7 Climate Change and Greenhouse Gases

7.1 Introduction

7.1.1 This chapter of the ES was prepared by Air Quality Consultants (AQC) Limited and Ecolyse and presents an assessment of both the impact of the project on the climate (through consideration of Greenhouse Gases (GHGs)), and the vulnerability of the project to climate change.

7.1.2 The chapter is therefore presented in two parts:

- Part A assesses the likely significant effects of the Development on Climate Change through consideration of the GHGs associated with the Development; and
- Part B considers the resilience of the Development to future changes in climate.

7.1.3 The chapter is supported by the following appendices:

- Appendix 7.1: Legislation, Policy and Guidance;
- Appendix 7.2: GHG Calculation Input Data; and
- Appendix 7.3: Glossary.

Competence

7.1.4 The assessment was led by Dr Graham Earl (PhD, IMechE), Director at Ecolyse Ltd. and supported by Laurence Caird (MEarthSci, CSci, MIES, MIAQM), Associate Director at Air Quality Consultants Ltd (AQC).

7.1.5 Dr Earl has over 25 years' experience in the fields of climate change, environment and asset management. Since the formation of Ecolyse six years ago, Dr Earl has developed approaches to assessing GHG emissions and climate change for EIA and has specialised in the assessment of climate change, and preparation of GHG inventories and climate resilience assessments for the purposes of EIAs for numerous light industrial, mixed used housing developments, as well as major infrastructure projects.

7.1.6 Mr Caird has over 16 years' experience in the fields of air quality and greenhouse gas emissions. He has helped shape a methodology for the assessment of greenhouse gas emissions within EIA and has produced carbon footprints and greenhouse gas assessments for numerous projects requiring EIAs including major industrial, energy from waste, residential, commercial and mixed-use developments.

7.2 Legislation, Planning Policy and Guidance

Relevant Legislation

7.2.1 The following legislation is relevant to the Development:

- Well-being of Future Generations (Wales) Act 2015[1];
- Climate Change Act (2008)[2];
- Climate Change Act 2008 (2050 Target Amendment) Order 2019[3];

- The Environment (Wales) Act 2016 (Amendment of 2050 Emissions Target) Regulations 2021[4];
- The Climate Change (Interim Emissions Targets) (Wales) (Amendment) Regulations 2021[5];
- The Climate Change (Carbon Budgets) (Wales) (Amendment) Regulations 2021[6];
- The Climate Change (Net Welsh Emissions Account Credit Limit) (Wales) Regulations 2021[7];
- Environmental Impact Assessment (EIA) Directive 2014[8]; and
- The Town and Country Planning (Environmental Impact Assessment) Regulations 2017[9].

7.2.2 The following international agreement is relevant to the Development:

- The United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement[10].

Planning Policy Context

7.2.3 The following planning policy is relevant to the Development:

- Welsh Government (2021). Planning Policy Wales. Edition 11[11];
- Future Wales, The National Plan 2040, February 2021[12]; and
- Welsh Government. (2019). Prosperity for All: A Low Carbon Wales[13].

7.2.4 The following local planning policy is relevant to the Development:

- Vale of Glamorgan Local Development Plan (LDP) 2011 – 2026 (Policy MD19 and Strategic Objective 2)[14]; and
- Vale of Glamorgan Renewable Energy Supplementary Planning Guidance[15].

Guidance

7.2.5 The following guidance is relevant to the Development:

- Institute of Environmental Management and Assessment (IEMA) guidance on Assessing Greenhouse Gas Emissions and Evaluating their Significance, 2nd edition (2022)[16] (the 'IEMA Guidance');
- IEMA EIA Guide To: Climate Change Resilience and Adaptation 2020[17];
- The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (GHG Protocol)[18];
- Publicly Available Standard (PAS) 2080: 2016 – Carbon Management in Infrastructure[19];
- Committee on Climate Change (CCC), Net Zero Technical Report, 2019[20];
- Royal Institution of Chartered Surveyors (RICS): Whole Life Carbon Assessment for the Built Environment, 1st edition[21];
- Energy Generation in Wales (2018)[22]; and
- Project Zero – The Vale of Glamorgan Council Climate Change Challenge Plan 2021 – 2030[23].

Part A: Greenhouse Gas Assessment

7.3 Assessment Methodology

Consultation

7.3.1 Further to guidance from PEDW that scoping consultation was not necessary there has been no scoping or consultation carried out for this ES.

Scope of the Assessment

7.3.2 The metric for assessing the climate change impacts of GHG emissions in this assessment is Global Warming Potential (GWP). This is expressed in units of CO_2 equivalent (CO_{2e}) over 100 years. This allows for the emissions of the seven key GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen trifluoride (NF_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) to be expressed in terms of their equivalent global warming potential in mass of CO_{2e}.

Potential Sources of Impact

7.3.3 The assessment has taken a whole life approach to develop a GHG footprint for the Development. The footprint sources considered include GHG emissions associated with:

- Embedded carbon in the materials used to construct the Development;
- Construction phase transport;
- The operation of the Development (i.e. main stack emissions);
- Auxiliary plant associated with the Development (i.e. shovel loaders and emergency diesel generators);
- Electricity consumed by the Development;
- Operational phase transport, including staff travel, delivery of waste wood to the Development, and removal of process by-products such as fly ash and Air Pollution Control Residues (APCR); and
- Repair and maintenance of the Development during its lifetime.

Matters Scoped Out

7.3.4 A small number of minor activities were scoped out consistent with the IEMA Guidance[16]. IEMA recommends that activities with emissions that individually make up less than 1% and in total equal less than 5% of the lifecycle emissions of the Development are scoped out of the assessment. These include:

- Emissions from construction site activities: these include the fuel and electricity consumption of on-Site plant, machinery and vehicles as well as emissions associated with the energy consumption of welfare facilities, site security and lighting. These emissions will constitute only a very small component of the lifetime GHG footprint of the Development. Including emissions from such site activities would not affect the conclusions of the assessment;
- Water consumption: the Development includes a fire water tank for emergencies and uses a small amount of potable water. The overall water consumption of the Development is estimated in section 6.5 of the Permit decision document (Appendix 1.2) as between 250 – 1,100 kg per tonne of biomass. Using emissions factors from the

Department of Business, Energy and Industrial Strategy (BEIS)[25] for water supply and treatment, the associated GHG emissions will range from 3 to 14 tonnes, which represents much less than 1% of the Development's GHG footprint and is therefore scoped out;

- Embedded carbon emissions for ancillary products used by the Development during operation have been scoped out. These include limestone as an incinerator bed additive, and urea, hydrated lime and activated carbon for use in the air pollution control systems. The annual quantities of these materials are very small (equivalent to only a couple of vehicle deliveries a week – see Table 7.6) and the embedded carbon emissions in these products will be a very small proportion of the Development's total GHG footprint. Emissions from transport of these products to the Site has been accounted for in the assessment; and
- Emissions associated with the end of life of the Development include those from the deconstruction or demolition of the buildings and structures and transport and disposal of buildings materials. The end-of-life fate of the Development is very uncertain, as the options will include replacement of the waste processing technologies, removal of the technologies and change of use of the structures to extend their usable life, or a completely new development on the Site. In all cases, there may be some GHG emissions associated with decommissioning, demolition and disposal; however, assuming a 25-year lifetime, this will likely occur at a time when the UK is expected to be approaching a net zero across the economy. Whilst it is not possible to assume that the GHG emissions from decommissioning will be zero, they are likely to be small and less than 1% of the Development's lifetime GHG footprint.

Spatial Scope

7.3.5 The assessment considers the GHGs generated as a result of the Development's lifecycle, taking into account the production of materials, transportation to and from the Development, as well as sources of GHG emissions within the Development boundary itself.

7.3.6 GHGs contribute to climate change, which is a global environmental effect and as such the study area for the assessment is not limited by any specific geographical scope or defined by specific sensitive receptors.

Temporal Scope

7.3.7 The temporal scope was consistent with assessing the whole life GHG emissions from the Development (excluding decommissioning which has been scoped out). The construction and operational phases of the Development were considered as follows:

- **Construction Phase**: Direct and indirect GHG emissions resulting from the Development over the construction period, which commenced in Q1 of 2016, and were substantially complete in Q1 of 2018, equivalent to a two-year construction period; and
- **Operational Phase**: The assessment considers direct and indirect GHG emissions from the Development in the anticipated year of opening (for the purposes of this assessment 2022 has been chosen as using an earlier assessment year ensures the assessment remains conservative) and throughout the lifetime of the Development. The lifetime emissions are assumed over an operational lifetime of 25 years, although this is not limited by the 2015 Permission. GHG emissions in the assessment year represent the worst case annual GHG emissions for the Development over its lifetime since the economy will be decarbonising over time consistent with meeting the UK's climate

change target to be net zero by 2050 and shown also for example by historic year on year fall in emissions factors for electricity generation as the grid decarbonises.

Establishing Baseline Conditions

Pre-Construction Baseline

7.3.8 Prior to construction, the Site was partially vacant and previously occupied by a container storage and refurbishment facility. The Site consisted of a compacted hard-standing area which was not vegetated. Baseline GHG emissions associated with the Site were related to vehicles and plant accessing and operating at the Site.

Current Baseline

7.3.9 The Site is now occupied by the Facility which comprises a steel portal frame building with a total footprint of c. 2,497 m^2 incorporating a 11.8 MWe biomass power plant (net electricity production of the Facility will be 10 MWe, see para 7.3.43 for further details), ancillary infrastructure and hardstanding. Whilst the Development is constructed, it is not operational. As such, baseline GHG emissions associated with the Development are considered to be zero, which is a worst-case assumption.

Identifying Likely Significant Effects

7.3.10 The assessment considered the whole life GHG emissions from the Development.

Construction (Retrospective)

7.3.11 GHGs associated with the construction of the Development relate to those embedded in the materials from which the Development was constructed, and emissions associated with on-Site construction works, and from construction traffic movements during the works.

Construction – Embedded Carbon

7.3.12 The precise quantum of construction products and materials used in the construction of the Development has not been recorded by the operator and is therefore not known. Thus, the assessment of embedded GHG emissions from construction materials is based on factors obtained from the Royal Institution of Chartered Surveyors (RICS) publication on a methodology to calculate embodied carbon of materials[24].

7.3.13 The RICS factors, shown in Figure 7.1, are provided as kilograms of CO_{2e} per m^2 of Gross Internal Area (GIA) for a range of building types and provide a method of calculating the embedded carbon in the development by multiplying the GIA area information for the Development by the appropriate carbon factors. The most representative category and associated carbon factor from Figure 7.1 for the Development are shown in Table 7.1. The total GIA for the Development is assumed as 3,032 m^2.

7.3.14 It should, however, be noted that the application of the selected RICS carbon factor does not account for any materials associated with the installed processing technology or concrete used to level the Site. As such, the assessment has applied a conservative uplift to account for embedded carbon associated with internal fit-out, to ensure a robust assessment.

Table 7.1: Selected Embedded Carbon Factors

Applicable Category from RICS [a]	RICS Carbon Factor ($kgCO_{2e}/m^2$)
Other Industrial / Utilities / Specialist Uses	545

[a] Selected from Figure 7.1.

Construction – Transport

7.3.15 The number of vehicle trips associated with the construction works, provided in Table 7.2, have conservatively been estimated by the project team with further detail provided in Appendix 3.10. These have been provided for construction site staff (travelling in light vehicles such as cars) and for construction materials and goods, which are conservatively assumed to have been Heavy Goods Vehicles (HGVs). All HGVs are assumed to have been articulated HGVs, which is a conservative assumption as these vehicles are larger than rigid HGVs and have greater GHG emissions.

Table 7.2: Construction Phase Transport Movements

Activity	Number of Movements (Daily)	Total Movements during 2-Year Construction Period [c]	Assumed Vehicle Type
Staff Vehicles during Construction Works [a]	100	73,000	Car
Vehicles for Deliveries of Goods and Materials [b]	100	73,000	Articulated HGV

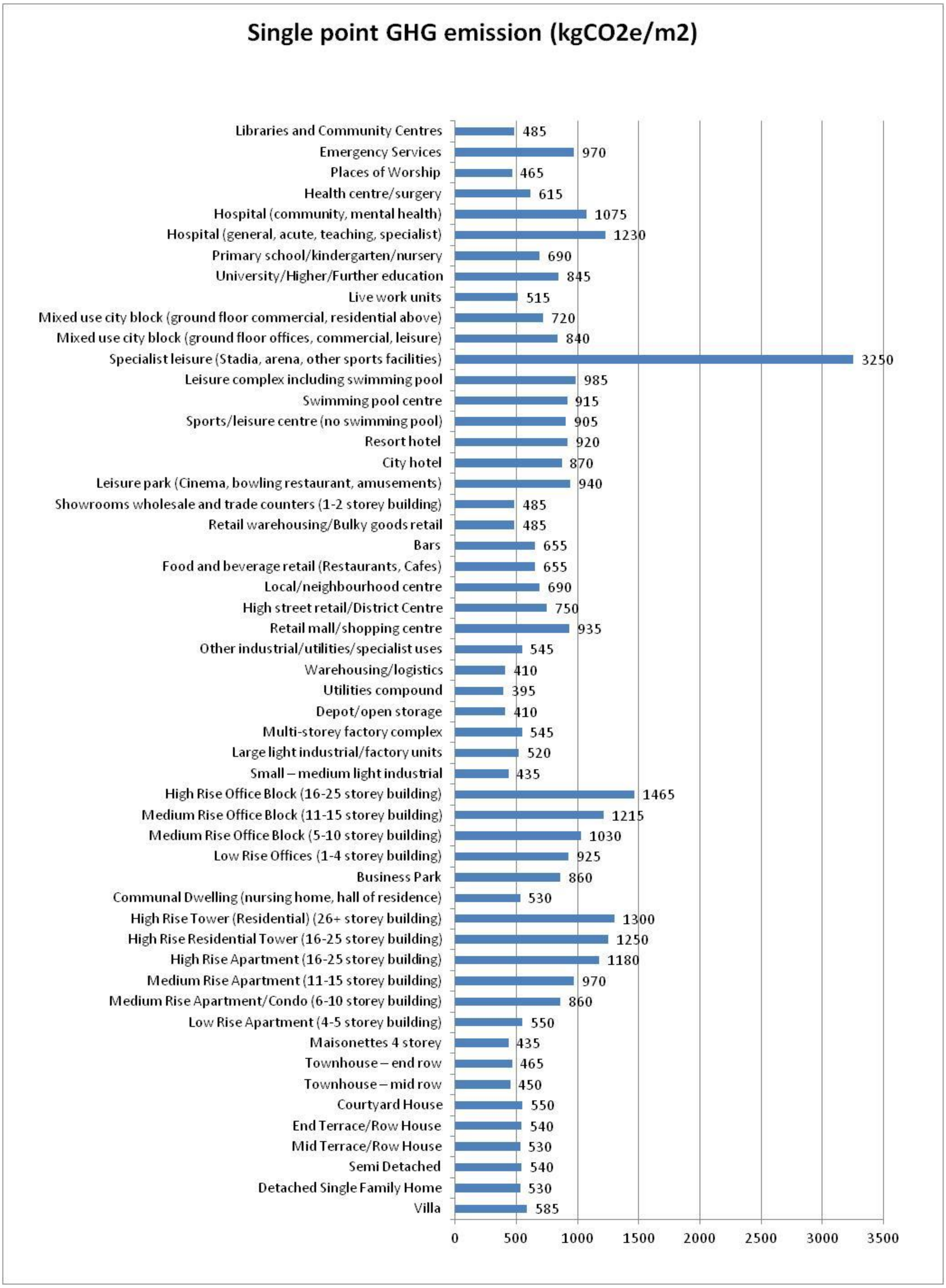
[a] Movements include each journey to and from the construction site.
[b] Movements account for the delivery vehicle arriving with goods and materials, and the return journey to its point of origin.
[c] Based on a construction period of two years (730 days).

7.3.16 The precise origin or destination of the vehicle trips used in the construction of the Development is not known. In the absence of these records best practice guidance published by RICS[21]. has been used which is considered to be conservative. This recommends an average travel distance for all articulated HGVs of 300 km to account for goods and materials being sourced nationally

7.3.17 The average travel distance for construction staff was assumed to be 50 km, which covers staff travelling from a number of nearby towns including Cardiff, Newport, Chepstow, Merthyr Tydfil and Port Talbot.

Figure 7.1: GHG Emission Factors for Materials Used in Construction

Figure reproduced from RICS[24].



7.3.18 Although the average travel distances are estimates, and vehicle trips to and from the Site during construction works will have varied greatly in origin and destination, the distances are intended to be overestimates, such that, when applied to all construction phase vehicles, it results in a robust estimate of overall construction phase transport emissions.

7.3.19 GHG emission factors for construction transport have been obtained from the BEIS publication on GHG Conversion Factors for Company Reporting[25] which sets out GHG emissions factors for a range of modes of transport valid for 2021. The GHG emissions factors are applied to the calculated total construction travel distance to estimate the GHG emissions from construction transport.

7.3.20 A summary of the 2021 GHG emission factors for selected modes of construction transport used in this GHG assessment are provided in Table 7.3. The assumption has been made that each HGV arrived at the Site fully laden and left empty. In reality, some vehicles may have arrived empty and left laden (for example when removing waste), but, as in each case an HGV journey is one-way laden and one-way unladen, the assumption that all HGVs arrived laden has been made for simplicity.

Table 7.3: 2021 Construction Transport GHG Factors for Relevant Modes

Activity	Type of Vehicle	Average Distance per Trip (km)	2021 BEIS Factor ($kgCO_{2e}$/km)
Construction Staff	Average Car	50	0.171
Goods and Materials Deliveries	Average Artic HGV – 100% Laden	300	1.067
	Average Artic HGV – 0% Laden	300	0.649

Operation

7.3.21 GHGs associated with the operation of the Development relate to emissions from the facility, ancillary plant associated with the facility (including emergency generators and mobile loading shovels), as well as emissions from transport.

Facility

7.3.22 GHG emissions from the facility are linked to the carbon content of the input biomass waste and comprise CO_2, plus small quantities of N_2O and CH_4 that are produced as combustion by-products.

7.3.23 In accordance with Government reporting of emissions from combustion of biomass, the CO_2 emissions from the Facility are considered to net carbon zero, due to the short carbon cycle of biomass feedstocks. The methodology paper for the Government's GHG conversion factors[26], provides guidance at paragraphs 9.14, which states:

"At the point of use, biofuels are defined as "net carbon zero" or "carbon neutral" as any CO_2 expelled during the burning of the fuel is cancelled out by the CO_2 absorbed by the feedstock used to produce the fuel during growth (This is a convention required by international GHG inventory guidelines and formal accounting rules). Therefore, all direct emissions from biofuels provided in the GHG Conversion factors dataset are only made up of CH_4 and N_2O emissions."

7.3.24 It is though appropriate to account for the N_2O and CH_4 emissions associated with the biomass combustion, as these emissions have much higher GWPs than CO_2. In addition, in order to apply a comprehensive lifecycle approach to the GHG assessment, emissions associated with the upstream processing and transport of the biomass should also be considered. In order to capture all of these emissions contributions, a GHG factor from BEIS data[26] has been used in the assessment. The factors account for the *"indirect/WTT/fuel lifecycle"* emissions (including N_2O and CH_4 during use) as described by BEIS in its GHG reporting methodology report[26].

7.3.25 The facility is designed to process 72,000 tonnes of dry waste wood per annum (equivalent to 86,400 tonnes per annum of wet waste wood) to generate the designed 10 MWe of net electrical output.

7.3.26 Key parameters assumed in the calculation of the GHG emissions from the facility are summarised in Table 7.4.

Table 7.4: Input Parameters for Biomass GHG Emissions Calculation

Parameter	Value	Unit	Source / Reference
Biomass Throughput	72,000 (dry)	Tonnes per annum (Tpa)	Development Operator
GHG Factor	57	TCO_2e/tonne	BEIS 2021[48]

Ancillary Plant Emissions

7.3.27 Ancillary plant associated with the Facility includes an emergency diesel generator (required for the safe operation and shut down of the facility in the event of a power failure or mains electricity black out), and a diesel mobile loading shovel, which is used between five and six hours each day to move feedstock around the fuel hall. GHG emissions are associated with fuel consumption of these plant. Estimated total diesel consumption volumes for the ancillary plant have been provided by the operator of the facility based on records, and are provided in Table 7.5. The GHG factor for mineral diesel has been obtained from BEIS 2021 GHG Conversion Factors for Company Reporting[25].

Table 7.5: Ancillary Plant Diesel Consumption and Associated GHG Factor

Plant	Annual Fuel Consumption (L)	Fuel Type	2021 BEIS Factor ($kgCO_{2e}$/L)
Emergency Generator and Mobile Loading Shovel	163,000	Diesel	2.706

Transport

7.3.28 GHG emissions from transport associated with the operation of the Development will relate to staff travel to and from the Site, and the import and export of biomass waste and process by-products from the facility. Upstream emissions from transport are included in the BEIS GHG factor for biomass consumption presented in Table 7.5, however this factor is based on default assumptions and it is not clear whether it covers transport to the point at which the wood chips are produced (i.e. to the factory gate) or to the end user. Therefore to be precautionary and provide a worst-case assessment, upstream transport emissions associated with delivery of wood chips to the Development have been calculated separately.

7.3.29 The transport movements associated with the Development are summarised in Table 7.6. Transport movements have been estimated by the project transport consultant, Vectos. Staff movements are based on eight staff trips per day during the week. The movements of HGVs for imports and exports have also been obtained from the project transport consultant, based on daily biomass deliveries and every 1 – 3 days for all other deliveries/removals.

7.3.30 The average trip distance for staff at the Development has been established at 50km which encompasses commuting from nearby towns. The average distance for HGVs importing and exporting materials from the facility has been determined for each material, as advised by the Appellant:

- The key distributors of biomass are located in Newport and Swansea, approximately 35 km and 66 km from the Development, respectively. For the purposes of this assessment, the greatest distance has been applied as a worst-case assumption;
- Urea is sourced from Seaham in County Durham, approximately 550 km from the Development;
- Limestone and Hydrated Lime are sourced from Matlock and Buxton in Derbyshire, respectively, 320 km from the Development; and
- For the purposes of the assessment it is assumed that by-products (fly ash and APCR) from the facility would be disposed of in landfill sites in Newport and Swansea, approximately 35 km and 66 km from the Development, respectively. Fly ash is non-hazardous and subject to waste classification testing would be re-used in the aggregate industry, although disposal has been assumed as a worst case. For the purposes of this assessment, the greatest distance has been applied as a worst-case assumption.

7.3.31 Biomass will be transported to the Development by 44 tonne HGVs using moving floor trailers, whilst hydrated lime and urea pill is delivered by articulated bulk powder tanker HGVs. Fly ash and APCR are removed from the Site using 32 tonne bulk tippers, which have a payload capacity of 20 tonnes.

Table 7.6: Operational Development Transport Movements

Activity	Trips per Annum	Average Trip Distance (km) [a]	Vehicle Type	2022 BEIS Factor ($kgCO_{2e}/km$)
Staff	4,784	50	Car	0.168
Imports – Biomass	4,320	66	Articulated HGV	0.858
Import – Urea	26	550	Articulated HGV	0.858
Import – Limestone / Hydrated Lime	35	320	Articulated HGV	0.858

Activity	Trips per Annum	Average Trip Distance (km) [a]	Vehicle Type	2022 BEIS Factor ($kgCO_{2e}$/km)
Export – Fly ash and APCR	239	66	Articulated HGV	0.858

[a] Average trip distances have been estimated based on proximity to nearby towns, but are intended to be worst-case.

7.3.32 GHG emission factors for transport in 2021 (latest available year) have been obtained from the BEIS publication on GHG Conversion Factors for Company Reporting[25] which sets out GHG emissions factors for a range of modes of transport valid for 2022.

7.3.33 Factors for 2022 (the assumed opening year) and each year up to 2046 (to account for the assumed lifetime) were determined by applying engine and fuel efficiency factors (sourced from the WebTAG data book[27]) to the 2021 BEIS factors, for different types of fuel/energy source, and vehicle size/type. The vehicle emissions factors for 2022-2046 used in this GHG assessment are provided in Appendix 7.2.

Repair, Maintenance and Refurbishment

7.3.34 Over the lifetime of the Development there will be GHG emissions associated with the repair, maintenance and refurbishment of the buildings and facilities[28]. These emissions are effectively 'unregulated' as there is no policy or standard for establishing compliance nor is there published data on good practice against which developments can be benchmarked. Nonetheless, emissions from repair, maintenance and refurbishment have been considered in the GHG assessment based on data from RICS[21]. RICS estimate that for commercial/warehouse type developments (the nearest available category to this Development), embedded GHG emissions during use (i.e. repair, maintenance and refurbishment) are around 62% of the embedded GHG emissions to practical completion. The lifetime GHG emissions from repair, refurbishment and maintenance have therefore been estimated to be 62% of the embedded emissions of the Development to practical completion.

Sensitivity of Receptor

7.3.35 The assessment of GHG emissions does not include identification of sensitive receptors, as GHG emissions do not directly affect specific locations, but lead to indirect effects by contributing to climate change. Impacts on specific areas are not included within this assessment, since the impacts of GHG emissions will affect the global atmosphere, and therefore need to be considered in a total context, rather than on localised areas.

Potential GHG Benefits of the Development

Energy Grid Offset

7.3.36 The energy generated by the facility can be used to replace energy that would otherwise be generated by other sources, including fossil natural gas combustion. The net electricity production of the Facility will be 10 MWe for 8,000 hours per year (see Table 7.4). This is the gross electricity production (11.8 MWe) minus the parasitic load (1.8 MWe). This gives a total electricity production value of 80,000 megawatt-hours per year (MWh/year).

7.3.37 The technical capability to offtake the heat is currently embedded in the design of the facility, however, at present, there is no available supply chain. This is actively being explored by the Operator at present. The Development is an active member of the Clean Growth Hub in the region and is receptive to developing clean offtakes when the supply chain emerges.

Cumulative Effects

7.3.38 As set out in the Institute of Environmental Management and Assessment (IEMA) Guidance[22] "*GHG emissions from all projects will contribute to climate change; the largest interrelated cumulative environmental effect*". This statement relates to 'cumulative' on a global scale as all emissions of GHGs contribute to climate change. The definition of 'cumulative effects' in the context of greenhouse gases and climate change therefore goes far beyond the typical definition of cumulative effects for EIA, which tends to focus on other proposed projects in the vicinity of the Development. Therefore, the assessment of GHG emissions which contribute to climate change is intrinsically cumulative.

7.3.39 On this point IEMA states that "*The atmospheric concentration of GHGs and resulting effect on climate change is affected by all sources and sinks globally, anthropogenic and otherwise. As GHG emission impacts and resulting effects are global rather than affecting one localised area, the approach to cumulative effects assessment for GHGs differs from that for many EIA topics where only projects within a geographically bounded study area of, for example, 10km would be included*".

7.3.40 In terms of this assessment the following are therefore relevant:

- The assessment will consider the effects of the Development in the context of national and local cumulative totals. Since the national totals assume that other developments will contribute GHGs, the assessment will consider their implications in determining significance; and
- The geographical location of emissions has no relevance to the assessment. Therefore, the effects of the Development are independent of any local cumulative emissions.

7.3.41 Taking this into account, an assessment of the GHG emissions associated with specific cumulative developments has not been undertaken and the cumulative GHG effects are considered to be the same as those for the completed Development.

Determining Effect Significance

7.3.42 For GHG emissions there are no recognised significance criteria and thresholds that relate to the quantum of GHG emissions released.

7.3.43 The approach to classifying and defining likely significant effects therefore relies on IEMA Guidance[16] and applying expert judgment on the significance of the Development's lifecycle GHG emissions taking into account their context, compliance with policy, and mitigation measures. In this respect IEMA has recently updated its guidance[16], building on its previous guidance published in 2017[29].

7.3.44 Specifically, the revised 2022 IEMA Guidance presents more nuanced levels of significance. The 2017 guidance stated that "*…in the absence of any significance criteria or defined threshold, it might be considered that all GHG emissions are significant…*". The updated guidance does not change IEMA's position (or the science) that all emissions contribute to climate change, however specifically in the EIA context it now provides relative significance descriptions to assist assessments.

7.3.45 The 2022 IEMA Guidance has therefore defined five distinct levels of significance (see Table 7.7 later in this section) which are not solely based on whether a project emits GHG emissions alone, but the degree to which the project's GHG emissions are consistent with science-based 1.5°C aligned emission trajectories towards net zero. For the UK and devolved administrations these trajectories are effectively defined by carbon budgets, including any sectoral pathways that are designed to achieve the UK's 2050 net zero target.

7.3.46 In defining its approach to significance, IEMA has established three underlying principles which has informed its approach, as follows:

- The GHG emissions from all projects will contribute to climate change, the largest interrelated cumulative environmental effect;
- The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive – e.g., population, fauna and soil; and
- GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant.

7.3.47 Based on these principles, IEMA concludes that:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact, which may be positive, negative or negligible.
- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages.
- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered.

7.3.48 In advising on the significance of any net change in GHG emission resulting from a development, IEMA identifies that in order to limit the adverse effects from climate change global temperature change needs to be limited to well below 2°C, aiming for 1.5°C. The implication of this objective is that global emissions need to fall to net zero by 2050.

7.3.49 The UK's response to limiting climate change is enshrined in law through the Climate Change Act which requires the UK economy to be net zero by 2050 following a trajectory set through five yearly carbon budgets. The 2050 target (and interim budgets set to date) are, according to the Committee on Climate Change (CCC), compatible with the required magnitude and rate of GHG emissions reductions required in the UK to meet the global goal of limiting climate change to less than 2°C, aiming for 1.5°C, thereby limiting severe adverse effects.

7.3.50 It follows therefore that the significance of any net change of GHG resulting from a development is not so much whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions consistent with a trajectory towards net zero by 2050.

7.3.51 To establish the significance of the GHG emissions from a Development therefore requires judgements on:

- their consistency with policy requirements, since these have been specified to ensure the economy decarbonises in line with the UK's net zero target; and
- the degree to which the Development has sought to mitigate its emissions.

7.3.52 Examining each of these dimensions allows the assessment to make professional judgement on the likely significance of effects based on a set of significance criteria established in the IEMA Guidance, summarised in Table 7.7.

Table 7.7: GHG Significance Criteria (Based on IEMA Guidance[16])

Significance Rating	Description	Criteria to Determine Significance of Net GHG Emissions
Major Adverse	A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.	The project's net GHG impacts are: not mitigated or are only compliant with do-minimum standards set through regulation; and do not provide further reductions required by existing local and national policy for projects of this type.
Moderate adverse	A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.	The project's net GHG impacts are: partially mitigated; and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type.
Minor Adverse	A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.	The project's net GHG impacts are: fully consistent with applicable existing and emerging policy requirements; and in line with good practice design standards for projects of this type.
Negligible	A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.	The project's net GHG impacts are: reduced through measures that go well beyond existing and emerging policy; and better than good practice design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050.
Beneficial	A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.	The project's net GHG impacts are: below zero; and it causes a reduction in atmospheric GHG concentrations, whether directly or indirectly, compared to the without-project baseline.

7.3.53 IEMA[16] also advises that:

- Major adverse, moderate adverse and beneficial effects should be considered significant in the context of EIA. Consequently, negligible and minor adverse are considered not significant;
- In the case of large-scale developments, irrespective of the level of mitigation if net GHG emissions exceed 5% of UK or devolved administrations carbon budget, this is a level of change that is considered significant;
- Meeting the minimum standards set through existing policy or regulation cannot necessarily be taken as evidence of avoiding a significant adverse effect, and it is recommended therefore that the assessment also considers emerging policy/standards and the guidance of expert bodies such as the CCC on necessary policy developments, particularly for multi-phased projects with long timescales; and
- To aid the evaluation of a project or plan it is important to demonstrate the relative severity of environmental effects. Therefore, it is essential to provide context for the magnitude of GHG emissions reported in the EIA in a way that helps determine the severity of these effects. IEMA advises that context can be provided through comparison of the whole life GHG emissions resulting from the Development with national, local and sectoral totals, as well as carbon budgets.

7.3.54 Therefore, the assessment of significance is established over two steps as follows:

Step 1: Establish Context of GHG Emissions

7.3.55 Context for decision making is provided by comparing the net change in the GHG emissions resulting from the Development with local and national GHG emissions totals, and carbon budgets.

Step 2: Determine Significance of Effects

7.3.56 Significance of effects is established through applying the criteria detailed in Table 7.7 based on professional judgement that considers:

- Step 2a: The consistency of the Development with national and local policies designed to limit GHG emissions and meet the UK's net zero target; and
- Step 2b: The robustness, timeliness and efficacy of mitigation measures proposed to avoid, reduce and compensate GHG emissions.

Assumptions and Limitations

7.3.57 The key components that contribute to the uncertainty of GHG emissions from the Development include;

- The factors used for future transport emissions are based on 2021 emission factors which have been scaled in line with predictions for decarbonisation of transport modes. It is, however, not possible to know what the vehicle fleets will be in the future, and as such the factors published by the UK Government used are the best projections available;
- No information is available regarding the origin or destination of vehicles associated with construction traffic; however, average trip distances have been adopted to be conservative and ensure a realistic worst-case; and

- The assessment has assumed that the parasitic electrical load associated with the Development encompasses all of its regulated and unregulated electricity demand, which is assumed to be a constant load of 1.8 MW.

7.4 Baseline Conditions

7.4.1 A worst-case assumption is that the baseline GHG emissions are assumed to be zero as the Facility.

7.5 Embedded Design and Mitigation

Construction

7.5.1 The construction works were carried out in accordance with a Construction Phase Plan (CPP), and Project Environmental Plan (PEP) that were secured by condition (Appendices 6.1and 6.2 respectively). The CPP and PEP included measures designed to reduce emissions from construction works, such as sustainable procurement, waste minimisation and management, energy efficient site lighting and welfare facilities, as well as specifying the use of low emission construction plant. These measures all served to minimise waste (and thus embodied carbon) and promote fuel efficiency.

7.5.2 The Facility operator put in place a Traffic Management Plan during construction, and the traffic management measures to be adopted during the works were defined in section 5.8 of the PEP (Appendix 6.2). The Traffic Management Plan included measures to control construction traffic flows and was prepared to reduce the environmental impact at the construction stage.

Operation

7.5.3 The Development has adopted best available technology for converting waste wood into electricity thus ensuring optimum grid offset from the Development. The energy efficiencies measures designed into the Development, which are reviewed and approved by NRW in the Permit Decision Document (Appendix 1.2) include:

- insulated pipes and thermal processes to minimise heat loss;
- use of high efficiency electrical motors for fans etc.; and
- waste heat is used internally (for example pre-heating combustion air to improve combustion efficiency).

7.5.4 Section 4.3.8 of the NRW Permit Decision Document reviews the energy efficiency of the Development against relevant Best Available Techniques (BAT), and the following findings are noted:

- the energy consumption (parasitic load) of the Development is 130 kWh/tonne of wood processed, which is in line with BAT (the BAT target is below 150 kWh/tonne);
- the Development is Combined Heat and Power (CHP)-ready which complies with BAT, even though it does not initially have any local heat offtake agreements; and
- the Development can generate 1.21 MWh of electricity per tonne of wood, which is better than the BAT target of 0.4 - 0.72 MWh per tonne.

7.5.5 Based on these findings, NRW concluded that the Development meets the requirements of both Article 50(5) of the Industrial Emissions Directive[30] and Article 14(5) of the Energy

Efficiency Directive[31]. NRW has also implemented a Permit condition (section 1.2 in the Permit conditions document) requiring the operator to review options for heat offtake on an ongoing basis (see Paragraph 7.6.48).

7.5.6 In addition, an Electric Vehicle (EV) charging point has been installed at the Facility for use by Site staff to charge EVs.

7.5.7 A comprehensive set of design measures have been adopted to ensure the building is resilient to future climate change. These are detailed in Table 7.21 and are also considered as primary mitigation measures.

7.6 Assessment of Effects

7.6.1 The climate change assessment considers the whole life GHG emissions resulting from the Development. The effect of GHG emissions released during the construction and operational phase is not distinguishable; therefore, there is no benefit in considering the likely significant effects separately for these phases. The assessment presents the quantification of the construction and completed Development's GHG emissions together to enable an assessment on the significance of those emissions.

7.6.2 This section is structured as follows:

- Quantification of whole life GHG emissions from the Development;
- Assessment of the likely significant effects (following the 2-step process described in Paragraph 7.3.54); and
- Assessment of residual effects.

Quantification of Whole Life GHG Emissions from the Development

Construction

Embedded Carbon

7.6.3 The calculation of the embedded GHGs in the materials used to construct the Development is provided in Table 7.8.

Table 7.8: Calculation of Embedded Carbon

Development Element	GIA (m^2)	RICS GHG Emissions Factor ($kgCO_2e/m^2$)	GHG Emissions (TCO_2e)
Wood Storage and Feed Building	1,132	545	617
Turbine, Welfare and Ancillaries Building	521		284
Main Process Building	845		460
ACC Unit	464		253
External Equipment	71		38
Total	2,962	-	1,652

7.6.4 The total embedded CO_2e emissions for the Development from construction to practical completion is estimated as 1,652 tonnes. As discussed in Paragraph 7.3.14, the calculation of embedded carbon based on the RICS value for Other Industrial/Utilities/Specialist Uses may not fully include sufficient allowance for the installation of technology and equipment inherent to the Development or hardstanding used to level and surface the Site. There is insufficient information on materials quantities to footprint this in detail, and so to ensure a conservative estimate of embedded carbon emissions is made, it has been assumed that the embedded carbon emissions of the Development totalled 10,000 tonnes. This is judged to be a conservative estimate in line with projects of a similar nature and scale.

7.6.5 Based on a construction period of two years (Q1 of 2016 to Q1 of 2018), this equated to 5,000 tonnes/annum.

Transport

7.6.6 The calculation of construction transport related GHG emissions for the Development are presented in Table 7.9. The assessment uses the total construction period vehicle movement data presented in Table 7.2 and multiplies them by the GHG emission factors for each mode of travel and assumed average travel distance provided in Table 7.3. Total vehicle numbers have been provided by the Transport Consultant (Vectos).

Table 7.9: Assessment of GHG Emissions from Construction Transport

Mode	Number of Trips During Construction Works [a]	Average Trip Distance (km) [b]	Total Distance Travelled During Construction (km) [b]	CO_2e Tonnes [c]
Staff Travel (Cars)	73,000	50	3,650,000	626
Delivery Vehicles (HGVs) [d]	73,000	300	21,900,000	18,791
Total				19,417

[a] See Table 7.2.
[b] See Table 7.3.
[c] Calculated using GHG emissions factors presented in Table 7.3.
[d] Assumes 50% of the trips (deliveries) were 100% laden and 50% of the trips (return journey) were unladen.

7.6.7 The total CO_2e emissions from construction traffic for the Development were 19,417 tonnes. Based on a construction period of two years (Q1 of 2016 to Q1 of 2018), this equated to 9,708 tonnes/annum.

Operational Assessment

Repair, Maintenance and Refurbishment

7.6.8 The GHG emission from the repair, maintenance and refurbishment of the Development over its lifetime have been estimated based on RICS data[21] which finds that for similar developments, the lifetime GHG emission from repair, maintenance and refurbishment are estimated to be 62% of those produced from the embodied carbon in construction materials.

7.6.9 The whole life GHG emissions from repair, maintenance and refurbishment is therefore 0.62 x 10,000 = 6,200 tonnes CO_2e which is equal to 248 tonnes CO_2e per annum based on a 25-year lifetime.

Facility Emissions

7.6.10 Annual emissions from the Facility have been calculated using the data described in Table 7.4.

7.6.11 The emissions associated with the Facility, which assumes CO_2 to be net zero, but includes indirect and fuel lifecycle emissions as well as direct N_2O and CH_4 emissions, is calculated to be 4,115 tonnes of CO_2e per year (when rounded) which equates to 102,875 tonnes CO_2e over the facility's 25-year lifetime.

Ancillary Plant Emissions

7.6.12 The emissions from the fuel consumption in ancillary plant associated with Development have been calculated using the data described in Table 7.5.

7.6.13 The annual emissions from ancillary plant at the Development in the opening year are 441 tonnes CO_2e. Over the expected 25-year lifetime of the Development, the total from ancillary plant emissions are 11,025 tonnes CO_2e assuming no decarbonisation through use of biofuels (i.e. it is assumed that fossil diesel is used in the ancillary plant throughout the Development's lifetime as a worst-case assumption).

Transport

7.6.14 The assessment of transport related GHG emissions for the Development in the notional opening year (2022) are presented in Table 7.10. The transport data used in the assessment have been provided by Vectos (Transport Consultant). The assessment of transport-related GHG emissions multiplies GHG emission factors published by BEIS[25], adjusted to the year 2022 for each mode of travel (see Table 7.6), by the distance travelled (provided by the Project Team, and based on RICS guidance[21] for local staff).

Table 7.10: Assessment of GHG Emissions from Operational Transport in Opening Year (2022)

Activity	Trips per Annum	Average Trip Distance (km)	Distance Travelled per Annum (km)	Opening Year CO_2e Emissions (Tonnes) [a]	Lifetime CO_{2e} Emissions (Tonnes) [b]
Cars					
Staff	4,784	50	239,200	40	680
Articulated HGV					
Imports – Biomass	4,320	66	285,120	245	6,116
Import – Urea	26	550	14,300	12	307
Import – Limestone / Hydrated Lime	35	320	11,200	10	240
Export – Fly ash and APCR	239	66	15,774	14	338
Total				320	7,682

[a] CO_2e emissions are calculated by multiplying distance travelled by CO_2e factors for 2022 in Table 7.6.
[b] Assuming a 25-year lifetime and calculated using the year-by-year CO_2e factors in Appendix 7.2.

7.6.15 The total transport GHG emissions are calculated as 320 tonnes of CO_2e per annum in the opening year. Over the 25-year lifetime of the Development, GHG emissions from transport are estimated to be 7,682 tonnes of CO_2e. This is a worst-case estimate as it does not make any allowance for decarbonisation of the road vehicle fleet through the lifetime of the Development (e.g. the uptake of low or zero emission electric, hydrogen or hybrid HGVs).

Energy Offset

7.6.16 The energy generated by the Facility can be used to replace energy that would otherwise be generated by other sources, including fossil natural gas combustion. The net electricity production of the Facility will be 10 Mwe for 8,000 hours per year (see Table 7.4). This is the gross electricity production (11.8 Mwe) minus the parasitic load (1.8 Mwe). This gives a total electricity production value of 80,000 megawatt-hours per year (MWh/year). Ofgem data[32] shows the average UK domestic electricity consumption in 2,900 kWh per annum per household, therefore the electricity generated by the Development is sufficient to power over 27,000 homes.

7.6.17 The Development will therefore generate 80,000 MWh/year of electricity that will be exported to the grid (Local Distribution Network). Importantly this electricity replaces energy generated by other sources i.e. if the Development does not provide 80,000 MWh per year of electricity, it would need to be generated by other means such as fossil fuel (e.g. natural gas) combustion. Therefore the GHG emissions associated with generation of this energy by other means can be calculated as a GHG offset.

7.6.18 A GHG offset calculation has been undertaken which considers the current carbon intensity of the UK energy grid, which is predominated by natural gas power, with the remainder comprising nuclear, renewables which include wind, solar, hydro and bioenergy (including biomass) and a small contribution from oil, coal and energy from waste. The calculation takes account of decarbonisation of the UK energy grid through the Development's lifetime i.e. accounts for reductions in energy generation from coal, oil and gas and increased contributions from nuclear, wind and solar which means that the carbon offset is lower each year between the opening year and final year of operation as lower emissions energy sources provide a larger share of UK energy.

7.6.19 The energy offset calculation is presented in detail in Appendix 7.2. It is estimated that the Development will offset 19,672 TCO_2e in the opening year (2022) and 205,300 TCO_2e over its 25-year lifetime.

7.6.20 The technical capability to offtake the heat is currently embedded in the design of the Facility, however, at present, there is no available supply chain. This is actively being explored by the Operator at present. The Development is an active member of the Clean Growth Hub in the region and is receptive to developing clean offtakes when the supply chain emerges.

Total GHG Emission Footprint

7.6.21 Table 7.11 summarises the net GHG emissions for the Development in the assessment year for each footprint element. The GHG emissions from the construction phase are annualised based on the two-year construction period. Annualising the construction GHG emissions allows them to be compared on a like-for-like basis to the operational GHG emissions which are reported on a per annum basis.

Table 7.11: GHG Footprint for the Development

Development Phase	Footprint Element	Tonnes of CO_2e		
		Baseline	Assessment Year (2022)	Lifetime Emissions (assumed 25 year operation)
Construction	Embodied	0	5,000	10,000
	Transport	0	9,708	19,417
Operation	Repair, Maintenance and Refurbishment	0	248	6,220
	Facility Emissions	0	4115	102,875
	Ancillary Plant Emissions	0	441	11,025
	Transport	0	320	7,682
Total		**0**	**19,833**	**157,198**
Grid Electricity Offset		0	-19,672	-205,300
Net Total Emissions		0	160	-48,102

7.6.22 Table 7.11 shows that the GHG emissions in the assessment year (taking into account both operational and construction related GHG emissions) is calculated as 19,833 tonnes CO_2e, and 157,198 tonnes CO_2e over the lifetime of the Development.

7.6.23 When the grid electricity offset is considered, the net change in GHG emissions is 160 tonnes in the opening year (i.e. the opening year grid offset is sufficient to offset nearly all the construction phase and first year operational phase emissions) and a saving of -48,102 tonnes CO_2e over the lifetime of the Development.

Assessment of Effects

7.6.24 The assessment of the significance of the GHG emission is informed through IEMA Guidance[16] detailed in Section 7.3 and follows a 2-step process detailed below.

Step 1: Establish Context

7.6.25 The GHG emissions from the Development are compared to national and local CO_2e totals to establish context.

7.6.26 Table 7.11 shows that the net emissions over the lifetime of the Development are negative, and as such, there will be an overall reduction in GHG emissions as a result of the Development. It is, however, acknowledged that the reduction will likely occur on a national spatial scale, rather than a local spatial scale. Nonetheless, whilst the reductions may not occur within the Vale of Glamorgan itself, the Development will offset GHG emissions nationally, by replacing the dependency on grid electricity and the production of greener electricity.

National

7.6.27 The UK and devolved administrations have legislated a 2050 net zero target following recommendations and analysis completed by the CCC[20]. To meet this target the CCC sets carbon budgets to define a pathway to net zero. Within these pathways the CCC consider biomass as a net zero energy source. The Welsh government have recently increased their target to net zero in line with the CCC's latest recommendations[5].

7.6.28 In addition, the Welsh Government has set a target to achieve 70% of Wales' electricity generation using renewable sources (which includes biomass power) by 2030[12].

7.6.29 As shown in Table 7.11, the Development results in a net reduction in GHG emissions nationally, both in the year of opening and across its lifetime. This means that within the pathway to net zero it can contribute to a reduction in national emissions and contribute to the Welsh Government's 2030 renewable electricity target, by providing energy that would otherwise be generated by more carbon intensive forms such as natural gas.

7.6.30 Retrofit of Carbon Capture Storage (CCS) technology on the Development before the end of its lifetime will further improve the potential net GHG emission savings (e.g. negative emissions) associated with the Development.

Local

7.6.31 Government-published GHG emissions by local authority[33] show the CO_2 emissions for the Vale of Glamorgan in 2019 (the latest published year) were 1,116 kilo tonnes CO_2. When considering the net emissions and accounting for grid electricity offset, the Development results in a net reduction in emissions over its lifetime. However, as discussed in Paragraph 7.6.26 the net reduction in GHG emissions will be experienced nationally and not locally and therefore it is appropriate to contextualise the emissions before grid offset with the Vale of Glamorgan's GHG emissions.

7.6.32 On this basis, comparing the Development's assessment year gross emission (19,833 TCO_2e) with the local authority emissions (1,116 kilo tonnes CO_2) shows that they would represent 1.8% of this 2019 total. Even accounting for emissions from the Vale of Glamorgan falling by 2022, the Development would still remain a small component of local emissions. It should also be noted that the Development's opening year GHG footprint includes all emissions from embedded carbon and from transport (during construction) which occurs nationally (i.e. is not restricted to the Vale of Glamorgan). This comparison is therefore very conservative.

Step 2: Determine Significance

7.6.33 Significance of effects is established through applying the criteria detailed in Table 7.7. This requires judgments on:

- Step 2a: The consistency of the Development with national, regional and local policies designed to limit GHG emissions and meet the UK's net zero target; and
- Step 2b: The robustness, timeliness and efficacy of mitigation measures proposed to avoid, reduce and compensate GHG.

7.6.34 Each is considered further below.

Step 2a: Consistency of the Development with National and Local Policies

National

7.6.35 In terms of future emissions, the CCC[18] has established a "balanced net zero pathway" which considers feasible and cost-effective policy and technology interventions to ensure the UK can meet its new net zero target.

7.6.36 For power generation under this scenario, the CCC consider that 100% of power generation by 2050 will be low carbon and for ground transport it forecasts that all ground transportation (apart from small number of HGVs) will be electrically powered. The CCC therefore forecast that power and ground transportation sectors are largely decarbonised by 2050 with any residual emissions removed through technical and or natural means.

7.6.37 It is therefore reasonable to assume that national policy measures will ensure that energy and transport emissions relating to the Development will be decarbonised consistent with the UK's net zero target. The recent Government announcement bringing forward the ban on sale of new vehicles that are not electrically powered to 2030 is an example of policy that is being developed. The Department for Transport's (DfT) strategy for decarbonising transport[34] sets targets of 2035 and 2040 to cease the sale of non-zero-emission HGVs. It is therefore expected that rollover of the haulage fleets operated by the Development's supply chain will be largely decarbonised by the end of the Development's life.

7.6.38 Importantly, the Development results in the generation of zero carbon electricity that is supportive of national and Welsh policies to meet the UK and Welsh Climate Change Target to be net zero by 2050. Specifically, this includes:

- providing a net GHG saving over its lifetime when considering grid electricity offsets, which assists on the transition to net zero and the Welsh Government's target to achieve 70% renewable electricity generation by 2030;
- the Development is CHP-ready and has been designed to allow future heat offtake; and
- the Development is CCS ready, allowing it to be retrofitted with CCS technology in the future to capture its residual carbon emissions, subject to economic viability and commercial feasibility.

7.6.39 In terms of planning policy the Development meets the requirements of Welsh Planning Policy[16] which provides explicit support for developments that will generate renewable low carbon energy. Furthermore, Welsh strategic planning policy as set out in Future Wales, the National Plan 2040[12] states that: "*The Welsh Government strongly supports the principle of developing renewable and low carbon energy from all technologies and at all scales to meet our future energy needs. In determining planning applications for renewable and low carbon energy development, decision makers must give significant weight to the need to meet Wales' international commitments and our target to generate 70% of consumed electricity by renewable means by 2030 in order to combat the climate emergency."*

Local

7.6.40 Policy MD2 of the Local Development Plan specifies that *"development proposals should…Mitigate the causes of climate change by minimising carbon and other greenhouse gas emissions associated with their design, construction, use and eventual demolition, and include features that provide effective adaptation to, and resilience against, the current and predicted future effects of climate change".*

7.6.41 As is discussed in 7.6.31 and 7.6.32, the emissions from the Development are small in the context of local emissions totals, but when the grid electricity offset is considered, is expected to lead to a net reduction in GHG emissions in the opening year and over the lifetime of the Development. By providing this potential net benefit, it is judged that the Development complies with Policy MD2 in relation to minimising GHG emissions.

7.6.42 Discussion on the Development in relation to climate change adaptation and resilience is provided in Part B of this Chapter.

7.6.43 Policy MD19 relates to low carbon and renewable energy generation and states that:

"Proposals for the generation of low carbon and renewable energy will be permitted where it can be demonstrated that there is no unacceptable impact on the interests of:

- *Best and most versatile agricultural land;*
- *Aviation safeguarding;*
- *Electrical, radio or other communication systems;*
- *Landscape importance;*
- *Natural and cultural heritage;*
- *Nature conservation;*
- *Residential amenity; and*
- *Soil conservation."*

7.6.44 The Development has been assessed through the ES and no adverse effects on these issues, and the planning permission granted in 2015 (and the appeal in 2010) confirms that VoGC accepted the principle of Development.

Step 2b: Robustness, Timeliness and Efficacy of Mitigation

7.6.45 The principles of the IEMA Guidance are that where GHGs cannot be avoided, that mitigation should be provided to minimise GHGs. Mitigation measures adopted by the Development are described for each element of the GHG footprint.

Construction

7.6.46 Mitigation measures that were adopted by the Development to minimise GHG emissions during the construction phase are described in Section 7.5.

Operation

Energy Efficiency

7.6.47 The Development achieves a high level of energy efficiency, which meets the BAT requirements required by the Industrial Emissions Directive. Beyond the efficient design of the gasification technology installed within the Development, further measures contribute to the overall energy efficiency of the facility as described in Paragraph 7.5.3.

7.6.48 The Permit for the Development requires the following performance enhancement measures with respect to energy efficiency:

"take appropriate measures to ensure that energy is recovered with a high level of energy efficiency and energy is used efficiently in the activities;

review and record at least every four years whether there are suitable opportunities to improve the energy efficiency of the activities; and

take any further appropriate measures identified by a review.

The operator shall provide and maintain steam and/or hot water pass-outs such that opportunities for the further use of waste heat may be capitalised upon should they become practicable.

The operator shall review the practicability of Combined Heat and Power (CHP) implementation at least every 2 years. The results shall be reported to Natural Resources Wales within 2 months of each review."

Efficient Use of Raw Materials

7.6.49 The Permit for the Development requires the following performance enhancement measures with respect to efficient use of raw materials:

"take appropriate measures to ensure that raw materials and water are used efficiently in the activities;

maintain records of raw materials and water used in the activities;

review and record at least every four years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use; and

take any further appropriate measures identified by a review."

Avoidance, Recovery and Disposal of Wastes

7.6.50 The Permit for the Development requires the following performance enhancement measures with respect to avoidance, recovery and disposal of wastes produced by the Development:

"the waste hierarchy referred to in Article 4 of the Waste Framework Directive is applied to the generation of waste by the activities;

any waste generated by the activities is treated in accordance with the waste hierarchy referred to in Article 4 of the Waste Framework Directive; and

where disposal is necessary, this is undertaken in a manner which minimises its impact on the environment.

The operator shall review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by a review."

Transport

7.6.51 A Green Travel Plan (GTP) was prepared to discharge Condition 29 of the 2015 Permission (included in Appendix 3.10). This presents a series of measures that have been secured, and thus will be delivered as part of the Development, and potential, which are additional measures that could be investigated should the secured measures not deliver the mode share targets outlined in the GTP. Provisional mode share targets have been set for car drivers, which aims to reduce single private journeys by 5% by Year 3 and 10% by Year 5. The GTP has been developed to *"seek to influence modes of travel to the Site, rather than merely predicting travel patterns and providing mitigation".* The main objectives of the GTP are:

- To remove travel as a barrier to social inclusion;
- Discourage the use of unsustainable modes of transport and enable staff to make travel choices that benefit themselves and their community;
- Raise awareness of alternative modes of transport and thus encourage a modal shift towards more sustainable travel modes;
- Minimise single car occupancy and total staff vehicle kilometres;
- Zero transport accidents on Site;
- Create a positive effect on local traffic volumes; and
- Create a positive effect on the local environment, particularly in terms of vehicle kilometres and vehicle emissions.

7.6.52 The GTP sets out a number of measures that will be facilitated by the appointment of a Travel Pan Co-ordinator (TPC) and through monitoring and surveys, as follows:

Measures to Encourage Walking

- High quality pedestrian provision including internal footways (Secured);
- Changing facilities and lockers (Secured);
- Showers (Secured);
- Drying area for clothes (Secured);
- Staff kitchen (Secured);
- Staff induction to include Active Travel (Secured);
- New road sign (Secured);
- Additional pedestrian signage (Potential);
- Financial incentives for walkers (Potential);
- Free or subsidised wet weather/high vis clothing (Potential);
- Walking clubs (Potential);
- Events to encourage walking (walkers' breakfast first Wednesday of the month etc.) (Potential); and
- Personalised travel planning (Potential).

Measures to Encourage Cycling

- Secure, lit, covered cycle parking close to entrances (Secured);
- Good on-site lighting (Secured);
- Lockers for staff (Secured);
- Showers and changing facilities (Secured);
- Staff kitchen (Secured);
- Staff induction to include Active Travel (Secured);
- Salary sacrifice tax-free cycle purchase scheme for staff (cycle2work) (Secured);
- Financial incentives for cyclists (e.g. mileage rate for work related journeys) (Potential);
- Free or subsidised wet weather/high vis clothing (Potential);
- Bicycle user group (BUG) (Potential);
- Training for those who are not confident cyclists (Potential);
- Provision of, or payment for, bike maintenance (possibly on site as part of course) (Potential);
- Negotiated discount with local bike shop – additional special rate for folding bikes (Potential);
- Interest free bike loan for staff (Potential);
- Facilities for e-bike charging (subject to demand) (Potential); and
- Events to encourage cycling (cyclists' breakfast first Wednesday of the month etc.) (Potential).

Measures to Encourage the Use of Public Transport

- Policy to state that all staff are expected to use public transport for work related journeys where this is a realistic option (Secured);
- Marketing – promoting the use of public transport in all written and electronic material (Secured);
- Bus routes and timetable information available to all staff (Secured);
- Financial incentives for bus/train users (e.g. mileage rate for work related journeys) (Potential);
- Interest free season ticket loans for annual season tickets for staff (Potential);
- Discount on bus/train season tickets (Potential);
- Travel pack (including bus routes and bus/train timetable info) (Potential); and
- Personalised travel planning.

Measures to Reduce Impact of Car Travel

- Active promotion of car share (Secured);
- Restricted on-site car parking provision (Secured);
- On-site parking for disabled drivers (Secured);
- On-site parking provision for powered two-wheelers (Secured);

- Policy to state that all staff are expected to use public transport for work related journeys where this is a realistic option (Secured);
- Marketing – promoting the use of sustainable transport in all written and electronic material (Secured);
- Permits issued on basis of need (Potential);
- Financial incentives for sustainable transport users (e.g. preferential mileage rate for work related journeys) (Potential);
- Guaranteed taxi home (if required) for car sharers (Potential);
- Reduced rate at local car-hire company (Potential); and
- Personalised travel planning (Potential).

Mitigation Summary

7.6.53 Table 7.12 sets out an assessment of the Development's approach to mitigation against the mitigation principles described in IEMA Guidance.

Table 7.12: Development Approach to Mitigation in Accordance with IEMA Mitigation Principles

Development Phase	Mitigation Measures
Construction	Good and best practice approach adopted that minimised materials with high embodied carbon. Best practice measures that minimised GHGs from construction activities. Implementation of PEP and CPP measures that minimised construction journeys and on-site emissions.
Operation - Energy Efficiency	In securing a Permit from NRW, the Development has been demonstrated to meet BAT in terms of energy efficiency, and the Permit includes measures to monitor and improve efficiency where possible, especially in relation to future heat offtake. This will ensure the benefits of the Development in terms of maximising usable energy are improved with time. Meeting BAT for energy efficiency represents robust and effective mitigation for a development of this type.
Operation – Transport	Implementation of GTP with best practice measures to promote use of sustainable transport modes. The GTP has been approved by Vale of Glamorgan Council in discharge of Condition 29, demonstrating its robustness and efficacy.
Operation – On-Site Emissions	Development provides a potential for net negative GHG emissions in the opening year and over its lifetime. This is due to the provision of biomass power avoiding emissions from power generation elsewhere. The net negative emissions in the opening year event account for the construction phase emissions, and therefore are timely and effective.

Summary of GHG Assessment

7.6.54 The assessment of significance has followed a 2-step process consistent with IEMA Guidance and is summarised below in Table 7.13.

Table 7.13: Assessment of Significance

Step	Description	Assessment
Step 1	Context	The Development has the potential to result in a net reduction in GHG emissions nationally over the course of its lifetime. In a local context, the gross emissions represent a small (less than 2%) component of local carbon emissions.
Step 2	Consistency with National and Local Policy	The Development has been considered in relation to national and local policy and found to be compliant with all relevant policies and supportive of national and Welsh targets to be net zero by 2050.
	Robustness, timeliness and efficacy of mitigation	The Facility has been designed to safeguard for future heat offtake and retrofit of CCS technology. The facility meets the requirements of BAT in terms of energy efficiency and has secured the approval of NRW in issuing a Permit to operate. Transport plans are in place to minimise and avoid transport emissions. Overall it is judged that mitigation measures are proposed in accordance with IEMA guidance.

7.6.55 As evidenced through the calculation of negative net emissions, the Development will be better than net zero over the lifetime of the Development and will result in a very small residual emission in the opening year, even accounting for all of the construction phase emissions. Based on Table 7.11 and with reference to IEMA's significance criteria (see Table 7.7), the effects would be described as beneficial.

7.6.56 However, it is acknowledged that there are a number of uncertainties associated with the assessment, including emission factors, grid offset values (e.g. the rate at which the energy supply sector will decarbonise) and embedded carbon related to the construction of the Development. The influence of uncertainty is that it might reduce the observed net benefit over the lifetime of the Development.

7.6.57 As such, to ensure a conservative assessment, it is judged that the net lifetime GHG effects of the Development is **beneficial**, but in line with IEMA guidance would be negligible and not significant.

Mitigation, Monitoring and Residual Effects

7.6.58 No additional measures are assumed to be taken forward at this stage and therefore the residual effects remain as stated above (net GHG saving that is beneficial, but negligible and not significant).

7.6.59 However, there are a number of additional measures that have not been accounted for in the assessment as it assumes a worst case. These include heat offtake, the fate of fly ash and APCRs and the future of bioenergy with carbon capture and storage (BECCS). These further measures are discussed further in turn below.

Heat offtake

7.6.60 The technical capability to offtake the heat is currently embedded in the design of the Facility. Development is an active member of the Clean Growth in the Region and is receptive to developing clean offtakes when the supply chain emerges.

7.6.61 The vast majority of heat for domestic and commercial land uses in Wales is natural gas, which provides a significant challenge to decarbonising the economy and reaching net zero goals. Use of heat from the Development can displace the use of natural gas for heating and therefore contribute to the pathway to net zero.

7.6.62 Greenhouse Gases (GHG) saved from heat provided by the Development that would otherwise be generated by fossil natural gas combustion would further increase the potential net GHG benefits of the Development described in Table 7.12. This would not materially affect the assessment of significance and the level of GHG offset would be dependent on the amount of heat supplied, which is not currently known, so has not been quantified in this assessment.

Fly Ash and APCR

7.6.63 In order for the fly ash to be recycled, its chemical composition needs to comply with certain requirements, determined through testing and analysis. Currently, the Facility has not been operational to enable the testing requirements to be met. The Permit includes conditions (Table S3.5) requiring compositional analysis of fly ash and APCR.

7.6.64 Subject to testing which confirms the fly ash material is non-hazardous (as indicated to date), fly ash would be taken to a facility in for re-use as recycled aggregate material. Treatment and re-use options are also being explored by the Appellant for APCR. Further details are provided in Appendix 3.16: Waste and Materials Note.

7.6.65 If these by products are recycled, they would most likely be used as a cementitious material for use in concrete manufacture. This would reduce the GHG intensity of the concrete which otherwise uses Portland cement which has high GHG emissions from the manufacturing process. These potential GHG offsets have not been quantified, and would likely be small in the context of the overall GHG footprint, and would not materially affect the assessment of significance.

Carbon capture

7.6.66 Carbon Capture and Storage (CCS) is the process of capturing CO_2 in the exhaust gases of the Development, and permanently storing them to prevent their return to the atmosphere. In the current biomass lifecycle, the source of the biomass absorbs CO_2 from the atmosphere as it grows, which is returned to the atmosphere when it is combusted (which is why it is considered net zero in terms of CO_2 emissions). By installing CCS on biomass facilities, a large portion of the CO_2 absorbed by the biomass during growth could be permanently sequestered, resulting in a net removal of CO_2 from the atmosphere. CCS technology is well developed, but not yet economically viable, but this is likely to change in the future as part of efforts to meet net zero targets.

Summary

7.6.67 Once fully operational, these options will be explored further by the operator. As set out above, should they be taken forward they would lead to the further reduction of the carbon footprint associated with the Development over the course of its lifetime and could improve the net benefits of the Development in terms of GHG emissions.

7.7 Cumulative Effects

7.7.1 The ES has identified a number of cumulative schemes for consideration in the assessment, as set out in Chapter 3: EIA Methodology and Appendix 3.2.

7.7.2 GHG emissions from all projects will contribute to climate change globally, not just locally. As set out in the IEMA guidance[16]: *"Effects of GHG emissions from specific cumulative projects therefore in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other".* This statement relates to 'cumulative' on a global scale. The definition of 'cumulative effects' in the context of GHGs and climate change therefore goes far beyond the typical definition of cumulative effects for EIA, which tends to focus on other proposed projects in the vicinity of the proposed Development.

7.7.3 It is therefore not considered necessary or appropriate to quantify GHG emissions from the cumulative schemes in this assessment as the assessment itself is intrinsically cumulative.

Table 7.14: Summary of Residual Effects

Effect	Receptor (Sensitivity)	Geographic Scale	Temporal Scale	Magnitude of Impact	Mitigation and Monitoring	Residual Effect
Construction (Retrospective) and Operational						
Whole Life GHG Emissions	Not Applicable	Global	Permanent	Negligible	N/A	Beneficial (Not Significant)
Cumulative Effects						
Whole Life GHG Emissions	Not Applicable	Global	Permanent	Negligible	N/A	Not Significant

Part B: Resilience to Climate Change

7.8 Assessment Methodology

7.8.1 This part of the chapter provides a qualitative assessment of the resilience of the Development to climate change. The assessment methodology takes into account the recommendations in the IEMA EIA guide to Climate Change Resilience and Adaptation[17] and has been adapted to ensure the assessment is proportionate to the Development.

Establishing Baseline Conditions

7.8.2 The assessment of resilience of the Development to the impacts of climate change was informed by regional scale information on historic and projected change in climate variables, and other studies undertaken relevant to the Development.

7.8.3 The future baseline conditions were defined by potential climate risks identified in the UK Climate Change Risk Assessment[35] and the Key Climate Projections: Headline Findings[36] produced by the Met Office UK. These are based on the latest UK climate projection dataset (UKCP18).

Identifying Likely Significant Effects

7.8.4 It is standard practice in EIA to distinguish between construction and operational effects of the development on the environment. The Resilience to Climate Change assessment, however, is required to establish any significant effects of climate change on the Development. The focus of the assessment is, therefore, in the future when it is anticipated that changes from the existing climate will have occurred, and these may pose risks in relation to the operational function of the Development.

7.8.5 In terms of mitigation to climate change, this is principally a function of the design which needs to anticipate future risks and build in appropriate adaptation measures as required. There is, therefore, an important focus on embedded measures to address future climate change.

7.8.6 The assessment therefore starts by establishing potential receptors, potential climate risks and considers the significance of that risk through an assessment of likelihood and consequence, taking into account embedded design measures.

7.8.7 As a further step the assessment identifies additional mitigation, as required, to address any significant effects and concludes on the residual risks.

7.8.8 The assessment does not explicitly consider climate risks during the construction period, since this has already occurred, and thus risks associated with climate change were well established and managed through standard practices.

7.8.9 Climate change by its nature occurs over many decades and future changes, as modelled by UKCP18, consider climate change in the 2050s and beyond. The focus of the assessment is, therefore, of the completed Development and the risks it may face due to future climate change in the context of design measures that are adopted during the construction phase and any additional operational measures that may be required in the future.

7.8.10 The assessment is carried out over four-steps, as follows:

Step 1: Identify Receptors

7.8.11 During this stage, relevant receptors in the Development which may be affected by climate change (e.g. change in average weather conditions and extreme events) are identified.

Step 2: Identify Potential Impacts of Climate Change on Receptors and Confirm Embedded Mitigation

7.8.12 This stage comprises identification of potential impacts of changes in a range of climate variables on the receptors identified in Step 1. This is undertaken using professional judgement with reference to supporting literature, and identifies the design measures to mitigate the impacts.

Step 3: Assess the Significance of Effects of Climate Change on Receptors

7.8.13 This step assesses the significance of each hazard (using definitions in Table 7.17) based on scoring the likely consequence and likelihood of that hazard arising, using a five-point scale described in Table 7.15 and Table 7.16. The assessment of significance and scoring of likelihood and consequence are based on IEMA 2020 guidance[31].

Table 7.15: Qualitative Description of Consequence

Measure of Consequence	Description
Negligible	No damage to the Proposed Development, minimal adverse effects on health, safety and the environment or financial loss. Little change to service and disruption lasting less than one day.
Minor Adverse	Localised disruption or loss of service. No permanent damage, minor restoration work required: disruption lasting less than one day. Small financial losses and/or slight adverse health or environmental effects.
Moderate Adverse	Limited damage and loss of service with damage recoverable by maintenance or minor repair. Disruption lasting more than one day but less than one week. Moderate financial losses. Adverse effects on health or the environment.
Large Adverse	Extensive damage and severe loss of service. Disruption lasting more than one week. Early renewal of 50-90% of the Proposed Development. Permanent physical injuries and/or fatalities. Major financial loss. Significant effect on the environment, requiring remediation.
Very Large Adverse	Permanent damage and complete loss of service. Disruption lasting more than one week. Early renewal of the Development >90%. Severe health effects or fatalities. Extreme financial loss. Very significant loss to the environment requiring remediation and restoration.

Table 7.16: Qualitative Description of Likelihood

Measure of Likelihood	Description (Assuming 25-year Lifetime)
Very High	The event occurs multiple times during the lifetime of the Development e.g., approximately annually.
High	The event occurs several times (approximately 12 events) during the lifetime of the Development.
Medium	The event occurs limited times (approximately 4 events) during the lifetime of the Development.
Low	The event occurs once during the lifetime of the Development.
Very Low	The event may occur once during the lifetime of the Development or may not occur at all.

7.8.14 These determinants are combined to assess the significance of effects on receptors, as shown in Table 7.17. The assessment is qualitative and based on expert judgment based on knowledge of similar schemes, engagement with the wider Project Team and a review of relevant literature.

7.8.15 The assessment of significance takes embedded mitigation into account. Embedded mitigation is identified through consultation with the Project Team.

Table 7.17: Significance Rating Matrix

Likelihood of Hazard Occurring	Consequence of Hazard Occurring				
	Negligible	Minor Adverse	Moderate Adverse	Large Adverse	Very Large Adverse
Very High	Not significant	Significant	Significant	Significant	Significant
High	Not significant	Significant	Significant	Significant	Significant
Medium	Not significant	Not significant	Significant	Significant	Significant
Low	Not significant	Not significant	Not significant	Significant	Significant
Very Low	Not significant	Not significant	Not significant	Not Significant	Not Significant

Step 4: Establish further adaptation measures and determine residual effects

7.8.16 In the fourth step, further adaptation measures for any significant effects are identified through expert opinion based on knowledge of similar schemes and consultation with the project team and any residual effects of climate change on the receptors are assessed using Table 7.15 to Table 7.17.

Geographical Scope

7.8.17 The study area for climate resilience, unlike other disciplines, focuses on the impact that climate will have on the Development (as opposed to the impact of the Development on the environment). The study area is, therefore, the footprint of the Development, split into its constituent parts (receptors).

7.8.18 The geographical scope of the climate projections that are used to define the future baseline are projections from UKCP18 for Wales.

Temporal Scope

7.8.19 IEMA guidance[16] advises that UKCP18 for the 2080s be used to inform assessments, using the Representative Concentration Pathway (RCP) 8.5 projections (high emissions scenario).

7.8.20 Based on the Development's anticipated lifetime, there is little justification to use 2080 projections for this assessment, and more relevant 2030-2049 projections have been used. The use of the high emissions scenario RCP8.5 projections ensures the assessment is conservative.

Assumptions & Limitations

7.8.21 This assessment provides a broad indication of the potential impacts of climate change on the Development based on a qualitative assessment and professional judgement using knowledge of similar schemes. The UKCP18 projections are the most up-to-date projections of climate change for the UK.

7.8.22 UKCP18 provides probabilistic projections of future climate for a range of emissions scenarios. Future GHGs emissions, and resulting pathway, is uncertain. A precautionary approach, consistent with IEMA guidance[16] has therefore been adopted here by selecting a high emissions scenario (RCP8.5).

7.8.23 The embedded adaptation measures are based on information provided by the Project Team. The determination of significance has been undertaken under the assumption that industry design standards will be adhered to where detailed design information is unavailable.

Consultation

7.8.24 No consultation is required for the climate resilience assessment. All data required for the assessment is publicly available. There are no statutory or non-statutory consultees for climate change.

7.9 Baseline Conditions

Existing Conditions

7.9.1 Table 7.18 sets out the current understanding of climate hazards within the Site, based on the assessments within the relevant technical chapters and the Vale of Glamorgan Corporate Risk Register.

Table 7.18: Current Climate Change Hazards

Climate Risk	Current Baseline
Tidal Flood Risk	A Technical Note on Drainage and Flood Risk (Appendix 3.14) has been prepared by SLR Consulting for the Development. This concludes that the present-day tidal flood risk is low, as the elevation of the Site (7.9-9.5 m AOD) would only be at risk of flooding in a 1 in 1,000-year event (tidal level of 8.56m AOD).
Drought	The local area is not known to be suffering significant water stress. Welsh Water operate a drought plan[37] to prevent and limit the effects of serious drought in the area.
Extreme weather events	There are a number of extreme weather event risks that affect The Vale of Glamorgan, such as: ▪ heatwaves; ▪ storms & gales; and ▪ low temperature & heavy snow.

7.9.2 There has been a significant human influence on the observed warming in the UK annual temperature since 1950. Statistical results from extreme value analysis suggest that the UK daily maximum and minimum temperature extremes have increased by just over 1°C since the 1950s, and that heavy seasonal and annual rainfall events have also increased.

7.10 Future Baseline

7.10.1 Climate modelling completed by the meteorological office (UKCP18)[33] is forecasting drier hotter summers, warmer wetter winters and more frequent extreme weather events due to climate change.

7.10.2 At the same time, there are upward trends in rainfall across the UK. Higher levels of winter rainfall have been experienced often in increasingly heavy rainfall events leading to more flooding and damage to buildings and infrastructure. These patterns are consistent with projections of more and heavier rainfall for the UK in a warmer global atmosphere. These changes increase health and safety risks to people and the built environment, increasing costs and disruption for repair and adaptation.

7.10.3 Five key climate risks are identified, as follows; Hotter Summers with extreme Temperatures (Heatwaves); Wetter Winters including Extreme Rainfall; Drier Summers including Drought; increased Wind and Storms; and Sea Level Rise and Tidal Flooding, which are considered in this assessment.

7.10.4 Information on predicted UK climate is taken from the UK Climate Projections were available[36]. UKCP18 are the most up-to-date projections of climate change for the UK. The projections include probabilistic projections of a range of climate variables for different emissions scenarios, known as Representative Concentration Pathways (RCPs), over a range of time slices.

7.10.5 In this section, the central estimate (50th percentile) projections for high emissions scenario (RCP8.5) are presented. The high emissions scenario was used to adopt a 'worst-case' estimate of climate projections. These are summarised in Table 7.19.

Table 7.19: Climate Projections for Wales Based on UKCP18 - RCP8.5 (50th Percentile)

Climate Risk	2030 - 2049
Mean Winter Rainfall	+ 6%
Mean Summer Rainfall	- 14%
Mean Summer Temperature	+ 1.4C
Mean Winter Temperature	+ 1.2C
Sea Level Change (Cardiff, 2050)	+ 0.39m[1]

7.10.6 Extreme weather events are considered for the Development. Climate change predictions indicate increasingly erratic weather pattern that are likely to lead to extreme weather events.

Snow

7.10.7 According to UKCP18 projections, a decrease in both falling and lying snow across the UK relative to the 1981-2010 baseline is expected by the end of the century. In general, the decreases are largest in low-lying/coastal regions such as Barry.

Wind

7.10.8 There are no compelling trends in storminess, as determined by maximum gust speeds, from the UK wind network over the last four decades. UKCP18 projections over the UK show an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant effects of wind are experienced. This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is modest compared to inter-annual variability.

7.11 Assessment of Climate Resilience

7.11.1 The assessment has followed the 4-step process identified earlier, as detailed further below.

Step 1: Identify Receptors

7.11.2 The key receptors identified are:

- the facility;
- the workforce; and
- users of energy generated by the facility (customers).

[1] The Flood Risk Assessment[37] adopts a similar estimate of 0.37 m increase in extreme sea level by 2047, following analysis of Welsh Government and Environment Agency allowances.

Step 2: Identify Potential Impacts of Climate Change on Receptors and Embedded Mitigation

7.11.3 A number of potential impacts were identified. The Project Team were consulted regarding the potential risks inherent to the Development's design. The results are detailed in Table 7.20 below.

Table 7.20: Climate Risks and Mitigation

Climate Variable	Receptor	Potential Impact	Design Measures to Mitigate Impacts
Hotter Summers Extreme Temperatures (Heatwaves)	The Facility	Heat damage to site infrastructure and equipment Fire risk Increased odours	Likely extremes of ambient temperature within tolerances of facility equipment. More frequent infrastructure (e.g. concrete hard standing) repairs may be necessary. Ambient temperatures unlikely to be high enough to trigger a fire directly, and wood is all contained inside in the Fuel Storage and Feed Building where it is not exposed to direct sunlight. Comprehensive Fire Prevention and Mitigation Plan in place as part of Permit. Waste wood has low odour potential, and will be stored in the Fuel Storage and Feed Building which includes roller shutter doors and a dust extraction system to prevent fugitive releases. The Development does not require an odour management plan to operate as it is suitably low-risk.
	Workforce	Heatstroke	Main working areas internal so no/minimal working in direct sunlight. Staff areas ventilated and access to drinking water.
Wetter Winters Extreme Rainfall	The Facility	Weathering of site infrastructure and equipment Surface water flooding	Most equipment housed within buildings to protect from damage. More frequent building/infrastructure repairs may be necessary. The Development surface drainage system has been designed to allow for 40% increase in rainfall event intensity[36].
Drier Summers	The Facility	Disruption to operation from	Water tank on site has capacity for resilience to periods of drought.

Drought		lack of water supply.	
Wind and Storms	The Facility	Wind damage to site infrastructure and equipment. Disruption to supply chain due to road network issues associated with storms.	Key equipment and infrastructure is housed within the main building to protect against wind damage, and biomass is stored internally within the Fuel Storage and Feed Building. The Facility has capacity in the Fuel Storage and Feed Building to store biomass fuel prior to use in the Facility, to ensure resilience to short term supply chain issues. Deliveries of products (urea, lime, diesel etc.) are relatively infrequent and there is storage capacity on Site to overcome likely supply chain issues.
	Customers	Disruption in electricity supply	Electricity is supplied to the Local Distribution Network so disruption at the Development would not directly affect customer supply.
Sea Level Rise and Tidal Flooding	The Facility	Flooding of the Development causing damage to Site infrastructure and equipment.	Flooding to the Main Process Building and turbine hall would only be experienced to a flood water depth of 0.2 m[36] under the worst-case 1 in 1000 year flood event. This level of flood water would not affect the equipment. The Fuel Storage and Feed Building is positioned on a part of the Site that is 9.27 m AOD and would not be affected by even a 1 in 1,000 year tidal flood event. Flooding is not likely to affect the ability of the Development to generate energy. Tidal flood risk is managed as part of a Flood Emergency Plan for the Development.
	Customers	Disruption in electricity supply	

Step 3: Assess the Significance of Effects of Climate Change on Receptors

7.11.4 Table 7.21 below details the assessment of climate risks identified in Step 2 above. This takes into account projections of future climate change in period up to 2049 and mitigation designed into the Facility.

Table 7.21: Climate Resilience Assessment

Climate Variable	Receptor	Potential Impact	Likelihood	Consequence	Significance
Warmer Winters Hotter Summers Extreme Temperatures (Heatwaves)	The Facility	Heat damage to site infrastructure and equipment	Low	Minor	Not significant
		Fire Risk	Very Low	Moderate	Not significant
		Increased odours	Very Low	Minor	Not significant
	Workforce	Heatstroke	Medium	Minor	Not significant
Wetter Winters Extreme Rainfall	The Facility	Weathering of site infrastructure and equipment	Low	Minor	Not significant
		Surface water flooding	Very Low	Minor	Not significant
Drier Summers Drought	The Facility	Disruption to operation from lack of water supply	Medium	Minor	Not significant
Wind and Storms	The Facility	Wind damage to site infrastructure and equipment	Low	Moderate	Not significant
		Disruption to supply chain due to road network issues associated with storms	Medium	Minor	Not significant
	Customers	Disruption in electricity supply	Low	Minor	Not significant

Sea Level Rise and Tidal Flooding	The Facility	Flooding of the Development causing damage to site infrastructure and equipment	Very Low	Minor	Not significant
	Customers	Disruption in electricity supply	Very Low	Minor	Not significant

Step 4: Establish Further Adaptation Measures and Determine Residual Effects

7.11.5 Table 7.21 above shows that the are no significant effects on the Development due to future climate change and as such no additional mitigation measures are required. The Development will operate in accordance with an Emergency Plan required by the Permit and this is intended as a live document with regular review and update, which can account for changes through the Development's lifetime that might be relevant to climate change.

Residual Effects

7.11.6 The residual effects are in line with those described in Paragraph 7.11.5 and are not significant.

7.12 Cumulative Effects

7.12.1 The EIA has identified a number of cumulative schemes for consideration in the assessment. All cumulative developments have been considered in the identification of cumulative effects from climate change.

7.12.2 The climate vulnerability assessment considers the impacts of climate change on the Development and as such, the receptors for the assessment are the Development and its users. The changes in climate variables described in the baseline section will be experienced by all developments in the vicinity of the Development. However, the potential impacts from climate change may alter as a result of cumulative developments.

7.12.3 Effects associated with flooding and surface water runoff as a result of higher winter rainfall and extreme rainfall events may be exacerbated by cumulative developments which increase the impermeable area in the vicinity of the Development. However, the Technical Note on Drainage and Flood Risk takes account of climate change and cumulative effects so this is not further assessed here.

7.12.4 Effects associated with higher summer temperatures and more extreme temperature events could be exacerbated by cumulative developments if they result in a large increase in hard surface in the vicinity of the Development (urban heat island effect). However, the

Development is already in an urbanised region, and no additional substantial heat island effect is probable based on the cumulative developments considered.

7.12.5 Cumulative effects with respect to climate resilience are therefore not significant.

7.13 Conclusions

7.13.1 The climate resilience measures identified and adopted by the design seek to minimise climate risks due to future climate change.

7.13.2 The assessment has found that the Development is resilient to likely climatic changes within the assumed lifetime of the Facility and the effects are not significant.

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