CHAPTER 9.0 CLIMATE CHANGE

APPENDICES (Volume 3 bound separately)

9.0 CLIMATE CHANGE

9.1 Introduction

9.1.1 This Chapter of the EIAR Main Report considers the potential significant effects arising from the LSEP to climate change, specifically greenhouse gas (GHG) emissions, and the likely significant effects of climate change on the LSEP (climate resilience).

9.1.2 This Chapter is supported by the following technical appendices:

- Appendix 9-1 – Carbon Assessment;
- Appendix 9-2 – Climate Change Resilience Baseline; and
- Appendix 9-3 – Climate Change Resilience Assessment Detailed Results.

9.1.3 The chapter follows the structure as listed below, separately considering GHG gas emissions and climate resilience within each section:

- Legislation, Policy and Guidance
- Methodology
- Baseline
- Assessment of Effects
- Mitigation
- Residual Effects and Conclusions

9.1.4 The Proposal to increase the waste fuel throughput of the LSEP from 600,000 tonnes per annum (tpa) to 728,000 tpa will not impact the LSEP's resilience to climate change. Furthermore, a climate change EIA was not included in the May 2011 ES, so the outcomes cannot be compared. However, a carbon assessment was submitted in support of the original Environmental Permit (EP) application (reference EPR/QP3136CV/A001) for the LSEP scheme. Review of this previous carbon assessment has identified that the methodologies and data sources which were utilised have been superseded by current practices. Accordingly, it is not deemed appropriate to undertake a direct comparison to the findings of the previous carbon assessment.

9.1.5 An EIA Chapter has been prepared for this EIAR, as per the requirements of The Electricity Works (Environmental Impact Assessment) (England and Wales)

Regulations 2017 (as amended) (the Electricity Works EIA Regulations) (hereafter referred to as the '2017 EIA Regulations'). This specifically requires a description of the likely significant effects of the development on the environment resulting from the impact of the project on climate chance, and a description of the vulnerability of the project to climate change. Further details of the requirements to include a Climate Change Chapter are set out in Section 9.2.

9.1.6 To enable an effective and appropriate comparison to be made between the LSEP scheme as consented and the LSEP scheme with the Proposal, new calculations have been made for the consented scheme using the current accepted methodology. These calculations use the consented waste throughput of 600,000 tpa and an assumed net export of electricity of 58.5MW.

9.1.7 The same methodology has also been applied to the calculations for the LSEP scheme as now proposed (i.e. 728,000 tpa waste throughput and an assumed net export of electricity of 69.9MW). Details of the methodology are set out in Section 9.3 of this Chapter and within Appendix 9-1.

9.1.8 The scope of this EIAR Chapter set out within the Scoping Report (see Appendix B of the Supporting Statement for the Variation Application). No comments were received from Cheshire West and Chester Council (CWACC) or any other statutory consultees on the approach proposed. As such, this EIA follows the methodology set out in the Scoping Report. When calculating the impact of CO_2 equivalent (CO_2e) emissions from the LSEP scheme with the Proposal, this has considered the total emissions (i.e. from 728,000 tpa of waste throughput), rather than just those emissions associated with the Proposal (i.e. from the 128,000 tpa increase in throughput). This allows a direct comparison to be made between the consented throughput of 600,000 tpa and the now proposed throughput of 728,000 tpa.

Competence

9.1.9 This Chapter and supporting technical appendices have been prepared by Hannah Lederer and reviewed by Rosalind Flavell at Fichtner Consulting Engineers. Hannah (BSc) is an associate member of the Institution of Environmental Sciences (IES) and Institute of Air Quality Management (IAQM). She has experience in undertaking carbon and climate change assessments for planning and permitting

purposes for Energy from Waste (EfW) developments across the UK. Rosalind (CEnv CSci MIAQM MIEnvSc PIEMA) is a chartered member of the IAQM and IES and a practitioner member of the IEMA. Rosalind has over ten years of experience undertaking environmental assessments for planning and permitting purposes for a wide range of developments including EfW facilities across the UK.

9.2 Legislation, Policy and Guidance

Assessment Methodology

Electricity Works EIA Regulations

9.2.1 The 2017 EIA Regulations introduced a requirement to consider climate and greenhouse gas emissions. Schedule 4(4) of the 2017 EIA Regulations relating to information for inclusion in EIA reports states *"A description of the factors specified in regulation 7(2) likely to be significantly affected by the development"* where regulation 7(2) includes:

(a) population and human health;

(b) biodiversity (for example, fauna and flora), with particular attention to habitats and species protected under the Habitats Directive or the Wild Birds Directive;

(c) land (for example, land take), soil (for example, organic matter, erosion, compaction, sealing), water (for example, hydromorphological changes, quantity and quality), air and climate (for example, greenhouse gas emissions, impacts relevant to adaptation);

(d) material assets, cultural heritage (including architectural and archaeological aspect) and the landscape; and

(e) the interaction between the factors referred to in sub-paragraphs (a) to (d)".

9.2.2 Schedule 4(5) requires: *"A description of the likely significant effects of the development on the environment resulting from, amongst other things;*

f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change;…

The description of the likely significant effects on the factors specified in regulation 7(2) must cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development. This description should take into

account the environmental protection objectives established at Union or Member State level which are relevant to the project, including in particular those established under the Habitats Directive or the Wild Birds Directive. Schedule 4 goes on to explain what information should be provided stating:

"6. A description of the forecasting methods or evidence used to identify and assess the significant effects on the environment, including details of difficulties (for example technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved.

7. A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). The description must explain the extent to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases.

8. A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and disasters that are relevant to the development.. Relevant information available and obtained through risk assessments under requirements imposed in accordance with European Union legislation such as the Seveso III Directive or the Nuclear Safety Directive and relevant assessments undertaken under domestic legislation may be used for this purpose provided that the requirements of the EIA Directive are met. Where appropriate, this description must include measures envisaged to prevent or mitigate the significant adverse effects of accidents and disasters referred to in sub-paragraph (1) on the environment and details of the preparedness for and proposed response to such emergencies."

National Policy

9.2.3 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how they are expected to be applied. The latest version of the NPPF was released in July 2021. In relation to carbon and greenhouse gas emissions, section 14 of the NPPF states that:

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

9.2.4 Paragraphs 153 – 158 provide policies in relation to the need to plan for climate change. Paragraph 154 states that: *"New development should be planned for in ways that:*

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design."

9.2.5 Paragraph 158 states that: *"When determining planning applications for renewable and low carbon development, local planning authorities should:*

a) not require applicants to demonstrate the overall need for renewable or low carbon energy…; and b) approve the application if its impacts are (or can be made) acceptable.

National Policy Guidance

9.2.6 The Institute of Environmental Management and Assessment (IEMA), the largest professional body for environmental practitioners, has published guidance on the approach to EIA for carbon emissions, titled 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2017). The guidance sets out areas for consideration at all stages of the assessment to assist EIA practitioners in taking an informed approached to the treatment of GHG emissions within an EIA.

9.2.7 The guidance mentions the legally binding GHG reduction targets and states that an EIA must give due consideration to how a project will contribute to the achievement of these targets.

9.2.8 The guidance gives detail on how to assess the significance of GHG emissions, in the context of sector, local and national carbon budgets.

9.2.9 IEMA has also produced guidance titled ‘Environmental Impact Assessment Guide to Climate Change and Resilience and Adaption’ (2020). This provides guidance on how to consider the impacts of climate change within project design.

9.2.10 This Chapter has been prepared in accordance with the 2017 EIA Regulations. It provides the information as required by Schedule 4 of the 2017 EIA Regulations and is in line with the requirements of the NPPF. In lieu of any statutory methodologies, this assessment has followed the appropriate methodologies from the IEMA guidance for GHG emissions and climate change resilience.

Climate Change

Climate Change Act

9.2.11 The UK government set a commitment to reduce GHG emissions in the UK to 50% of 1990 levels by 2025, and to 80% by 2050 through the implementation of the Climate Change Act 2008, the framework for UK climate change policy. More recent legislation (The Climate Change Act 2008 (2050 Target Amendment) Order 2019) has introduced a new binding target of "net zero by 2050".

National Policy

9.2.12 The principal policies of the NPPF relating to climate have been set out above.

9.2.13 In response to The Climate Change Act 2008 (2050 Target Amendment) Order 2019, the Government set out how it will tackle climate change within ‘Leading on Clean Growth The Government Response to the Committee on Climate Change’s (CCC’s) 2019 Progress Report to Parliament – Reducing UK emissions’ (October 2019).

9.2.14 This report responds to the CCC specific recommendations across the key sectors in the Clean Growth Strategy: power; buildings (domestic and non-domestic); industry (including CCUS and hydrogen); transport; and natural resources (including livestock, crops, trees, land use and waste).

9.2.15 Within this report, the Government recognises the need to divert waste from landfill, setting out that *"growth in energy from waste and alternative residual waste treatment infrastructure will divert further waste from landfill."*

9.2.16 In November 2020, the Government published it's 'Ten Point Plan for a Green Industrial Revolution'. Point no. 4 (Accelerating the Shift to Zero Emission Vehicles), states that a consultation on the phase out of new diesel HGVs will be launched in 2021. Point no. 8 (Investing in Carbon Capture, Usage and Storage (CCUS)) discusses the investment in and introduction of CCUS technologies to the UK. The scheme plans to invest £1 billion in the establishment of CCUS in two industrial clusters by 2025 and a further two industrial clusters by 2030, with the aim to capture 10 Mt of carbon from a multitude of developments within these areas by 2030. It is anticipated that these four sites will kick start the development and validity of CCUS technologies, infrastructure and establishment within the UK.

9.2.17 Of relevance are the National Policy Statements, which can be material planning considerations for planning applications. EN-1 (Energy) and EN-3 (Renewable Energy Infrastructure). In relation to carbon and GHG emissions, Section 2.2 of EN-1 sets out the road to meeting GHG emissions targets by 2050 and describes how the UK must reduce its dependence on fossil fuels, pursue its objectives for renewables and ensure that electricity consumed is almost exclusively from "low-carbon" sources. Section 1 of EN-3 identifies that a significant increase in generation from large-scale renewable energy infrastructure is necessary to meet the 15% renewable energy target. Specifically, in regards to EfW, section 2.5 of the statement identifies the following:

"The recovery of energy from the combustion of waste, where in accordance with the waste hierarchy, will play an increasingly important role in meeting the UK's energy needs. Where the waste burned is deemed renewable, this can also contribute to meeting the UK's renewable energy targets. Further, the recovery of energy from the combustion of waste forms an important element of waste management strategies in both England and Wales"

9.2.18 The Energy White Paper (Powering our Net Zero Future) was published by the Secretary of State for Business, Energy and Industrial Strategy by Command of Her Majesty in December 2020. It further details and clarifies the points set out in

the Ten Point Plan to set the energy-related measures in a long-term strategic vision for the UK's energy system, consistent with net zero emissions by 2050. Of particular relevance, it gives a commitment to putting in place the commercial framework required to help stimulate the market to deliver a future pipeline of power CCUS projects. With reference to Bioenergy with Carbon Capture and Storage (BECCS), which energy from waste is included within, a preliminary position paper in expected by summer 2021.

9.2.19 The Sixth Carbon Budget was published by the CCC in December 2020. It specifies increased carbon reduction targets for the period 2033-2037 and sets out the requirements and actions to reach these targets. The requirements and targets still recognise EfW plants play a part of the long-term waste disposal plan for the UK. There are requirements to reduce overall recycling rates within the UK and overall residual waste volumes. However, The Sixth Carbon Budget recognises that the maximum recycling rates are uncertain and none of the modelled scenarios have 100% recycling; it is expected for there to always be a level of residual waste which will require disposal. Therefore, targets for bans on first biodegradable waste in landfill and then all waste in general, and the phase out of waste exports leave a requirement for EfW plants in the long term.

9.2.20 The Sixth Carbon Budget also emphasises the requirement for Carbon Capture and Storage (CCS) at EfW plants. All modelled scenarios include CCS at EfW plants by 2050, and the more ambitious scenarios factor in some CCS towards the end of the 2020s. It is appreciated that waste sector will not achieve full decarbonisation by 2050. However, upon the installation of CCS at EfW plants, their emissions will only be the 5-10%[1] which CCS does not capture.

Local Policy

9.2.21 CWACC are the local planning authority. The relevant local policies have been reviewed and summarised within this section.

9.2.22 CWACC declared a climate emergency in May 2019 and have since produced two plans to set out the associated challenges and actions. The 'Carbon Management

[1] *CCS efficiency rates are recognised as an uncertainty, but are predicted to be between 90 and 95%.*

Plan'[2], focuses on how the council as an organisation can be carbon neutral by 2030 and the 'Climate Emergency Response Plan'[3] (the climate plan) focuses on how to achieve borough-wide carbon neutrality by 2045. Note this is 5 years earlier than the countrywide aims of 2050.

9.2.23 At the time of writing, the final version of the plan is yet to be released, however there is a draft available. The climate plan states that, the borough is the fourth highest emitting of all local authorities in the UK, as a result of the concentration of industry in the north of the borough. CWACC recognise this as a challenge, responsibility and opportunity. The climate plan sets out that to achieve carbon neutrality by 2045, the next 6 years (presumed 2021-2026) are crucial in making unprecedented progress.

9.2.24 The climate plan states the aim to reach carbon neutrality by reaching a balance of carbon emissions and carbon offsetting measures, but stresses the efforts to primarily reduce emissions so that there are less to offset. The climate plan has been produced with the support of a report from the Tyndall Centre for Climate Change Research, which provides a number of recommendations to the council. These include a carbon budget of 24.0 $MtCO_2$ for the period 2020 to 2100. At 2017 emissions levels, the council would use this entire budget within 6 years from 2020. The report suggests a requirement of at least 14% reductions in CO_2 per year. CWACC's plans to achieve this, of relevance to the Proposal include;

- *Aim of an 11 per cent reduction in industrial energy demand to be achieved by 2025 and moving towards a 38.5 per cent reduction by 2050;*
- *Aim of a 6 per cent electrification of industrial processes with a view to a 31 per cent increase by 2050;*
- *Significant expansions in carbon capture usage and storage are required; with 2 per cent of industrial energy coming from carbon capture and storage by 2025, increasing to 42 per cent by 2050;*
- *The challenge to decarbonise road freight. Some transition to zero carbon freight is assumed in the trajectories to zero carbon;*

[2] Carbon Management Plan, Cheshire West and Chester Council (https://www.cheshirewestandchester.gov.uk/your-council/councillors-and-committees/the-climate-emergency/documents/carbon-management-plan.pdf)
[3] Climate Emergency Response Plan, Cheshire West and Chester Council (Carbon Management Plan, Cheshire West and Chester Council)

- *Work with Cheshire West Recycling to procure the most efficient and environmentally friendly fleet possible, including exploring purchasing electric or hydrogen vehicles;*
- *Need to accelerate transition from gas in homes and business, with gas boilers to be banned in 2025. Planned installation of 43,400 new heating systems, including technologies such as air or ground-source heat pumps; and*
- *Review opportunities to use de-commissioned landfill sites to provide renewable energy.*

9.2.25 At the time of writing, CWACC is undertaking a strategic review of its waste strategy to provide a 10 year plan for the management of household waste and recycling. Recommended relevant measures include;

- *"larger capacity recycling bins to replace boxes, working with residents to drive down residual (non-recyclable) waste;*
- *divert as much waste as possible from landfill through processing and anaerobic digestion;*
- *work with the market to exploit emerging technologies that minimise the environmental impact and cost of processing; and*
- *new waste collection fleet to be implemented to support the proposed service changes, including… two fully electric 26 tonne Refuse Collection Vehicles (RCVs) and some new Euro 6 Diesel engine vehicles (the most energy efficient available) with a view to repower these to an alternative low carbon fuel as the technology and infrastructure permits."*

9.2.26 It should be noted that projects such as HyNet, (an innovative low carbon and hydrogen energy project planning on implementing CCS and low carbon hydrogen production in the North West) have the potential to dramatically reduce carbon emissions across the north west and offer the opportunity for CWACC to become the UKs first low-carbon hydrogen council.

9.2.27 CWACC's climate plan is emissions based and does not include any plans for improving the climate resilience of the Cheshire West and Chester region.

Local Policy Guidance

9.2.28 The CCC, the UK's independent advisory body to the government, in 2019 published a technical report[4] (referred to hereafter as the CCC Report) which sets out recommendations to the UK Government on how to achieve the target of net zero carbon emissions by 2050. The CCC Report sets out how key biodegradable waste streams should be diverted from landfill within the UK alongside an increase in recycling. To achieve this and deliver substantial emissions reductions in the waste sector, the report advises that key investment is required in alternative waste treatment facilities (such as anaerobic digestion, mechanical-biological treatment and EfW). The report acknowledges that a lack of investment in these areas may encourage the export of waste.

9.2.29 The CCC Report envisages a future generation mix where renewables dominate, which includes generation from both hydro and energy from waste plants. The continued development and investment in low carbon technologies will be key in achieving a net-zero future. The intermittency of renewables is recognised and there is support for base-load low-carbon generating plants. Consequently, EfW plants (which supplies a steady and reliable source of renewable energy) would play a key role in UK renewable power generation and contribute to achieving a net zero future.

9.2.30 The CCC has (June 2021) published their most recent recommendations to the UK government on how to achieve the target of net zero carbon emissions by 2050[5]. The report notes the rising contribution to overall UK emissions from EfW plants and recommends the fitting of CCUS or CCS. CCUS/CCS technologies are still being developed and are currently not economically or technically feasible for application in large-scale EfW projects. However, EfW plants may have the potential to incorporate these systems in the future, and this will be reviewed by LSEP as these technologies develop, subject to commercial and economic feasibility and government schemes.

9.2.31 In July 2020 the non-profit organisation Policy Connect, supported by a cross-party group of MPs, released the results of an enquiry into the role of UK waste

[4] *Net Zero Technical Report (Committee on Climate Change, 2019)*
[5] *Reducing UK emissions: 2021 Progress Report to Parliament (Committee on Climate Change, June 2021)*

management in the drive to achieve net zero carbon by 2050. Titled 'No Time to Waste: Resources, Recovery and the Road to Net Zero', the report has received contributions from 50 organisations, through parliamentary roundtables, interviews, and written submissions. The report concludes that even if the UK does meet its 2035 recycling targets, there will continue to be large volumes of residual waste produced long into the future. Therefore, investment in EfW capacity will enable the maximum use of low carbon waste heat to support housing, industry and other factors.

9.2.32 The UK Government published a formal response[6] to the CCC progress report of 2020[7] (the response to the 2021 report has not yet been published), identifying that "*energy from waste, has a key role to play in achieving net zero*". The response also enforced the aim to reduce volumes of biodegradable waste sent to landfill or residual treatment, with "*remaining waste will increasingly be treated by alternatives to landfill, such as energy from waste plants*". The UK Government is also taking further steps to work towards waste prevention including developing a new tax on plastic packaging that has less than 30% recycled content and introducing a ban on the supply of plastic straws, stirrers and cotton buds.

9.2.33 The waste management hierarchy ranks waste management options in order of sustainability, with more sustainable waste management options placed higher in the waste management hierarchy. The thermal treatment of residual waste in an efficient EfW plant is a recovery operation, meaning it should be favoured over the disposal of waste in a landfill.

Policy and Guidance in Relation to the Proposal

9.2.34 It is clear from the above policies and guidance that LSEP supports national and local initiatives to reduce carbon emissions and the Proposal would seek to further support further reductions in carbon emissions.

9.2.35 National Policy Statements, Local Authority strategy, the CCC Report, No Time To Waste, the government response to the CCC progress report, and the waste

[6] The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament, Reducing UK emissions. Presented to Parliament pursuant to section 37 of the Climate Change act 2008 (HM Government, October 2020).
[7] Reducing UK emissions: 2020 Progress Report to Parliament (Committee on Climate Change, June 2020)

hierarchy, all advocate the importance of EfW in reducing the need for waste disposal in landfill.

9.2.36 It is recognised that residual waste volumes have decreased and will continue to do so in line with the 2035 recycling targets and local targets. However, it is acknowledged there will still be residual waste and so a requirement to treat it. Therefore, policy and guidance support the EfW capacity as a preferred method of waste disposal compared to landfill.

9.2.37 The Ten Point Plan states the plans initiated for reduced emission HGVs and for the establishment of CCUS in the UK. The time frames mentioned suggest that neither of these points will impact the LSEP until at least 2030. The potential for CCUS at LSEP is assessed in the sensitivity analysis.

9.2.38 Local policy highlights the aim to reduce CO_2 emissions dramatically between 2021 and 2026, and continuously to reach net zero. It plans to reduce emissions from road freight, reduce gas fired heating in domestic housing in favour of lower carbon alternatives and review opportunities for renewable energy. The LSEP will offer an alternative to landfill for waste and be CHP ready, offering a potential opportunity to help achieve these aims.

9.3 Methodology

Scope of Assessment

9.3.1 This assessment considers the impacts of the following:

- GHG emissions associated with the operation of the LSEP with the Proposal.
- The resilience of the LSEP to climate change.

Assessment Methodology and Significance Criteria

GHG Emissions

9.3.2 Although the quantification of GHG emissions for an EIA may vary in methodology and approach between projects, it is expected that in almost all cases, a calculated (not measured) approach is taken because these are completed in advance of a project commencing development. The assessment has been undertaken in line with IEMA (2017) guidance, which recommends the following structure to calculate GHG emissions:

$$GHG\ emission/removal\ = GHG\ emission\ factor\ \times Activity\ data$$

9.3.3 The detailed methodology for calculating GHG emissions from the LSEP with the Proposal, including equations, is presented within Technical Appendix 9-1, and is in line with the methodology presented in both the IEMA guidance and the UK Government guidance document 'Energy recovery for residual waste – A carbon based modelling approach'.

9.3.4 With regard to GHG emissions, the IEMA (2017) guidance defines the baseline as a reference point against which the impact of a new development can be compared against (sometimes referred to 'business as usual', where assumptions are made on current and future greenhouse gas emissions). The baseline can be in the form of:

"a) GHG emissions within the agreed physical and temporal boundary of a project but without the proposed project; or

b) GHG emissions arising from an alternative project design and assumptions".

9.3.5 The main assessment of the GHG emissions focusses on the LSEP with the Proposal.

9.3.6 At the time of writing, the LSEP is under construction but not yet operational. Therefore, a current baseline cannot be established in relation to emissions from the LSEP site boundary; in this instance, there are zero GHG emissions to report. Furthermore, as the impact of GHG emissions from the LSEP will be worldwide, a physical boundary to their impact cannot be defined. Therefore, option b) has been chosen to establish the baseline.

9.3.7 For this assessment, the principal 'alternative project design and assumptions' will be 1) sending the waste to landfill, as this is currently the most likely alternative destination for the waste, and 2) generating electricity via gas-fired power stations, as this is the current 'marginal' technology. This is supported by the DEFRA guide 'Energy from Waste - A guide to the debate' which states that "*a gas fired power station (Combined Cycle Gas Turbine - CCGT) is a reasonable comparator as this is the most likely technology if you wanted to build a new power station today*". However, as set out below a number of sensitivity scenarios have been considered.

9.3.8 The assessment of CO_2 emissions from the LSEP with the Proposal also takes into account the carbon emissions from vehicle movements to and from the facility. This is further detailed within the corresponding sections of the Carbon Assessment (Appendix 9-1).

9.3.9 Future baselines should capture both operational and transportation GHG emissions. This has been reflected by the assessment of transport emissions (indirect) in addition to direct emissions. The estimated 25-year operational lifetime of the LSEP has been taken into consideration when assessing operational emissions and the net impact. In addition, a change in both UK grid mix over time and how this affects the net impact, and future expected decrease in plastic and food waste to waste compositions have been examined within a sensitivity analysis.

9.3.10 The ultimate goal of establishing a baseline is being able to assess and report the net GHG impact of the LSEP with the Proposal.

9.3.11 The resulting CO_2 emissions have been assessed for their significance in the context of UK carbon budgets and sector emissions.

9.3.12 In the absence of any significance criteria or a defined threshold, it might be considered that all GHG emissions are significant. Climate change has the potential to lead to significant environmental effects on all topics (population, fauna, soil etc.) in the EIA Directive, which is in place to ensure that plans, programmes and projects likely to have significant effects on the environment are made subject to an environmental assessment. The IEMA (2017) guidance states that:

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

9.3.13 To provide some context for the significance of this, the net impact of emissions has been assessed in relation to local carbon emissions and sector carbon emissions. The data is sourced from UK local authority and regional CO_2 emissions national statistics for the latest available data, 2019. The values have been sourced from the 2005 to 2019 UK local and regional CO_2 emissions data tables. In lieu of any results for waste as an individual sector, the 'Industry Other Fuels' sector has been used, within which waste is included amongst other fuels. This sector has been looked at on a national and local scale. A summary of these baseline figures is provided in the baseline section.

9.3.14 The emissions from the LSEP with the Proposal have also been compared to the UK carbon budgets for the periods 2023-2027, 2028-2032 and 2033-2037. As there are no local or sector carbon budgets, the significance cannot be assessed at these levels. It is also noted that the sixth carbon budget only reaches 2037. Future continuation in the reduction of these budgets is expected in order to reach net zero by 2050. A summary of the future baseline figures for the currently published UK carbon budgets is provided in the future baseline section.

9.3.15 The significance of the emissions is defined based on a >1% difference to the future UK carbon budget being considered significant, and a <1% difference being insignificant. In lieu of any specific guidance, the 1% value has been chosen as a

screening criteria as it would only be a small contribution to the total. This aligns with other disciplines such as air quality.

9.3.16 When considering the future baseline, it is important to acknowledge that the UK Government's aim is for net zero emissions overall. It will not be possible to eliminate all emissions of carbon, but we will need negative emissions to counter carbon emissions. In order to achieve net zero it is important to reduce emissions from certain sectors, including waste, even though emissions from this sector may not be completely removed.

Climate Change Resilience

9.3.17 The 2017 EIA Regulations include the requirement to include information on the vulnerability to climate change. Therefore, a review of climate change resilience for the LSEP scheme has been conducted. The review follows the IEMA 2020 guidance as follows.

9.3.18 The baseline climate data has been sourced from the nearest meteorological site to the LSEP site, using Met Office climate averages from the period 1981-2010, which are published on the Met Office website.

9.3.19 The future baseline has been defined using UK Climate Projections 2018 (UKCP18) to determine the changes in climate which the LSEP will be at risk to. UKCP18 are a set of climate projections and tools to access climate data. The data used within this assessment has been extracted from the UKCP18 key results spreadsheet for the scenarios as detailed in Table 9.1.

Table 9.1: Future Baseline CO_2 Emissions Summary

Projection	Emissions scenario	Percentile	Area	Baseline time period	Time horizon
UKCP18	RCP8.5	50%, 10 and 90% (where appropriate)	North-West England	1981-2000	2040-2049

9.3.20 The identified changes have then been incorporated to the current baseline climatic conditions to give a local prediction of future climatic conditions.

9.3.21 The Scoping Opinion (see Appendix C of the Supporting Statement to the Variation Application) has confirmed that the following impacts do not require assessment and have therefore not been included within the baseline section.

- Sea level rise, storm surge and storm tide - there are no anticipated impacts as the site is not in a coastal region;
- Decreased summer precipitation – a decrease in precipitation will have no anticipated impacts on the LSEP;
- Snow and ice - the UKCP18 predictions anticipate less snow and ice than the current baseline and as such the risk from snow and ice is not anticipated to increase due to climate change;
- Increased winter temperatures - increases in winter temperatures do not exceed the current baseline for other times of the year and so the proposals would not be vulnerable to this effect;
- Increase in summer temperatures - increases in temperatures could affect electrical infrastructure and conditions within working areas. However, cooling systems will be included in the design to allow for a range of ambient temperatures which will include for any projected increases due to climate change;
- Relative humidity – changes in humidity are not included in the UKCP18 predictions and it is not likely to have a significant effect on the proposals at the LSEP is designed to allow for a range of ambient conditions; and
- Water quality and soils - water availability has the potential to cause changes to the mobilisation of pollutants. More acidic soils and/or water can increase the deterioration of building materials. Soil stability may be altered by a change in water availability. However, the design has accounted for a range of conditions.

9.3.22 Receptors which are vulnerable to climate change have been identified in the Scoping Report (see Appendix B of the Supporting Statement to the Variation Application). These are reproduced below:

- Plant buildings and operation;
- Vehicular access to site (for workers and waste);
- Grid connection and local users; and
- On site workers.

9.3.23 For each receptor, the significance of each predicted climatic impact and its impact upon the receptor has been assessed. When determining the significance of the effect this has included consideration of the mitigation incorporated into the design.

9.3.24 The sensitivity of a receptor is the degree of response of a receiver to a change and its capacity to accommodate and recover from a change if it were to be affected. The susceptibility and vulnerability to climate change are considered when determining the resulting sensitivity of a receptor to the impacts of climate change. As stated in the IEMA (2020) guidance, susceptibility is "*the ability of the receptor to be affected by a change, vulnerability is the potential exposure of the receptor to a change and sensitivity is the degree of response of a receiver to change and a function of its capacity to accommodate and recover from a change if it is affected."* The susceptibilities and vulnerabilities have been selected for each impact of climate change for each receptor using the 'susceptibility of receptor' and 'vulnerability of receptor' thresholds as set out in the IEMA (2020) guidance. Table 9.2 summarises.

Table 9.2: Climate change receptors - susceptibility and vulnerability scale

Scale	Susceptibility	Vulnerability
High	Receptor has no ability to withstand/not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g. lose much of its original function and form).	Receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climate conditions continuing in future (e.g. river flows and groundwater level) or only able to tolerate a very limited variation in climate conditions
Moderate	Receptor has some limited ability to withstand/not be altered by the projected changes to the existing/prevailing climatic conditions (e.g. retain elements of its original function and form).	Receptor is dependent on some climatic factors but able to tolerate a range of conditions (e.g. a species which has a wide geographic range across the entire UK but is not found in southern Spain).
Low	Receptor has the ability to withstand/not be altered much by the projected changes to the existing/prevailing climatic factors (e.g. retain much of its original function and form).	Climatic factors have little influence on the receptors (consider whether it is justifiable to assess such receptors further within the context of EIA – i.e. it is likely that such issues should have been excluded through the EIA scoping process).

9.3.25 In addition to the susceptibility and vulnerability, the value / importance of the receptor has been used to reach a reasoned conclusion on sensitivity using

professional judgement. The greater the susceptibility, and/or vulnerability of the receptor, the greater the likelihood that receptor would also be of higher sensitivity. For instance, a high-value receptor that has very little resilience to change in climatic conditions is considered to be more likely to have a higher sensitivity than a high-value receptor that is very resilient to changes in climatic conditions.

9.3.26 The susceptibility, vulnerability, and value of receptor have been considered to determine a sensitivity descriptor of low, medium and high for each receptor. These descriptors have been determined based on professional judgement and are in line with the following examples.

9.3.27 The sensitivity of a receptor to the impacts of fluvial flooding could be described as 'low' under the following scenario:

- The value of the receptor is low - such an unused low grade farmers field;
- The vulnerability is low - as it does not lie within the flood plain so is unlikely to be impacted by fluvial flooding associated with increased rainfall as a result of climate change; and
- The susceptibility is low - as the receptor would have the ability to return to its previous use as the event would only cause temporary loss of use of the field, and damages would be limited.

9.3.28 The sensitivity of a receptor to the impacts of fluvial flooding could be described as 'high' under the following scenario:

- The value of the receptor is high - such a residential property;
- The vulnerability is high - as it lies within the flood plain and is likely to be impacted by fluvial flooding associated with increased rainfall as a result of climate change; and
- The susceptibility is high - as there are no flood defences or on site mitigation measures and therefore no ability to withstand fluvial flooding.

9.3.29 The sensitivity of a receptor to the impacts of fluvial flooding could be described as 'medium' under the following scenario:

- The value of the receptor is high - such a residential property;
- The vulnerability is high - as it lies within the flood plain and is likely to be impacted by fluvial flooding associated with increased rainfall as a result of climate change; and

- The susceptibility is low - as there are effective mitigation measures in place such as flood defences which would allow the property to withstand the projected increases in rainfall and associated fluvial flooding events.

9.3.30 For each receptor and each identified change in climate, the magnitude of effect has been identified. As stated in the IEMA (2020) guidance, magnitude is the degree of a change from the relevant baseline conditions which derives from the construction and operation of a development. This is based on a combination of probability, which would take into account the chance of the effect occurring over the lifespan of the development, and consequence, which would reflect the scale or complexity of the effect, considering degree of harm, duration, frequency and reversibility of effect. A combination of probability and consequence has been used to reach a reasoned conclusion on the magnitude of effect using professional judgement. Where a probability and /or consequence of the effect is high then the magnitude of effect would also be high. Descriptors of negligible, small, medium and large have been used to define the magnitude of impact in line with the following examples in relation to fluvial flooding:

- A negligible magnitude of change may be used to describe a scenario where there is a low probability of a fluvial flooding occurring, if the receptor is not within or close to a flood zone, and the consequence of flooding would be low, for example the damage caused by fluvial flooding of a low grade farm field is minimal and reversible;
- A small magnitude of change may be used to describe a scenario where there is a low probability of a fluvial flood occurring, i.e. the receptor is not within a flood zone, but there is a higher consequence of risk, for example a residential property may undergo a small amount of damage. A small magnitude of change could also be used to describe a scenario where there is a high probability of fluvial flooding, but the consequence is low, for example the damage caused by flooding of a low grade farm field is minimal and reversible;
- A medium magnitude of change may be used to describe a scenario where there is some probability of a fluvial flood event occurring, if the receptor is within a flood zone, and there is some consequence to a flood, for example a residential property may undergo some amount of damage; and
- A large magnitude of change may be used to describe a scenario where there is a high probability of a fluvial flood event occurring, if the receptor is within a

flood zone particularly close to a river, and there is a likely consequence to a flood, for example a residential property may undergo significant damage.

9.3.31 The basis for assigning the significance is in line with IEMA (2020) methodology and uses professional judgement. The significance of effect has been determined, taking into account the sensitivity for each receptor and the magnitude for each climate change effect. The following matrix in Table 9.3 provides an example of how the sensitivity of receptor and magnitude of change can be used to determine the effect and its significance.

Table 9.3: Climate change significance matrix

Sensitivity descriptor	Magnitude of change descriptors			
	Negligible	**Small**	**Medium**	**Large**
Low	Negligible	Negligible	Negligible	Slight
Medium	Slight	Slight	Moderate	Substantial
High	Moderate	Moderate	Substantial	Substantial

Limitations of assessment

9.3.32 Limitations of the assessment and difficulties encountered during the assessment have been taken into account wherever possible and stated below.

GHG emissions

9.3.33 When considering the GHG emissions from the LSEP with the Proposal, the following assumptions have been made:

- As a conservative assumption it has been assumed that there will be 10 start-ups a year at LSEP where the auxiliary burners will be in operation. A more likely number would be 3, based on other EfWs in the UK, so it is likely that this would be lower, reducing the overall GHG emissions;
- Recent bidding of EfW plants into the capacity market means they are competing primarily with combined cycle gas turbines (CCGT), gas engines and diesel engines. CCGT has been used as the comparator for displaced electricity and may possibly be conservative compared to the other options providing balancing services;
- There is considerable uncertainty in literature surrounding the amount of biogenic carbon that is sequestered in landfill. A sequestration rate of 50% for

biogenic carbon in landfill has been applied to the baseline scenario, and a sensitivity carried out with a much higher content;

- There is uncertainty over the landfill gas capture rate, this has been accounted for by including a sensitivity analysis using a low and high capture rate;
- The transportation distances of the waste are not fixed, therefore when considering the carbon burden of the transportation of waste reasonable assumptions have been applied. In order to be conservative, this has not included any consideration of waste transport via rail;
- The generation assumptions are reasonably based on operating at the design NCV of 10 MJ/kg for 8,426 hours. It may be that the LSEP with the Proposal generates more electricity at the upper end of the NCV range and may operate for more than 8,426 hours if there are limited periods of shutdown/outages;
- The assessment has conservatively assumed that LSEP will not export heat. The LSEP is designed as a combined heat and power plant (CHP) and if heat is exported in the future this would significantly increase the carbon benefits of LSEP scheme; and
- The future of the UK electricity grid mix is uncertain. Therefore, the current 'marginal' comparator has been used to assess grid displacement, and a sensitivity included to account for changes in the UK electricity grid mix.

Climate Change Resilience

9.3.34 When considering resilience of the LSEP to climate change the following assumptions have been made:

- The specific impact to climate change on construction has not been considered as it is assumed that climate change impacts will not be significant within the 3 years that it is predicted construction to take; and
- There may be some uncertainty over the climate change projections. Being projections they are in their nature not definite. However, they are taken from UKCP18, which provide the most up to date assessment of how the UK climate may change in the future and are supported by BEIS and DEFRA. This assessment has used projections for 2040-2059 for a 'high emissions scenario'. This is considered to be conservative. However, any under or over estimations will not impact to outcome of the assessment, as significance assumptions are based on the impacts which the climate changes cause, for which small differences in the magnitude of change will not impede on.

9.4 Baseline

GHG Emissions

Current Baseline

Waste alternative: landfill baseline

9.4.1 As stated within section 3.2 of the Carbon Assessment (Appendix 9-1), the baseline for the alternative treatment route available for residual waste is landfill.

9.4.2 Landfill is justified as the most likely alternative for waste management to the LSEP because the UK does not have enough EfW capacity to treat all residual waste. This position is also relevant on a more local scale, where landfill still has a role to play in current residual waste management practice within Cheshire[8]. If a new EfW capacity is provided, this means that less waste overall will be sent to landfill and therefore, at both a national and local level, the correct comparator is landfill.

9.4.3 For waste which is disposed of in landfill, the biogenic carbon degrades and produces landfill gas (LFG). LFG is comprised of methane and carbon dioxide, so has a significant carbon burden. Some of the methane in the LFG can be recovered and combusted in a gas engine to produce electricity, therefore creating some offset. There is also carbon release associated with the transport of waste to landfill. Section 3.2 of the Carbon Assessment (Appendix 9-1) presents the assumptions and calculations for the emissions associated with landfill which form the baseline. This is based on the same tonnage of annual waste going to landfill rather than being processed within the LSEP, based on the total throughput of LSEP with the Proposal (728,000 tpa) These are summarised in Table 9.4.

Table 9.4: Baseline Landfill GHG Emissions Summary[9]

Item	Units	Value
Releases to atmosphere from landfill gas	tCO_2e p.a.	313,507
Indirect transport emissions from landfill	tCO_2e p.a.	1,975

[8] Hampshire Minerals and Waste Plan, Assessment of need for waste management facilities in Hampshire: Landfill and Surcharging Report (2012)
[9] Case 1 – which uses waste compositions derived from data from 2007 and 2016, and Case 2 – which uses waste compositions derived from more recent data (from 2017, published in 2020)

Offset through grid displacement from the export of electricity from landfill gas engines	tCO_2e p.a.	-47,648
Total	tCO_2e p.a.	**267,834**

9.4.4 An alternative baseline scenario could be export for recovery (exporting the waste abroad for processing). Whilst the export of waste is permissible, the energy recovered from this waste would not contribute towards UK renewable energy targets and would effectively be a lost resource to the UK. The UK government is keen to support domestic markets where they can provide better environmental outcomes, to ensure that the UK benefits from the energy generated from UK waste. Recent estimates indicate that over the past few years the UK has been reducing the amount of waste exported ('UK Energy from Waste Statistics 2020', Tolvik, 2021).

9.4.5 Should waste export for recovery be considered as an alternative baseline it is expected that the conclusions of the assessment will remain the same and that the LSEP with the Proposal would have a net benefit. This conclusion has been reached as the transport emissions associated with the export of waste abroad would be significantly greater than the transport emissions associated with processing the waste within the UK.

9.4.6 Taking the above into consideration, landfill is considered to be a suitable baseline comparator for the purposes of the assessment.

Electricity production alternative: CCGT baseline

9.4.7 The assumed net export of electricity of 69.9 MW to the electricity distribution network from the LSEP (accounting for the increase in waste fuel throughput of the Proposal) would displace electricity otherwise produced. Therefore, the Carbon Assessment (Appendix 9-1) has included this offset within its calculations. As justified in section 3.1.3 of the Carbon Assessment the most likely source of electricity which LSEP will be displacing is that from Combined Cycle Gas Turbines (CCGTs). This is because in the UK CCGTs operate under the concept of the marginal generating unit and they are the most likely form of electricity generation to be used to balance demand. Other electricity sources such as wind and solar, are intermittent, with varying electricity supplies dependent on the weather conditions and time of year. As the Proposal will be displacing gas generation

rather than renewables or nuclear, CCGTs are considered the most appropriate comparative technology.

9.4.8 A summary of the results as reported in the Carbon Assessment is presented in Table 9.5.

Table 9.5: Baseline Electricity Offset Summary

Item	Units	Value [10]
Net electrical output of LSEP with the Proposal	MW	69.9
Net electricity exported from LSEP with the Proposal	MWh	588,972
Total CO_2 offset through export of electricity*	tCO_2e p.a.	**218,509**
* based on the UK electricity conversion factor for CCGT (BEIS, 2020)		

9.4.9 A summary of the baseline figures of local and sector carbon emissions, used for the assessment of significance, is provided in Table 9.6 below.

Table 9.6: Baseline Carbon Dioxide Emissions Summary

Item	Units	Value [11]
UK Industry Other Fuels Sector 2019	$ktCO_2e$	16,768.5
Cheshire West and Chester Council Total 2019	$ktCO_2e$	3,856.8
Cheshire West and Chester Council Industry Other Fuels Sector 2019	$ktCO_2e$	169.0

Future Baseline

9.4.10 The LSEP is expected to have at least a 25 year lifetime. Therefore, for all assessments, the future baselines must be considered.

Waste alternative: landfill baseline

9.4.11 UK government strategy emphasises the aim to reduce the amount of both plastics and food waste in residual waste. The reduction in either of these would have

[10] Case 1 – which uses waste compositions derived from data from 2007 and 2016, and Case 2 – which uses waste compositions derived from more recent data (from 2017, published in 2020)
[11] Case 1 – which uses waste compositions derived from data from 2007 and 2016, and Case 2 – which uses waste compositions derived from more recent data (from 2017, published in 2020)

opposing impacts on the waste composition. A decrease in plastic waste would create a higher biogenic waste composition and so decrease the carbon emissions and increase the net carbon benefit. Whereas a decrease in food waste would create a lower biogenic waste composition and so increase the carbon emissions and decrease the net carbon benefit. Therefore, the impacts to some extent cancel each other out.

Electricity production alternative: CCGT baseline

9.4.12 Due to the UK government's target to achieve net zero by 2050, it is anticipated that in the operational lifetime of the LSEP, there will be an increased reliance on renewable forms of electricity generation. However, it is considered that the construction of the Proposal will have little or no effect on how nuclear, wind, or solar plants operate and will not restrict or impede their development. This is due to the intermittency of renewables and the long term need remaining for reliable power sources. Nevertheless, there may be improvements in technologies and the storage of power within the lifetime of the LSEP. Therefore, alternative grid displacement factors, which would be relevant if LSEP were to displace renewable sources of energy, have been considered in the sensitivity analysis within Appendix 9-1.

9.4.13 A summary of the future carbon budgets, used for the assessment of significance, is provided in Table 9.7 below.

Table 9.7 Future Baseline Carbon Dioxide Emissions Summary

Item	Units	Value [12]
UK carbon budget 2023 - 2027	MtCO2e	1,950
UK carbon budget 2028 - 2032	MtCO2e	1,725
UK carbon budget 2033 - 2037	MtCO2e	965

[12] *Case 1 – which uses waste compositions derived from data from 2007 and 2016, and Case 2 – which uses waste compositions derived from more recent data (from 2017, published in 2020)*

Climate Change Resilience

Current Baseline

9.4.14 The information on current climate is sourced from historical climate averages data from the period 1981-2010, as set out on the Met Office website. Trends are as described in the Met Office regional profile for North West England and data taken from the closest long-term meteorological station to the Site, Woodford, which is approximately 17 km to the north east. Full details of the baseline climate are provided in Appendix 9-2 and summarised in Table 9.8.

Future Baseline

9.4.15 As described in the methodology section, the future baseline is calculated from the current Woodford climatic data and applying the predicted changes in North West England climate as set out in UKCP18. This assessment uses the UKCP18 predictions as set out in Table 9.8. The predicted changes to baseline climate are detailed within Appendix 9-2.

9.4.16 In summary, the current baseline and future baselines used for the purpose of this assessment are provided in Table 9.8. It is also qualitatively assumed that there will be increases in both the intensity rainfall and speeds of winds in winter.

Table 9.8: Future Baseline Climate Conditions

Item	Units	Baseline (Woodford 1981-2010)	Predicted change (UKCP18)	Future baseline (At Woodford 2040-2059 [13]
Central (50th percentile) estimate				
Mean annual temperatures	ºC	9.4	1.7%	9.4
Mean winter temperatures	ºC	3.9	1.6%	3.9
Mean summer temperatures	ºC	15.1	1.8%	15.1
Mean winter precipitation	mm	74.3	7.0%	79.5
Mean summer	mm	70.4	-15.0%	59.8

[13] Case 1 – which uses waste compositions derived from data from 2007 and 2016, and Case 2 – which uses waste compositions derived from more recent data (from 2017, published in 2020)

precipitation				
High (90th percentile) estimate				
Mean summer precipitation	mm	70.4	0.0%	70.4

9.5 Assessment of Effects

GHG emissions

Incorporated Mitigation

9.5.1 The LSEP has been through a detailed design process which has considered measures to minimise the impact to GHG emissions. These are listed in full within the mitigations section of this Chapter. The assessment of GHG emissions has considered these incorporated mitigation measures.

Operational Phase

9.5.2 A detailed Carbon Assessment is included in Appendix 9-1. A summary of the key results from the assessment are provided in Table 9.9.

Table 9.9: Summary of the Key Results from the GHG Assessment

Parameter	Emissions (t CO2e per annum)
Releases from landfill gas	313,507
Transport of waste and outputs to landfill	1,975
Offset of grid electricity from landfill gas engines	-47,648
Total landfill (baseline) emissions	**267,834**
Transport of waste to and outputs from LSEP with the Proposal	14,358
Offset of grid electricity with the generation from LSEP with the Proposal	-218,509
Emissions from LSEP with the Proposal	311,996
Total LSEP (with the Proposal) Emissions	**107,845**
Net benefit of LSEP with the Proposal	**159,989**

9.5.3 The net benefit of LSEP with the Proposal has been calculated as the difference between the predicted emissions from the equivalent tonnage (728,000 tpa) of

waste being processed in landfill and the emissions produced by LSEP with the Proposal. As shown, processing waste at LSEP with the Proposal will produce 159,989 less tonnes CO_2e per annum than the landfill counterfactual. Therefore, processing waste at LSEP with the Proposal will cause a net carbon benefit of approximately 159,989 tCO2e per annum when compared to the landfill baseline.

9.5.4 Another way to express the benefit of LSEP with the Proposal is to consider the additional power generated by LSEP with the Proposal as compared to the landfill counterfactual and calculate the effective net carbon emissions per MWh of additional electricity exported. This is referred to as the effective carbon intensity and is calculated to be -0.024 tCO2e/MWh. These calculations are displayed in further detail within the Carbon Assessment.

9.5.5 The lifetime impact of LSEP is based on a lifetime of 25 years. The carbon benefits will therefore be cumulative over time. However, during the lifetime of LSEP a number of key variable assumptions have been applied.

9.5.6 The cumulative impact of LSEP with the Proposal is assessed in section 4.3 of the Carbon Assessment and takes into account the following variations in assumptions:

- The grid displacement factor is varied from 0.233 kg CO_2e/kWh in 2023 to 0.029 kg CO_2e/kWh by 2047 (using BEIS grid displacement factors), as the future grid is expected to be powered by increasing renewable energy sources; and
- Waste composition is varied by 2% decrease of plastics and 3% decrease in food waste each year.

9.5.7 Although the results show that LSEP scheme (as consented) will have an eventual net disbenefit per annum over landfill (due to the predicted change in future waste compositions), a cumulative carbon benefit of the LSEP scheme over 25 years operation will be delivered (over landfill). This is estimated to be 190,912 tCO2e.

9.5.8 The results also show this cumulative benefit will be significantly greater for the LSEP with the Proposal, which is estimated to be 277,383 tCO2e (i.e. the Proposal will have an additional benefit of 86,471 tCO2e). These results are displayed visually within the Carbon Assessment.

9.5.9 To determine the significance of the calculated annual carbon emissions[14] from LSEP with the Proposal, these have been compared to the current baselines as displayed in Table 9.10.

Table 9.10: Summary of the Key Results from the GHG Assessment

Item	Value (tCO_2e)	Landfill emissions as % of background	LSEP with the Proposal emissions as % of background	Net benefit as % of background
UK Industry Other Fuels Sector 2019	16,768,500	1.60%	0.64%	0.95%
Cheshire West and Chester Total 2019	3,856,800	6.94%	2.80%	4.15%
Cheshire West and Chester Industry Other Fuels Sector 2019	169000	158.48%	63.81%	94.67%

9.5.10 The contribution of emissions from LSEP with the Proposal are below 1% of the UK total Industry Other Fuels Sector and therefore are not considered a significant contribution on a national scale. However, the contribution of emissions from landfill for the equivalent amount of waste is above 1%, so could be considered significant. Therefore, the processing of waste at LSEP rather than landfill reduces the contribution of carbon emissions to the UK Industry Other Fuels sector.

9.5.11 Although LSEP is a national project, the carbon emissions have also been compared to the local baseline emissions of Cheshire West and Chester. When compared to the total Cheshire West and Chester emissions, the carbon contributions of LSEP with the Proposal are at 2.80% of the 2019 baseline, which would be considered significant. However, results show that the contributions of LSEP with the Proposal are lower than the landfill equivalent, and therefore there is a significant benefit of LSEP with the Proposal compared to landfill.

9.5.12 When compared to the Industry Other Fuels sector of Cheshire West and Chester, the emissions from LSEP with the Proposal are a significant contribution, however, again these are significantly less than the landfill equivalent, and thus the LSEP scheme with the Proposal would bring a significant benefit. It is noted that the

[14] *Refer to Table 8.6*

landfill contribution is greater than 100% of the baseline emissions from the Industry Other Fuels sector of Cheshire West and Chester from 2019. This is because this value assumes that all the waste which is to be processed in LSEP is currently landfilled within Cheshire West and Chester. This is not true, as the LSEP under the Proposal will receive waste deliveries from various other counties, which would have otherwise processed the waste within them. Therefore, it is not entirely appropriate to use local emission baselines to determine the significance of the carbon impact at LSEP with the Proposal.

9.5.13 These emissions are positive, and so will be contributing to the carbon emissions of the region and UK. However, IEMA guidance recognises that it is important to consider the 'net' effects of the emissions, when compared against the likely alternative:

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

9.5.14 The contribution of emissions from LSEP with the Proposal has been compared to UK carbon budgets in Table 9.11 to assess the significance of the net carbon benefit. The net benefit has been taken from the mean annual benefit from the corresponding years to the carbon budgets.

Table 9.11: Summary of the Key Results from the GHG Assessment

	2023-2027		2028-2032		2033-2037	
	Value (tCO2e)	**As % of budget**	**Value (tCO2e)**	**As % of budget**	**Value (tCO2e)**	**As % of budget**
Cumulative emissions from landfill	287,033	0.015%	287,363	0.017%	284,648	0.029%
Cumulative emissions from LSEP with the Proposal	169,829	0.009%	217,834	0.013%	250,153	0.026%
Cumulative benefit	117,204	0.006%	69,529	0.004%	34,495	0.004%

9.5.15 The cumulative contribution of emissions from LSEP with the Proposal are below 1% of carbon budgets to 2032 and are therefore not considered a significant contribution.

9.5.16 The cumulative net benefit values of LSEP with the Proposal, for each of the future periods, are also below 1%, and so are not considered to be of a significant contribution to reducing carbon emissions nationally.

Sensitivity analysis

9.5.17 The Carbon Assessment (Appendix 9-1) has included the following sensitivity analyses:

Refuse Derived Fuel

9.5.18 The assessment has used a waste composition of municipal and commercial and industrial waste, as specified in section 3.1.1 of the Carbon Assessment (Appendix 9-1). The exact composition of the waste to be used is not fully confirmed. There is the potential that there will be some refuse derived fuel (RDF) processed at the LSEP facility. Therefore, the incorporation of 30% RDF waste has been included as a sensitivity. Under the RDF scenario, the benefit of LSEP with the Proposal is 132,261 tCO_2e per annum.

LFG capture rate

9.5.19 The assessment has used a 50% LFG capture rate. This is based on the Golders Associates report for DEFRA, which states that the collection efficiency for the landfill sites within the UK was estimated to be 52%. Other literature has suggested that higher LFG rates may be more appropriate, for example for larger, modern landfill sites. The sensitivity assessment using a range of capture rates from 52% to 75% estimates that there is a net benefit of LSEP with the Proposal for all LFG capture rates. The benefit ranges between 89,650 and 320,763 tCO_2e per annum.

Grid displacement factor

9.5.20 The assessment has used the grid displacement factor applicable for a CCGT, as justified in Section **Error! Reference source not found.** of Appendix 9-1. There is

some debate over the type of power which would be displaced and so we have considered the effect of using lower figures, which would only be relevant if the Facility were to displace other renewable sources of electricity. The sensitivity assessment using a range of lower grid displacement factors between 0.371 t CO_2e/MWh (used within the assessment) and 0.280 t CO_2e/MWh estimates that there is a net benefit of LSEP with the Proposal for all grid displacement factors assessed. The benefit ranges between 118,079 and 159,989 tCO_2e per annum.

Waste composition

9.5.21 Government strategy to reduce the amount of both plastics and food waste in residual waste will have an impact on the composition of waste. A waste composition sensitivity is included within section 4.1.3 of the Carbon Assessment (Appendix 9-1) which assesses the impact of a 25% reduction in plastic, 25% reduction in food and the combined impact of both. All scenarios resulted in a net carbon benefit. The benefits were estimated to be between 143,622 and 195,356 t CO_2e per annum or between -0.0608 and -0.0621 tCO_2e/MWh effective carbon intensity.

Other contributions

9.5.22 The export of heat from the LSEP is, at present, an economically unviable option. This has been confirmed through a recent study undertaken in July 2021. This 'Heat Demand Investigation' can be viewed in full at the appendices to the Supporting Statement of the Variation Application. Accordingly, heat export considerations have not been included within the main body of this assessment. However, the LSEP has been designed to be a Combined Heat and Power (CHP) ready plant, and it will therefore be possible to export heat from the LSEP if options to do so become viable in the future. If heat were to be exported, the net benefit of the LSEP will increase.

9.5.23 The LSEP scheme does not allow for on-site metals recovery. However, the IBA, in which there will be some metal content, will be sent offsite where it will be processed and metals removed. The recycling of these metals brings further carbon benefits compared to if the same tonnage of metals were otherwise sent to landfill.

9.5.24 The fuel procurement strategy and fuel contracts are not yet finalised, and there is still potential for the availability of rail borne waste to be implemented within the lifetime of LSEP. However, the option for rail as a transport mode has recently been assessed within an 'Alternative Transport Modes' report (June 2021). The report can be viewed in full at the appendices to the Supporting Statement of the s.36 variation application. The report concluded that delivery of waste to the LSEP by rail is an unviable option at present, and as such, it has not been quantitatively assessed within this assessment. However, if a proportion of waste were to be brought to LSEP site by rail, this would provide a more efficient transport route and the overall transport emissions associated with the LSEP would be reduced, hence overall carbon benefits of the scheme would increase.

Climate Change Resilience

9.5.25 The climate change resilience has been assessed for the following vulnerable receptors:

- Plant buildings and operation;
- Vehicular access to Site (for workers and waste);
- Grid connection and local users; and
- On-site workers

9.5.26 For each receptor, the impact of each predicted climatic effect is assessed. This has taken into account the design mitigation measures embedded into the proposals. The susceptibility and vulnerability to climate change have been considered to determine the resulting sensitivity to the impacts of climate change. Magnitude and then overall significance of the effects have then been determined. Full details of the assessment can be found in Appendix 9-3. Table 9.12 provides a summary.

Table 9.12: Summary of the Key Results from the GHG Assessment

Predicted change in climate	Impact	Susceptibility	Vulnerability	Resulting sensitivity	Magnitude of effect considering mitigation	Overall significance
Plant buildings and operation						
Increase in precipitation	Surface water flooding	Low	Moderate	Low	Small	Negligible
	Fluvial flooding	Moderate	Moderate	Medium	Small	Slight

	Groundwater flooding	Moderate	Low	Medium	Negligible	Slight
Extreme events	Building damage from high winds	Low	Moderate	Medium	Small	Slight
Vehicular access to site						
Increase in winter precipitation	Flooding of access roads	Moderate	Low	Low	Small	Negligible
Extreme events	Trees and branches blocking access roads	Low	Moderate	Low	Small	Negligible
Grid connection and local users						
Increase in winter precipitation	Infrastructure damage due to flooding	Moderate	Low	Low	Small	Negligible
On-site workers						
Increased winter precipitation	On-site Flooding (fluvial, groundwater or surface water)	Moderate	Low	Low	Small	Negligible
Extreme events	Surges in wind and effects on worker safety	Low	Moderate	Medium	Small	Slight

9.5.27 In summary, the overall significance of climate change on the LSEP is assessed to be negligible to slight. This is not a significant effect.

9.6 Mitigation Measures

9.6.1 The LSEP has been through a detailed design process which has considered measures to minimise the impact to GHG emissions and improve the resilience of the scheme to climate change. These measures are set out as follows:

- The LSEP has an Environmental Permit (EP) to operate, which will be varied (as part of a separate application) to allow for the increase in throughput now proposed. In accordance with the EP requirements, the Applicant will be required to ensure the scheme is operated with a high level of energy efficiency

and to use energy and water efficiently, including maintaining records of utilities consumption.

- The provision of a sustainable drainage system. This includes surface water attenuation storage on site and will have a long-term management plan for its upkeep, maintenance and operation.
- Waste water would be recycled where possible within the LSEP or adjacent premises. Contaminated or unsuitable water will also be directed to an existing appropriately authorised effluent treatment facility on the wider Lostock site. As a result, water use would be relatively low for an industrial user. The consumption of water within the process will be recorded as a requirement of the EP.
- The LSEP is CHP ready, and therefore, it it were to become viable within the local community and heat offtake agreements were made, the LSEP could be a provider of heat to the local community and further offset carbon emissions from alternative heat sources. The export of heat in the form of hot water or steam, and period reviews of the viability of CHP implementation are requirements of the EP.
- The LSEP will be operated to ISO 14001 certification. This is the international standard for environmental management systems (EMS), which will provide the LSEP with a framework for making policy and process changes that help improve its environmental performance. The EMS will require the Applicant to set objectives and targets to reduce the environmental impacts associated with operation of the LSEP.
- Incinerator Bottom Ash (IBA) will be exported offsite for metal recovery and reprocessing into a secondary aggregate. The Air Pollution Control Residues (APCr) would be transported offsite to a permitted hazardous disposal facility or residues may be taken to an appropriate treatment facility where, for example, they could be re-used in the stabilisation of acid wastes or used in cement manufacture. The uses of IBA and APCr will be periodically reviewed to ensure they are used for the most sustainable uses.
- The LSEP facility is designed structurally to tolerate increasing storm patterns, including higher winds. Part of the structural design for the building wind loading studies will be carried out which include a safety factor which is sufficient to allow for these strong winds.
- The LSEP has a three day contingency plan, to account for any halt in feedstock availability. The waste bunker has the capacity for four days' worth of

waste storage; there are five days of APCr residues maintained on site; and there is sufficient storage capacity for three days of IBA storage. Therefore, the LSEP will be able to continue normal operations for three days.

- The LSEP has been designed so that the grid connection and associated cables are underground. This protects them from any above ground damage from storm or wind events and the cables are designed to be resilient to water and so would not be impacted by any flooding events.

9.6.2 There are some potential further enhancements to the LSEP which are not appropriate for current inclusion in design but may become feasible within the lifetime of the LSEP.

- CCUS and its implementation within the UK is a relatively new technology, so the infrastructure of the process, such as regulatory frameworks and available markets for recovered carbon dioxide, are not yet established. The recently published UK Government report 'Ten Point Plan for a Green Revolution' outlines the Government's ambitions to capture 10 Mt of CO_2 a year by 2030. The Government aims to incorporate CCUS in up to four industrial clusters in areas such as the North East, the Humber, the North West, Scotland and Wales (due to their proximity to the North Sea), with CCUS developed primarily alongside hydrogen plants. It is anticipated that these 4 sites will kick start the development and validity of CCUS technologies, infrastructure and establishment within the UK. Although the Ten Point Plan does not make specific reference to the incorporation of CCUS with EfW plants, the 2020 Policy Connect report ('No Time to Waste'), states the following with regards EfW with CCS: *"Carbon Capture and Storage (CCS) technology is increasingly being trialled for different industries across the world. Recently a number of EfW plants across Europe have incorporated CCS both during the design and retrospectively".* Taking this into consideration, the Applicant will continue to review the feasibility of retrospectively installing a CCS system as these technologies develop, subject to commercial and economic feasibility.
- The use of CCS technology on EfW facilities presents an opportunity for negative emissions associated with the biogenic fraction of the waste. BECCS is considered by CCC as one of the key mechanisms to enable net zero to be achieved in the UK. As such the application of CCS on EfW facilities could become an important tool for the UK Government.

- The recently published UK Government report 'Ten Point Plan for a Green Revolution' states that a consultation on the phase out of new diesel HGVs will be launched in 2021. It states there will be £20 million invested in freight trials to pioneer hydrogen and other zero emission lorries, to support industry to develop cost-effective, zero-emission HGVs in the UK.

9.6.3 In addition, current mitigation measures will be constantly under review; the EP will require that records of energy and water consumption are maintained, the EP will require that there are periodic reviews of heat export viability; the uses of IBA and APCr will be periodically reviewed; and the EMS will require the Applicant to set objectives and targets to reduce the environmental impacts associated with operation of the Proposal.

9.7 Comparison to Existing s36 Consent

9.7.1 The May 2011 ES did not include a climate change EIA, so the outcomes within this EIA report cannot be compared with the original application. However, a carbon assessment was undertaken in 2010 and submitted in support of the Environmental Permit (EP) application EPR/QP3136CV/A001, which estimates the net annual greenhouse gas emissions saving would be between 152,000 and 174,000 tCO_2e per annum, under the current permit and s.36 consent (as varied).

9.7.2 The outcomes of the pervious carbon assessment are not directly comparable to this one, as the previous carbon assessment was based on a number of different or outdated assumptions, including but not limited to; a lower tonnage and electricity output, different transport assumptions, different waste composition, inclusion of metals recover, older emissions factors, and offset of energy from Winnington CHP.

For the purpose of comparison, a further carbon assessment has been undertaken using the currently consented tonnage of 600,000tpa and a 67.3MW gross / 58.5MW net electrical generation, as permitted by the existing s.36 consent. All other inputs remain the same as the assessment undertaken for the LSEP with the Proposal with the exception of reduced quantities of raw materials and residues. It can be concluded that the carbon benefits would increase for the LSEP scheme, when incorporating the Proposal (i.e. an additional 128,000 tpa waste throughput).

This is due to consideration of increased emissions from the extra tonnage of waste in landfill, and the higher offset of electricity generated.

9.8 Residual Effects and Conclusions

GHG emissions

9.8.1 In line with national and local policy the carbon emissions from the LSEP scheme with the proposed additional waste throughput have been calculated and demonstrate that LSEP scheme with the Proposal will have an overall net carbon benefit when compared to the baseline. This has been carried out in line with the requirements of the EIA Regulations. In addition, when comparing a range of sensitivities to account for varying waste composition, grid displacement factors and landfill gas capture rates, there remains a net benefit associated with the LSEP with the Proposal.

9.8.2 The emissions of the LSEP scheme with the Proposal have been compared to the total emissions of the UK Industry Other Fuels Sector and it has been concluded that they do not make a significant contribution. Furthermore, the emissions impact for the landfill alternative of waste disposal are considered significant, and thus the waste diverted from landfill as a result of the Proposal will increase the carbon benefits of the LSEP scheme as a whole.

9.8.3 Therefore, it can be concluded that the Proposal will increase the positive effect of the LSEP scheme in reducing carbon emissions (when compared to the baseline) and contribute to the achievement of the GHG reduction targets.

9.8.4 The cumulative impact of the LSEP scheme with the Proposal was assessed for the expected 25 year operational lifetime. Even when taking a very conservative approach and accounting for an increased supply of renewable energy within the electricity mix, the LSEP with the Proposal will have a net carbon benefit. Accordingly, the Proposal will contribute to the overall reduction in carbon emissions for the UK and thus also contribute towards the UKs Net Zero commitments. Additionally, it would make a significant contribution towards local commitments made by CWACC and other local Councils through their declaration of local climate emergencies.

9.8.5 In an overall conclusion of GHG emissions, the Proposal to increase the waste tonnage of the consented LSEP facility will have a **positive effect** to reducing carbon emissions when compared to the baseline. The Consented Development will deliver considerable carbon benefits via the existing consent, and these will be significantly greater with the inclusion of the Proposal.

Climate Change Resilience

9.8.6 In line with national and local policy, the resilience of the LSEP scheme to climate change has been assessed (see Appendix 9-3). The assessment concluded that the projected climate change effects over the lifetime of the LSEP would have a negligible to slight effect and therefore there will be no significant effects on key vulnerable receptors. The LSEP scheme provides additional resilience to the local electrical distribution grid and end users to deal with outages across the generation and distribution network. The Proposal will serve to increase this resilience due to the additional electricity generated from greater waste throughput of the LSEP. The LSEP scheme is considered to be appropriately designed to adapt to impacts arising from climate change and there are no significant residual effects.

Summary

9.8.7 In line with the 2017 EIA Regulations, this Chapter of the EIAR Main Report sets out the impact of the LSEP scheme (accounting for the amendments now proposed) on climate with reference to GHG emissions and the vulnerability of the project to climate change. A description of the forecasting methods used to assess the significant effects has been provided including details of the difficulties encountered.

9.8.8 The impacts of the LSEP scheme (as now proposed) to GHG emissions have been assessed in line with the IEMA Guidance ‘Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2017). It was concluded that there will be a net carbon benefit of the LSEP scheme and that these benefits will be greatly increased through the Proposal. The net carbon benefit on a local scale is greater than 1% and accordingly is considered to be significant.

9.8.9 In line with the IEMA guidance ‘Environmental Impact Assessment Guide to Climate Change and Resilience and Adaption’ (2020), it has been concluded that

the projected climate change effects over the lifetime of the LSEP scheme (with the Proposal) will have a negligible to slight effect, and as such, there will be no significant effects on vulnerable receptors. The LSEP, as currently consented, will provide resilience to the local electrical distribution grid and end users to deal with outages across the generation and distribution network. The Proposal will serve to improve this resilience further due to the additional electricity generated from greater waste throughput of the LSEP.

9.8.10 The measures to avoid, prevent, reduce of offset any significant adverse effects on climate change and the vulnerability of the LSEP scheme are already included in the consented design of the LSEP, which will not be altered by the Proposal. As such, the LSEP is considered to be appropriately designed to adapt to impacts arising from climate change and there are no significant residual effects. The Proposal would not change this.

9.8.11 In conclusion, the LSEP is considered to be resilient to the effects of climate change and the Proposal will provide further reduction in GHG emissions to those that the Consented Development will already deliver.