: the conversion of waste into electricity within Cory Riverside Energy's operations, with waste transport by road and river; and the disposal of the same waste to a UK landfill site with waste transport by road only. This was accepted as suitable for the goal of the study and to be in line with the UK Government 2014 Defra study, Energy from Waste: A Carbon Based Modelling Approach.

The main findings of the peer-review were:

- The carbon footprint study is based on an appropriate methodology and identifies the key carbon impact categories for Cory Riverside Energy's own Energy from Waste activities and an alternative scenario of the waste being sent off to Landfill.
- The study also supports Cory Riverside Energy's results regarding the comparative analysis of their own Energy from Waste operations to the alternative scenario of Landfill.

1 March 2017

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"Cory Riverside Energy's mission is to provide London with a safe, secure, affordable and sustainable energy supply and to continue to do so into the future."
SWL 4T

Who we are

Cory Riverside Energy ('Cory') is one of the leading waste management companies in London with 275 employees across a network of sites and facilities. Established in 1896, Cory has served London for over 120 years. Working closely with local authorities, Cory manages over 750,000 tonnes of London's waste. Uniquely, the business operates a 'green highway' on the River Thames, using a fleet of tugs and barges to sustainably transfer London's municipal and commercial waste and recyclable by-products to/from Riverside EfW facility. The energy from waste facility at Riverside generates circa 525,000 MWh of baseload electricity, powering the equivalent of 160,000 homes per year. Cory Riverside Energy's mission is to provide London with a safe, secure, affordable and sustainable energy supply and to continue to do so into the future.

160,000

Households powered with the c.525,000 MWh energy we generate

10,000

Up to 10k tonnes of Air Pollution Control Residue recycled to create building blocks for use in construction

100,000

Vehicle journeys saved using our carbon efficient fleet of tugs and barges to move waste along the Thames

200,000

Up to 200k tonnes of ash recycled as construction aggregate

149,000

Tonnes of carbon saved by not sending waste to landfill

750,000

Up to 750k tonnes of London's waste turned into electricity and recycling product

Abstract

In the UK and across Europe, strategies on waste management have shifted from traditional waste disposal in landfills to increased recycling and waste treatment in energy recovery facilities[1]. A consensus has emerged that diversion of waste from landfill is fundamental to reaching a circular economy and reducing carbon emissions. The purpose of this paper is to capture the impact Cory Riverside Energy has on reducing UK carbon emissions, with respect to alternative energy generation and waste management pathways. Results of this paper highlight that Cory Riverside Energy's operations in London provide substantial carbon benefits over alternatives through:

- *Utilisation of an R1 rated[2] efficient energy recovery facility that recovers more energy from waste than traditional landfill gas generation;*
- *Preventing methane gas escaping to the atmosphere at landfills, which has a much higher global warming potential than carbon dioxide;*
- *Advantages over alternatives on all three aspects of the UK energy trilemma: security of energy supply; cost-effectiveness; and low carbon generation;*
- *Operation of 'green highway' on River Thames. Using tugs and barges to transfer waste and recyclables, reducing lorry movements and congestion on London's roads.*

1 See Energy from waste, A guide to the debate, Department for Environment, Food & Rural Affairs, 2014 here

2 See Guidance on R1 Status here

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Glossary

APCR
Air pollution control residue – residue from treatment of exhaust gas from energy recovery.

Biogenic waste
Waste from biological material from living or recently living organisms.

Calorific Value
Calorific Value (CV) – is a measure of the amount of energy contained within waste that could potentially be released when it is completely combusted.

CHP
Combined Heat and Power (CHP) – is the use of a heat engine or a power station simultaneously to generate both electricity and useful heat.

Fossil waste
Material within the waste stream that has come from sources such as coal, oil and natural gas which have been locked underground for millions of years.

Greenhouse Gas (GHG) Protocol
The Greenhouse Gas (GHG) Protocol, developed by World Resources Institute (WRI) sets the global standard for how to measure, manage, and report greenhouse gas emissions.

Global warming potential
The Global Warming Potential (GWP) is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2).

IBA
Incinerator bottom ash - ash that is left over after waste is burnt in an incinerator.

kWh
Kilowatt hour – i.e. a measure of electrical energy equivalent to a power consumption of one thousands watts for one hour. The common unit of electricity.

R1 Status
The definition in the revised Waste Framework Directive for a 'recovery' operation. For municipal waste incinerators this is based on a calculation of a plant's efficiency in converting tonnages of municipal waste to energy.

Residual waste
Residual waste is waste that cannot be recycled for economic, environmental or practical reasons.

Waste Hierarchy
In an ideal world all waste would be prevented. In reality, for a range of social, economic and practical reasons, this does not happen. Where waste does exist it is usually best to reuse it if possible, and if not, to recycle it. What can't be recycled, the residual waste, could either go to energy recovery or as a last resort, landfill. This general order of preference is known as the waste hierarchy.

Context

Carbon reduction is widely recognised in existing literature as the primary tool for justifying different approaches relating to energy and waste policy[3]. The flagship UK policy, the 2008 Climate Change Act[4] sets out a legally binding target of at least an 80% cut in UK greenhouse gas emissions by 2050 against a 1990 baseline. In addition, the UK also has a legally-binding target of achieving 15% of its total energy (electricity, heat, transport) from renewables by 2020[5]. Within this policy context, energy from waste must play a major role in reducing waste to landfill and reducing UK carbon emissions[6].

WHAT IS ENERGY FROM WASTE?

Energy from Waste (EfW) is the recovery of energy, by various different technologies, from residual waste. It plays a valuable role in reducing the environmental impacts of waste management[7]. This role is core to the UK waste hierarchy[8]. Priority is given to waste prevention, re-use and recycling/composting. For waste that remains, energy recovery is preferable to disposal at landfill.

WHY IS IT IMPORTANT?

Energy generation in the UK faces complex challenges: delivering security of energy supply; in a cost-effective manner; through low carbon technology; thereby reducing dependency on imported fossil fuels. The challenge of meeting these core policy objectives has been coined the "UK energy trilemma" *(see Figure 1)*. This trilemma dominates energy policy discussion. This paper aims to demonstrate Cory Riverside Energy's performance in managing waste in line with the waste hierarchy alongside being a solution to the "energy trilemma". To achieve this a model was utilised to quantify; the overall carbon[9] emissions arising from the waste management processes of Cory Riverside Energy. This includes waste transport; treatment; energy recovery; and aggregate recycling. The overall carbon emissions attributable to Cory are compared against an average landfill disposal route representative of the UK. In this way, the net carbon saving of Cory's processes can be quantified. The metric chosen is tonnes CO_2 saved per annum.

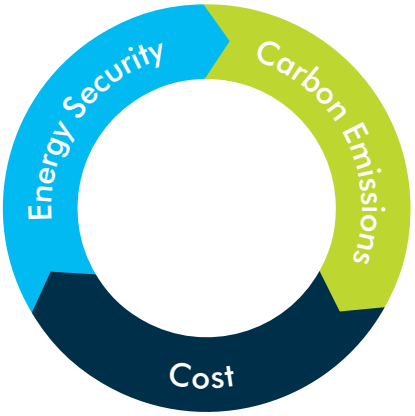


Figure 1 *UK Energy Trilemma Schematic*

3 See Energy recovery for residual waste, Department for Environment, Food & Rural Affairs, 2014 here

4 See UK Climate Change Act 2008 here

5 See EU Renewable Directive 2009/28/EC here

6 See Climate Change Mitigation Potential of the Waste Sector, German Federal Environment Agency here

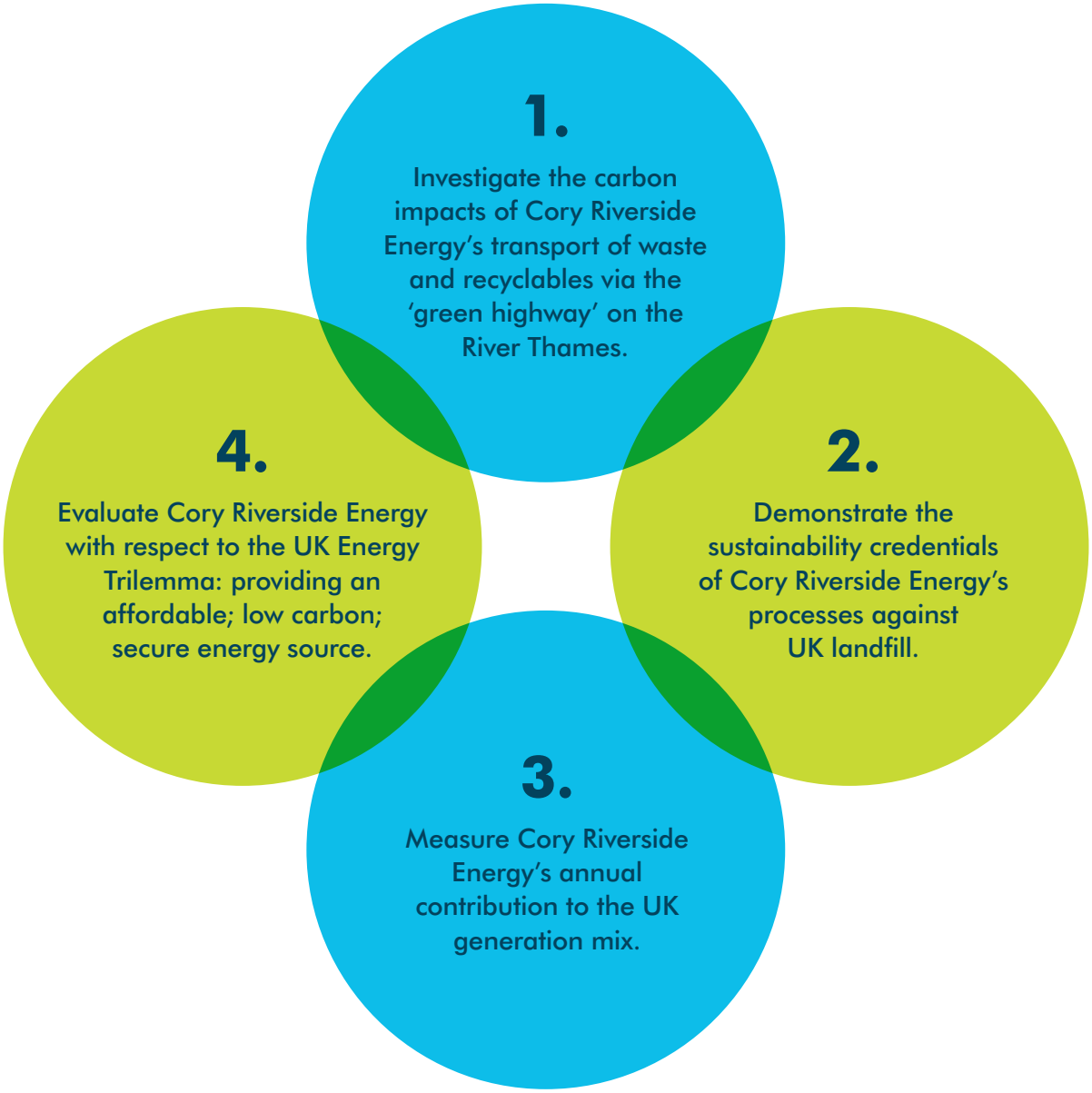
7 See *UK Green Investment Bank, Residual Waste Report, 2014* here

8 See Defra Guidance on waste hierarchy here

9 Carbon; CO_2 and CO_2e are used interchangeably throughout report to represent greenhouse gas emissions

Aims

The purpose of the study was to investigate Cory Riverside Energy's contribution in reducing UK carbon emissions by providing safe, secure, affordable and sustainable energy. It focused on following aims:



Scope and Boundary

The scope of study was to compare carbon emissions resulting from Cory Riverside Energy's operations with UK landfill disposal. Two carbon models were developed to incorporate emissions profiles: energy from waste and landfill[10].

The boundary of the Cory energy from waste model begins when residual waste enters the management responsibility at its transfer stations. From here, carbon (or CO_2) emissions are calculated throughout the process. Energy generated at Riverside EfW was assumed to offset fossil fuels and thereby replace CO_2 emissions that would have stemmed from an alternative generating source. This is in line with UK Government guidance on the appraisal of electricity generation options[11]. The reprocessing of incinerator bottom ash (IBA) and air pollution control residue (APCR) into recycled aggregate is contracted out by Cory Riverside Energy. Downstream CO_2 savings from IBA and APCR recycling are not included as being attributable to Cory Riverside Energy in this paper but a wider discussion on the use of recyclable products is included in *Section 2.6*. A baseline scenario of waste disposal to UK landfill was utilised as a benchmark to contrast the performance of Cory Riverside Energy's process. This approach is in line with other studies of this kind[12]. To achieve a like-for-like comparison, assumptions have been made. CO_2 and methane (CH_4) emissions which would otherwise have arisen from diverting waste processed at Riverside EfW to landfill are estimated. In similar fashion to the boundary set for Cory Riverside Energy, transport of waste, emissions from landfill, and total fossil fuel energy generation offset are all incorporated in CO_2 emissions assessment from landfill.

10 Principles laid down by *ISO 14064-1: 2006* and the *Greenhouse Gas Protocol*[10] were employed. Data in the models is representative of 2015.

11 *DUKES Guidance: Valuation of energy use and greenhouse gas emissions for appraisal*, see here

12 See *Energy recovery for residual waste, Department for Environment, Food & Rural Affairs, 2014* here

1.0 Carbon in Waste

The chemical content of residual waste impacts how CO_2 emissions are calculated from EfW; or separately from a landfill processes. The key science underpinning calculations of CO_2 emissions from EfW or landfill is developed below.

1.1 NATURE OF RESIDUAL WASTE

Waste going to EfW or landfill is assumed to be residual waste. A typical black bag of residual waste contains a mixture of diverse items, including paper, food, plastics, clothes, glass and metals. The mixture of different items comes from different sources (e.g. food) will have originated from biological sources. This waste is classified as biogenic carbon. Some of the waste materials (e.g. plastics) will have originated from fossil fuels such as oil. Carbon in this type of waste is known as non-biogenic (fossil) carbon. Some of the waste (e.g. clothes), will contain both biogenic and fossil carbon, while others will contain little or no carbon (e.g. metals). Waste combustion or landfill produces CO_2 emissions proportional to carbon content of waste.

1.2 CALCULATION OF CARBON EMISSIONS FROM EFW PROCESS

In EfW plants, the calculation of CO_2 process emissions includes non-biogenic (fossil) carbon in waste only. Any release of biogenic CO_2 emissions discounted. The United Nations governing body, the Intergovernmental Panel on Climate Change (IPCC), have agreed conventions for doing this[13]. This avoids double counting of carbon only relatively recently absorbed by biogenic matter and not to be considered from fossil fuels.

1.3 CALCULATION OF CARBON EMISSIONS FROM A LANDFILL PROCESS

In landfill operations, CO_2 emissions stem primarily from the methane constituent of landfill gases escaping to atmosphere. Methane is a very potent greenhouse gas, estimated to have 25 times the global warming potential of CO_2[14]. Small quantities of methane that escape to the atmosphere produce large amounts of CO_2 equivalent emissions. To understand methane and CO_2 emissions from landfill, four main processes are relevant:

1. *A large proportion of waste (thus carbon content) does not degrade to produce gas: instead remains trapped in the landfill. This is termed sequestration. It is beneficial for environment as it traps carbon of fossil origin from converting to landfill gas and escaping to atmosphere;*
2. *A smaller proportion of waste comprised of both organic and non-organic matter biodegrades: this produces a landfill gas comprising of CO_2 and methane;*
3. *The majority of landfill gas is collected and used as fuel in landfill gas combustion engines and turbines that generate electricity; and*
4. *A percentage of landfill gas escapes directly to the atmosphere and contributes to climate change. Landfill gas is converted to CO_2e to quantify the carbon impact.*

1.4 ADDITIONAL GREENHOUSE GASES

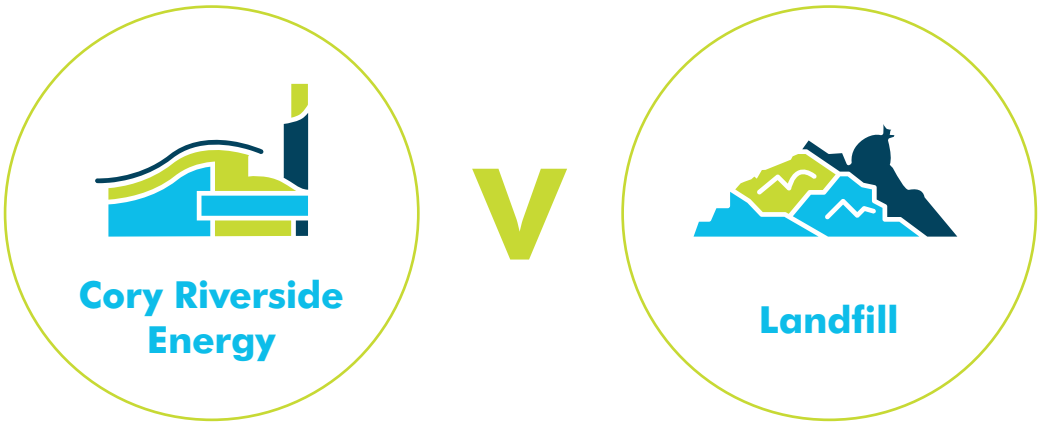
Both EfW facilities and landfills emit small quantities of other greenhouse gases, alongside carbon dioxide (CO_2) and methane (CH_4), such as nitrous oxide (N_2O). The inclusion of N_2O would result in a small disbenefit from energy from waste over landfill. However, the impact of these additional greenhouse gases is classified as de-minimis on the outcome of the study; it would impact the results by <0.1% and is therefore excluded. It is more suited to detailed life-cycle analysis outwith of this study.

13 See IPCC: Emissions from Waste Incineration: Good practise guidance (reference on page 1) here

14 See global warming potential of Methane here

2.0 Carbon Models

The models compare two scenarios:



These are summarised in *Table 1* across four energy consuming boundaries:

1. Transfer Stations
2. Transport
3. Process
4. Avoided Fossil Fuels

The input into the carbon models is 700,138 tonnes residual waste. Output from the models is the comparison of energy generation (MWh) and CO_2 emissions (tCO_2) associated with waste treatment from energy from waste or landfill.

Boundary	1 Transfer Stations	2 Transport	3 Process	4 Avoided Fossil Fuels
Cory Riverside Energy	Energy consumption at waste transfer stations	Transport of waste to EfW via the River Thames waterway	CO_2 emissions to produce energy from waste	CO_2 benefits from avoided fossil fuel power generation
Landfill	Conservatively excluded from landfill model	Transport of waste via road to landfill	CO_2 emissions from landfill	CO_2 benefits from avoided fossil fuel power generation

Table 1: *Cory Riverside Energy vs Landfill Carbon Models*

2.1 Transfer Stations

CORY RIVERSIDE ENERGY

Cory Riverside Energy's electricity, natural gas and gas oil (red diesel) consumption at the transfer stations and management buildings are recorded in the model. Total energy consumption (kWh) and carbon emissions (tCO_2) are presented in *Table 2*, with *Figure 2* itemising it by energy sources. Electricity consumption at transfer stations is the main activity that produces carbon emissions.

LANDFILL

At all times, CO_2 emissions from landfill have been estimated on a conservative basis. This provides a defensible counter-factual comparison with Cory processes. In landfill model energy consumption (hence CO_2 emissions) at transfer stations has been excluded. It is assumed that the transport section accounts for all energy to collect and transport waste to landfill.

Energy Sources	kWh	tCO_2
Electricity	7,490,256	3,871
Natural gas	847,871	177
Gas oil	407,379	112
Total	**8,745,506**	**4,160**

Table 2 *Transfer Stations: Energy and CO_2 emissions*

TRANSFER STATIONS
(% OF CARBON FOOTPRINT)

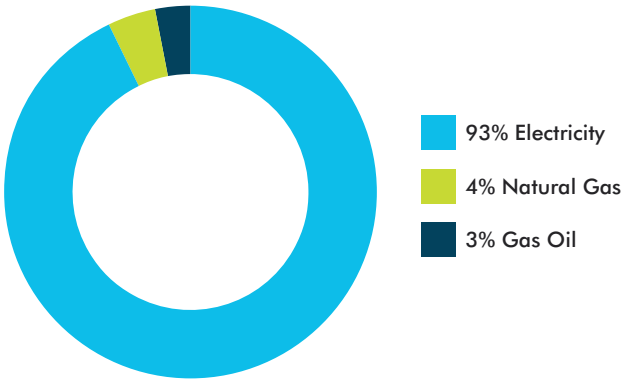


Figure 2 *Cory Riverside Energy: Transfer Stations*

2.2 Transport

CORY RIVERSIDE ENERGY
RIVER AND ROAD

Cory is the largest barge (or lighterage) operator in London, operating on River Thames for over 110 years. Cory uniquely use the River Thames as a *green highway* to transport waste to Riverside EfW plant by lighterage. Residual waste is transported in sealed containers on barges that can transport up to 300-tonnes at a time. Cory operates 5 "Damen Shoalbusters" tug boats. Total fuel consumed on these tugs to transport waste in 2015 was 1,013,445 litres. This equates to 1.60 litres of fuel to transport one tonne of waste via the *green highway*.

Alongside river operations, a smaller percentage (9.7%) of waste reaches Riverside EfW via road transport. This fuel consumption is estimated based on Waste Collection Vehicle Fuel Efficiency Report, 2010[15]; this report states 8.41 litres of fuel are used to transport one tonne of waste to landfill. This equates to 574,272 litres overall. Associated CO_2 emissions are included in Cory's transport carbon footprint discussed in *Table 3*. This allows comparison with standard landfill transportation systems.

15 See WRAP 2010 Report here

LANDFILL
ROAD

Road based waste collection dominates the landfill sector and therefore provides the best comparison with Cory's processes. Standard refuse collection vehicles (RCVs) are predominantly diesel in the UK. The *Waste Collection Vehicle Fuel Efficiency Report, 2010* was the best available report to represent fuel consumption in UK landfill fleet. This specified that 8.41 litres of diesel are consumed to transport one tonne of waste to landfill in the trail that was undertaken. Using this calculus, it takes 5,888,161 litres of diesel to transport 700,138 tonnes to landfill. See *Table 3* and *Figure 3* on following page for comparison between Cory Riverside Energy and UK landfill transport processes. The Cory 'green highway' is responsible for substantial annual carbon savings.

Energy Sources	Diesel *(litres)*	Marine Oil *(litres)*	CO_2 Emissions *(tonnes)*
Cory Riverside Energy	574,272	1,013,445	5,163
Landfill	5,888,161	–	18,642

Table 3 *Transport: Cory Riverside Energy Vs Landfill*

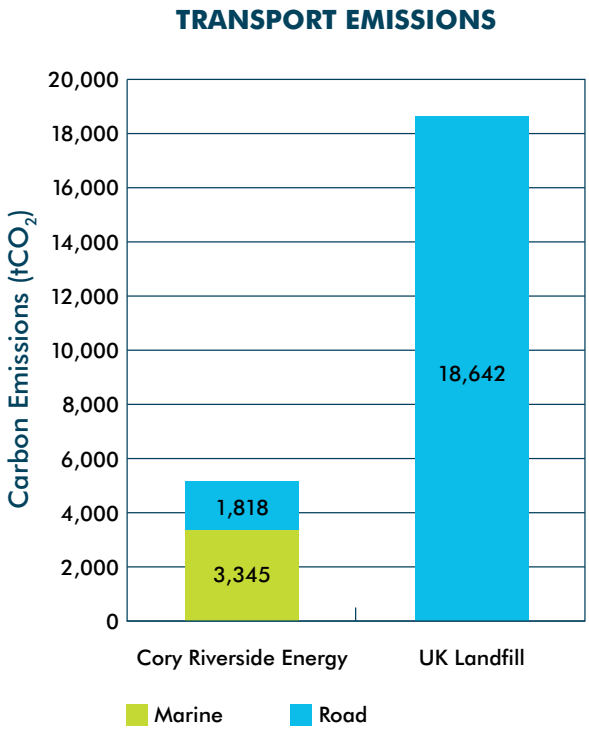


Figure 3 *Cory Riverside Energy vs Landfill*

WHAT BENEFITS DOES CORY'S 'GREEN HIGHWAY' BRING TO LONDON?

CARBON REDUCTION

The use of the River Thames by Cory to transport waste and aggregates has major carbon savings when benchmarked against typical road transport to landfill; we estimate fuel savings totalling millions of litres. The absolute saving of circa 13,500 tCO_2 equates to 19.25 kg CO_2 per tonne of waste or aggregate transported. It equates to removing 100,000 truck journeys from London's road every year or taking 6,000 cars off London's roads[16]. To put this in context, the transport sector is widely regarded as being one of the most difficult areas to achieve substantial long-term CO_2 reductions. Cory's river operations are playing a leading role in reducing CO_2 in London.

100,000

Vehicle journeys saved using our carbon efficient fleet of tugs and barges to move waste along the River Thames

LOCAL AIR POLLUTION IMPROVEMENTS

The essential transportation of waste inevitably creates side effects (external impacts). External impacts are not borne by one individual or business in itself. They affect society at large[17]. It is widely recognised that road based transport has higher external impacts than other forms of transport. Examples of external impacts from road transportation include:

- *Accident costs;*
- *Costs of congestion (delay costs); and*
- *Air pollution and human health costs*

Furthermore, the Greater London Authority has placed great emphasis on improving air quality in London[18]. A recent study by the Royal College of Physicians and the Royal College of Paediatrics and Child Health concluded that exposure to particulate matter and nitrogen oxide pollution is responsible for the equivalent of 40,00 deaths each year in the UK[19]. Furthermore, it imposes a cost to society between £15 billion and £20 billion per year. For reference, this is greater than the sum associated with obesity (£10 billion)[20].

Cory Riverside Energy contributes to reducing local air pollution by taking refuse collection vehicles off congested roads in central London and using the River Thames instead. Cory is proud of its contribution in reducing impacts from road transport in the Greater London Area and fully supports initiatives for a cleaner, greener, safer London.

16 Average CO_2 emissions from UK car is 2.33 tonnes per annum

17 See External Costs of Transport, European Commission Report here

18 See Mayor of London public consultation launch July 2016 here

19 See Royal College of Physicians Report, 2016 here

20 See Defra, Air Pollution action in a changing climate, 2010 here

2.3 Energy from Waste

2.3.1 WASTE COMPOSITION

The composition of waste received by Riverside EfW is measured annually via sample data taken from waste stream. This reporting is conducted by a third party on behalf of Cory. Reporting uses Ofgem's methodology to calculate the percentage of waste entering Riverside that is derived from biogenic sources.

CARBON CONTENT

In 2015, chemical analysis revealed 27% of the waste entering Riverside EfW contains carbon (C) by weight. This result is higher than the 23% used in the Defra carbon modelling study, but within the typical range of municipal solid waste in the UK (20-30%)[21]. Calorific value and therefore energy produced is highly correlated to carbon content; this model uses calorific value as a proxy for carbon content.

BIOGENIC CONTENT

Table 4 summarises the composition of waste by: % weight of total sample; % of CV of energy recovery process; biogenic content; non-biogenic content. This allows quantification of the biogenic and non-biogenic proportion in the waste stream. Results highlight: 54.10% of the waste is biogenic in origin; 45.90% of waste is of fossil fuel origin. For the purpose of calculating CO_2 emissions from EfW, only emissions from waste of fossil fuel are considered.

21 See Carbon Balances 2006, Energy Impacts of the Management of UK Waste Streams, here

Waste Composition	By Weight %	By CV %	Biogenic Content %	Non Biogenic %	Qualifying Renewable %	Fossil Carbon %
Paper and card	27.83	27.80	100	0	27.8	0
Plastic film	8.51	18.67	0	100	0	18.67
Dense plastic	7.77	17.28	0	100	0	17.28
Textiles	3.43	5.25	50	50	2.625	2.62
Misc. Combustible	9.55	12.26	50	50	6.13	6.13
Misc. Non-Combustible	5.39	0.00	50	50	0	0
Glass	4.52	0.00	0	100	0	0
Putrescibles	26.44	16.35	100	0	16.35	0
Ferrous Metal	1.58	0.00	0	100	0	0
Non-ferrous Metal	1.00	0.00	0	100	0	0
Hazardous	1.21	0.00	0	100	0	0
Fines	2.77	2.39	50	50	1.195	1.19
Total	**100%**	**100%**	–	–	**54.10%**	**45.90%**

Table 4 *Waste Composition*

2.3.2 RIVERSIDE EFW PROCESS EMISSIONS

This section discusses CO_2 emissions from the energy recovery process at Riverside EfW. It follows principles laid down in other studies and reports[22]. As waste is combusted, all carbon (biogenic and fossil) is converted to CO_2. As per IPCC convention[23], only fossil CO_2 is considered derived from fossil fuels and counted towards emissions. CO_2 emissions from Riverside EfW are summarised in *Table 5*. A further circa 350 tonnes of CO_2 are emitted at Riverside covering: grid electricity; gas oil and mains water. This is incorporated into the final calculation in results section.

22 See Energy recovery for residual waste, Department for Environment, Food & Rural Affairs, 2014 here

23 See IPCC: Emissions from Waste Incineration: Good practise guidance (reference on page 1) here

317,914

tonnes of CO_2

Derived from fossil fuels; emitted from the energy recovery process at Riverside whilst treating 700,138 tonnes of waste

454

kg CO_2

Derived from fossil fuels; emitted per tonne of waste treated

Mass of Waste *(tonnes)*	x	Carbon *(%)*	x	Fossil Carbon *(%)*	=	*Mass of Fossil Carbon (tonnes)	x	Carbon to $C0_2$ *(44/12)*	=	**Total Fossil CO_2
700,138		27		45.90		86,704		3.667		317,914

*Mass of waste x Percentage Carbon in waste x Fossil Carbon = Mass of Fossil Carbon (tonnes) in waste

**Mass of Fossil Carbon x 44/12 (C to CO_2 conversion) = Total Fossil CO_2 from energy recovery (tCO_2)

Table 5 *CO_2 Emissions from Riverside EfW*

2.3.3 ENERGY GENERATION

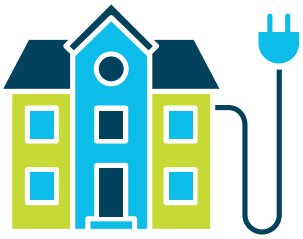
Table 6 summarises the 2015 energy generation and export to grid. Energy generation is a function of the thermal efficiency of the process. Each process in the EfW system: burning waste; producing heat; generating steam; and driving a turbine, results in energy losses affecting efficiency. By maximising thermal efficiency, the overall environmental benefit of the plant is consistently maintained. Riverside EfW is at the top performing end of electricity only EfW facilities in the UK and this ensures classification as an R1 recovery facility. Riverside EfW generated 574,385 MWh in 2015. 515,166 MWh was exported. This energy is considered to substitute for displaced fossil fuel generation and results in CO_2 savings which is discussed in *Section 2.5*. In 2015, the electricity exported from Riverside EfW would be enough to power over 160,000 homes[24]. 54% of this energy can be considered renewable generation, contributing to UK renewable energy targets. Riverside has the potential and is planned to operate as a combined heat and power (CHP) plant in the future. This increases the carbon reduction benefits from waste to energy recovery as the utilisation of excess heat from the process does not produce any additional CO_2.

Mass of Waste *(tonnes)*	Energy Generated *(MWh)*	Energy Exported *(MWh)*
700,138	574,385	515,166

Table 6 *Riverside EfW Energy Generation (MWh) 2015*

2.3.4 AIR QUALITY CONTROL

Local air pollution is taken very seriously at Cory. Energy from waste plants are tightly controlled under the Waste Incineration Directive (2000/76/EC)[25]. These requirements have been recast into the Industrial Emissions Directive (2010/75/EU)[26]. This sets stringent limits for a number of potential pollutants. It also sets demanding operating requirements which help to minimise pollution. Cory Riverside EfW monthly emissions records are available to publically download from the Cory Riverside Energy website. Cory reports emissions data to the Environment Agency on a daily basis and has an excellent emissions record.



160,000

Households powered with the c.525,000 MWh energy we generate

24 Annual UK domestic energy consumption at 3,300 kWh per annum in medium household, see reference here

25 See Waste Incineration Directive here

26 See Industrial Emissions Directive here

2.4 Landfill

This section models the methane emissions that would result in diverting the residual waste mass treated at Riverside EfW to a typical UK landfill. It converts methane emissions to CO_2 equivalent (CO_2e). Estimates of methane produced by a landfill site are subject to considerable uncertainty. The rate of methane production varies: as a function of time; climatic conditions; waste stream composition; and management.

In order to model a meaningful comparison with EfW processes, data assumptions are applied. Firstly, residual waste destined for landfill is considered to have the same carbon and biogenic content as waste that was treated at Riverside EfW. This allows an all else being equal comparison. Variable data sources and fixed data sources laying behind assumptions are summarised in *Table 7* and *Table 8*.

Variable Landfill Assumptions	Value	Data source
Total percentage Carbon (by weight)	27%	Compositional and Chemical Analysis of Waste Entering Riverside EfW, January 2015
Carbon that is sequestered as ground deposit and does not degrade to landfill gas	73%	Adapted from 2014 Defra Study
Carbon that will decompose landfill gas	27%	Adapted from 2014 Defra Study
Landfill gas capture rate	66%	Adapted from 2014 Defra Study
Total Methane oxidised	3%	Adapted from Defra 2014 Study. Of the 30% of landfill gas not captured, 10% will be oxidised to CO_2 in the landfill cap (3% total)
Methane released to atmosphere	27%	The remaining 27% of methane is released to atmosphere
Electrical conversion efficiency	41%	Adapted from Defra 2014 Study

Table 7 *Variable Landfill Assumptions*

Fixed Landfill Assumptions	Value	Data source
Methane – Global Warming Potential CO_2e	25	IPCC default value[27]
Landfill Gas: Used to generate energy	50%	IPCC default value
Landfill Gas: CO_2 to Methane Ratio	50%	IPCC default value
Calorific value of methane	50	Mj/tonne

Table 8 *Fixed Landfill Assumptions*

27 See GWP of Methane here

Carbon emissions from landfill come from methane in landfill gas escaping to atmosphere. Following the assumptions laid down in *Table 7* and *Table 8*; 27% of the methane generated as a result of the landfilling of 700,138 tonnes waste will create CO_2e emissions. *Table 9* summarises this result.

Landfill emissions - calculation	Tonnes	%
1. Total Waste Input	700,138	–
2. Total Percentage Carbon	–	27%
3. Percentage Carbon Sequestered	–	73%
4. Decomposable Carbon Proportion	–	27%
5. *Mass of Decomposable Carbon (1 x 2 x 4 = 5)	51,002 (C)	–
6. Mass of Methane (5) x 0.5 x 16/12 (Methane in Landfill Gas)	34,002 (CH_4)	100%
7. Mass of Methane Captured (6) x 0.66	22,441 (CH_4)	66%
8. Mass of Methane Oxidised (6) x (1 – 0.7)*(0.1)	1,156 (CH_4)	3%
9. **Mass of Methane Released to Atmosphere	10,404 (CH_4)	31%
10. ***CO2e from Methane released (9) x 25	260,111 (CO_2e)	–

*Calculate mass decomposable carbon (C) in the waste stream.
**Calculate the mass of methane released to atmosphere.
***Calculate the CO2 equivalent from this methane release.

Table 9 *Carbon emissions from landfill*

260,111
tonnes of CO_2e

Assumed to represent emissions from UK landfill to treat 700,138 waste

2.4.1 LANDFILL – ENERGY GENERATION

Based on a 66% landfill gas capture rate, 700,138 tonnes waste at a UK landfill would generate 63,716 MWh (see *Table 10*). This energy is considered to substitute for displaced fossil fuel generation and results in CO_2 savings which are discussed in *Section 2.5*.

Mass of Methane Captured	Proportion Used for Generation	Calorific Value (MJ/t)	Electrical Conversion Efficiency	Energy Generated (Gj)	*Energy Generated (MWh)
22,441	50%	50.00	41%	230,020	63,716

*Mass of methane captured x Proportion used for generation x Calorific value of waste x Electrical efficiency = **Energy Generation (Gj): convert to MWh**

Table 10 *Energy Generation from Landfill*

2.5 Avoided Fossil Fuels

HOW DOES ENERGY FROM WASTE OR LANDFILL REDUCE FOSSIL FUEL USE?

The most significant factor when assessing CO_2 savings from EfW or landfill is how much fossil fuels are used for conventional power generation. When energy derived from either EfW or landfill is available, conventional power (hence fossil fuels) will be displaced. When estimating carbon reductions, the UK government position is that electricity produced by combined cycle gas turbine (CCGT) is displaced; CCGT represents the current trend in new plant commissioning. Therefore, generating electricity from waste offsets CO_2 emissions from CCGT plants producing an equivalent amount of energy at that time. An equation summarises this:

Energy Generated (MWh) **X** **Carbon Intensity of CCGT (tCO_2/MWh)** **=** **Total CO_2 offset (tCO_2e)**

The accepted life-cycle carbon intensity for UK CCGT in 2015 was 0.385 tCO_2/MWh generated[28]. This number is used to quantify carbon offset from Riverside EfW (576,569 MWh) and UK landfill (63,716 MWh). *Figure 4* highlights a key finding of this study. Riverside EfW outperforms landfill by producing greater carbon savings through generating more energy.

512,853 MWh

the extra energy generated at Cory Riverside Energy over a landfill gas operation treating the same amount of waste

AVOIDED CARBON EMISSIONS AND ENERGY GENERATION

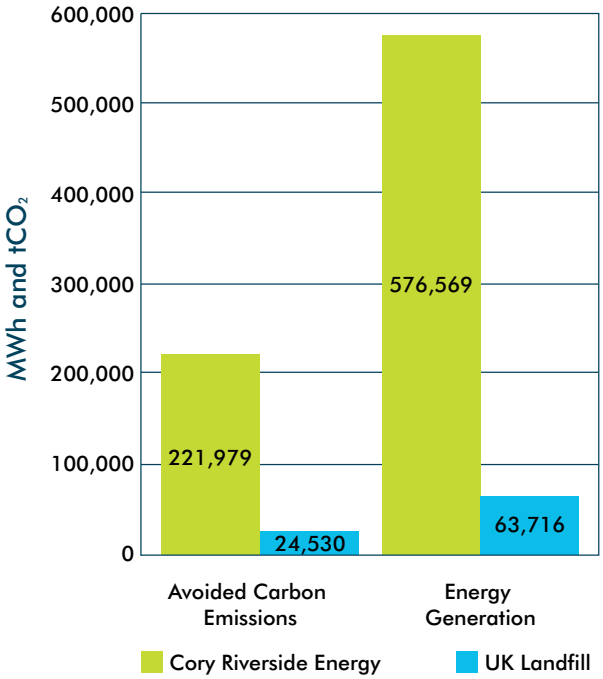


Figure 4 *Cory Riverside Energy vs Landfill*

28 See GOV.UK Electricity Grid Emissions Factors here

2.6 Aggregate Replacements

Aggregate replacement using both recycled Incinerator Bottom Ash (IBA) and Air Pollution Control Residues (APCR) can have significant carbon and wider environmental benefits. The Riverside EfW facility produces circa 200,000 tonnes of IBA and 17,500 tonnes of APCR per annum. IBA is used as a construction aggregate. APCR is used to make building blocks.

The benefits of this recycling has been assessed in many academic papers with varying but substantial levels of positive support for CO_2 emissions savings from aggregate recycling[29]. Cory Riverside Energy choses to work with third party aggregate recyclers such as Ballast Phoenix, Carbon8 and Castle Environmental to ensure that these by-products of the EfW process are turned back into a reusable aggregate. CO_2 savings from IBA and APCR are not directly claimed by Cory Riverside Energy in the carbon model utilised in this study. Furthermore, the carbon footprint from transport under the operations control of Cory is excluded from this model. Given its small percentage (<0.1 %) we consider it de-minimis to overall report and its findings.

10,000

tonnes of Air Pollution Control Residue recycled to create building blocks for use in construction

200,000

tonnes of ash used as aggregate to build roads

29 See aggregate recycling papers (Burnley et al., 2015; Grosso et al., 2011 and Rigamonti et al., 2012)

"Using the River Thames as a 'green highway', the Cory fleet of five tugs, more than 50 barges and in excess of 1,500 containers transport c.1 million tonnes of residual waste and aggregate per year. In doing so, the 'green highway' saves carbon and removes 100,000 vehicles movements from London's congested roads."

3.0 Results

Through our 'green highway' and efficient energy generation, this study has demonstrated that the Cory Riverside Energy operation is a significantly more environmentally beneficial method of managing residential municipal waste than landfill. The results from the carbon models are provided below. A net carbon footprint is set out for both models: Cory Riverside Energy and Landfill (see *Table 11* and *Figure 5*).

Carbon Models	1 Transfer Stations	2 Transport	3 Process	4 Avoided Fossil Fuels	Total
Scenario	tCO_2e	tCO_2e	tCO_2e	tCO_2e	Total tCO_2e
Cory Riverside Energy	4,160	5,163	318,269	(221,979)	**105,613**
UK Landfill	-	18,642	260,111	(24,530)	**254,223**
Net Carbon Saving (tCO_2e)	(4,160)	13,478	(58,157)	197,449	**148,610**

Table 11 *Carbon Model Comparison*

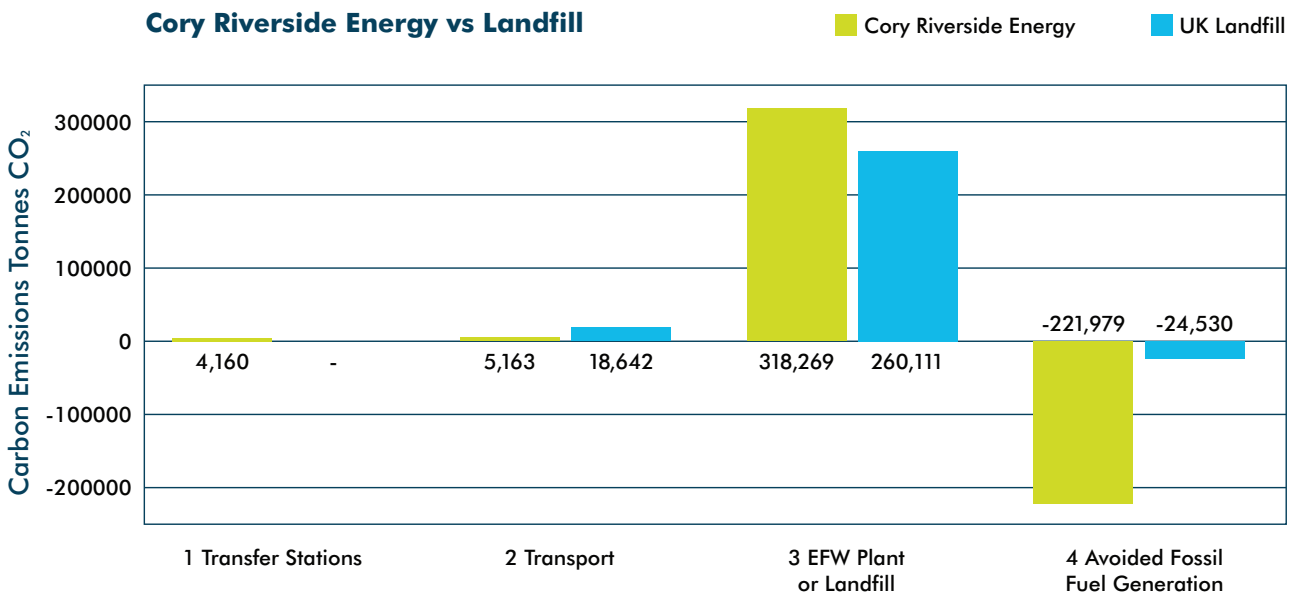


Figure 5 *Carbon Model Results: Cory vs Landfill*

3.1 Findings

Findings indicate a strong carbon case, and associated wider benefits from the Cory Riverside Energy process:

1. POSITIVE ENVIRONMENTAL IMPACT

Cory's holistic process resulted in a net reduction of approximately 149,000 tonnes CO_2 when compared to disposing the same quantity of waste in a landfill. This is a carbon saving of circa 212 kg CO_2 per tonne of waste handled.

2. RENEWABLE ENERGY

Riverside EfW produces over 9 times the amount of exportable electricity in comparison to landfill processing the same amount of residual waste.

3. EFFICIENT PROVEN TECHNOLOGY

The Riverside EfW facilities R1 recovery status demonstrates an efficient modern operation. Riverside EfW maximises energy generation supplied to UK National Grid while minimising environmental impacts.

4. 'GREEN HIGHWAY' ON RIVER THAMES

The Green Highway on River Thames has large carbon benefits; it saves circa. 13,500 tonnes CO_2 per annum when compared with standard road based waste transport. It reduces up to 100,000 lorry movements on London's roads.

5. ENERGY SECURITY

Riverside EfW powers the equivalent of 160,000 homes per annum with reliable, locally sourced baseload electricity from UK citizens waste. This creates less dependence on imported fossil fuels. It complements other renewable energy sources such as wind and solar.

6. COST EFFECTIVE

Energy from waste reduces costs to consumers through reductions in landfill taxes and dependency on the price volatility of imported fossil fuels.

3.2 Sensitivity Analysis

To further enhance this study, the sensitivity of the model output to the input assumptions in energy from waste and landfill was tested. It was found to be highly sensitive to changes in:

- Carbon intensity of displaced energy source;
- Proportion of decomposable carbon going to methane at landfill; and
- Landfill gas capture rates

To assess how variations in inputs affect overall carbon benefits from EfW over landfill, the unit of comparison used is kilograms CO_2 saved by EfW over landfill in treating one tonne of waste. For reference, a 2014 Green Investment Bank analysis has this saving across their portfolio at 200 kg CO_2 per tonne residual waste[30].

CARBON INTENSITY OF DISPLACED ENERGY SOURCE

Comparison with other energy generation methods gives different results due to the differing carbon intensity of the energy source being offset. This study has adopted UK Government guidance and compared output to CCGT. However, there is acknowledgement in academic literature that this may be a flawed approach[31 32]. If Riverside EfW and landfill were assumed to offset energy generated from the UK grid emissions factor, or a CCGT: Coal mix, this would significantly increase the carbon benefit of energy from waste over landfill due to the increased electricity produced by EfW over landfill from same amount of waste. *Table 12* describes the influence that changes to carbon intensity of displaced energy source has on the performance of EfW over landfill.

Scenario	EfW Carbon Saving *(kg)*
Per tonne waste	
CCGT (used in model) (0.385 kg CO_2 per kWh)	212
UK Grid Emissions Factor (0.412 kg CO_2 per kWh)	232
CCGT 70%: Coal 30% (0.539 kg CO_2 per kWh)	325

Table 12 *Influence of energy mix used in calculating savings*

30 Green Investment Bank, 2014: UK Residual Waste Market. See here

31 Burnley, Stephen; Coleman, Terry and Peirce, Adam (2015). Factors influencing the life cycle burdens of the recovery of energy from residual municipal waste. Waste Management, 39 pp. 295–304. See here

32 Lund, H., Mathiesen, B.V., Christensen, P. et al. Int J Life Cycle Assess (2010) See here

CHANGES IN DECOMPOSABLE CARBON GOING TO METHANE AT LANDFILL

The study is highly sensitive to the level of sequestration assumed, especially at high biogenic content. In the modelling the assumed proportion of decomposable C going to methane is 27%. This is in line with Defra 2014 study. By reducing the level of carbon sequestration at landfill; hence increasing the DDOC proportion, the amount of methane released to atmosphere is increased. This results in a significant increased carbon benefit of EfW over landfill. Similarly, if more carbon is sequestered at the landfill, less escapes to atmosphere at methane reducing carbon savings (see *Table 13*).

Scenario	Landfill Emissions	EfW Carbon Saving *(kg)*
Per tonne waste		
DDOC 21%	202,309	139
DDOC 27% (used in model)	260,111	212
DDOC 33%	327,548	299

Table 13 *Influence of Decomposable Carbon proportion (DDOC)*

Scenario	Landfill Emissions	EfW Carbon Saving *(kg)*
Per tonne waste		
Landfill (60% gas capture)	306,014	281
Landfill (66% gas capture)	260,111	212
Landfill (75% gas capture)	229,510	109

Table 14 *Landfill Gas Capture Rates*

LANDFILL GAS CAPTURE RATES

The modelled level of methane release from landfill is dictated by the landfill gas capture rate. In the Defra 2014 study, three scenarios are analysed to represent landfill gas capture: high methane emissions (50 % gas capture); central methane emissions (60% gas capture) and low methane emissions (75% capture). Level of landfill gas capture is a controversial debate in this area. A 2006, Eunomia Report[33] indicates that there is very little in the way of field measurements to substantiate the use of the Defra high gas capture rate (75%). It also notes that field measurement from The Netherlands gives figures of between 10-55% for instantaneous gas capture and average rates of 25%. Default values for reporting to the IPCC are specified around 20%. The modelled assumption used in our analysis was 66% gas capture. Using a higher value for landfill gas capture is a defensible way of being conservative and not over-estimating the benefits from EfW over landfill. It should be clearly stated that lifetime gas capture rates from a landfill are unlikely to reach 66%. *Table 12* compares the carbon emissions that arise from landfill all else being equal at 60% capture, 66% capture and 75% gas capture (see *Table 14*).

Reducing the proportion of landfill gas captured significantly increases the carbon emissions associated with treating residual waste at landfill; this significantly increases the carbon benefit of Riverside EfW over landfill. Similarly increasing the landfill gas capture rate to 75%, over the level modelled in this report would result in a lower carbon saving from EfW over landfill. There are overall carbon benefits for EfW over landfill across all the variable scenarios that were looked at in this sensitivity analysis. Furthermore, following investigation in this sensitivity analysis, the results used in this reports' carbon model are conservative.

32 See Eunomia 2006 Report here

Summary

The results from this study indicate a strong carbon saving by sending residual waste for EfW treatment at Cory Riverside Energy as opposed to landfill disposal.

The general trends exemplified by all modelling supports this statement. The level of carbon saving is very dependent on the level of landfill gas capture and undoubtedly more research is required to estimate this in an accurate manner. Much more work is also required to better understand the level of sequestration; subsequently DDOC proportion in landfills to remove the present considerable uncertainty. The biogenic content of waste has an influence on the results of this study. The higher the biogenic content of waste, the better performance of Riverside EfW against landfill. Cory Riverside Energy are already taking steps to actively understand and maintain their highest possible biogenic content in waste treatment process. This includes quarterly monitoring of composition of waste entering the facility. As with all modelling results, the above should be interpreted with a suitable degree of caution. One limitation of comparing energy recovery to landfill is different time scales. In energy recovery CO_2 is emitted during incineration; at landfill CO_2 emissions occur over a much longer time frame. This is an inevitable limitation in any study of this nature, however it does not invalidate the findings or conclusions.

"By minimising waste to landfill and maximising energy generation through our efficient plant operation, we provide a unique waste management solution that generates a secure supply of affordable, low carbon renewable energy."

4.0 Conclusions

The key conclusions of this study mirror the research aims:

"Cory's river based, local waste disposal and energy generation solution, has substantial carbon savings compared to road based transport and landfilling of waste."

ABOUT THE AUTHORS

Ethan O Brien is a Carbon Management Advisor at Cory Riverside Energy. Ethan graduated with an MSc from the University of Edinburgh Business School in 2014. Ethan has international work experience, developing renewable energy projects in East Africa, alongside consulting on carbon management and energy efficiency for a range of UK businesses across the manufacturing, retail, agricultural and commercial sectors. Ethan is a member of the Energy Managers Association and in the process of becoming a Chartered Energy Manager (CEM) and Member of the Energy Institute (MEI).

Nicola Topliss is the Group Environmental Manager at Cory Riverside Energy and has over 10 years' experience in the waste management industry. Nicola has always had a keen interest in the environment and has a BSc in Environmental Science from the University of East Anglia, where her interest in carbon management first started, in the Tyndall Centre for Climate Change Research. She represents the company on the Environmental Service Association's Regulations working group and the Environmental Industries Commission's Waste Management and Resource Efficiency working group. In 2010 she successfully worked on a number of carbon saving initiatives for the London Mayors' Green 500 Awards scheme, which resulted in a Platinum and Gold award for the group.

CREDITS

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LEGAL STATEMENT

CORY
RIVERSIDE ENERGY

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