10. Climate Change

Introduction

10.1 This Chapter reports the outcome of the assessment of likely significant environmental effects arising from the Proposed Scheme in relation to climate change in terms of the contribution of the Proposed Scheme to climate change through the release of greenhouse gas (GHG) emissions, and also the resilience of the Proposed Scheme to climate change.

10.2 The Chapter describes the technical consultation that has been undertaken during the EIA, the scope of the assessment and assessment methodology, and a summary of the baseline information that has informed the assessment.

10.3 In line with **Chapter 2: Approach to EIA**, the assessment reports on the likely significant environmental effects, the further mitigation measures required to prevent, reduce or offset any significant adverse effects, or further enhance beneficial effects. The conclusions are provided both in terms of the residual effects and whether these are considered significant. The assessment of effects takes into consideration both primary and tertiary mitigation (see **Chapter 2: Approach to EIA** for further details) and is informed by the EIA Scoping process (**Appendix 2.1**) and iterative scoping process where applicable. Also, as stated in Chapter 2: Approach to EIA, the assessment of GHG emissions with this Chapter has been mindful of recent case law in respect of carbon assessments, scope of assessments, and the role of the IEMA guidance.

10.4 This Chapter is intended to be read as part of the wider ES with particular reference to the introductory Chapters of this ES (**Chapters 1 – 5**). This chapter is also intended to be read in conjunction with the **Sustainability and Energy Statement**.

10.5 In addition, this Chapter should be read in conjunction with **Chapter 14: Assessment of Cumulative Effects**.

10.6 The terms "carbon", "carbon dioxide (CO_2)", “carbon dioxide equivalent (CO_2e)” and “greenhouse gases (GHGs)" are used interchangeably depending on the terminology of referenced documents.

Summary of Consultation

10.7 No statutory consultee exists in relation to climate change, and as a result no consultation has been undertaken beyond the EIA Scoping process. The general approach to climate change was discussed in one of the general EIA Scoping discussions (as set out in **Chapter 2: Approach to EIA**).

Scope of the Assessment

10.8 As set out in **Chapter 2: Approach to EIA**, the scoping of the EIA and ES has utilised a combination of informal consultation with NPTCBC, culminating in a formal request for an EIA Scoping Opinion in June 2023, supported by an EIA Scoping Report (**Appendix 2.1**). At the point of submission of PAC, an EIA Scoping Opinion from NPTCBC was pending.

10.9 Although the EIA Scoping Report looked to establish the overall framework of the EIA and ES, an iterative scoping process has been adopted in order to respond to the evolving engineering design of the Proposed Scheme. In a similar manner, a number of changes have occurred to the Proposed Scheme since the preparation and submission of the EIA Scoping Report, as set out within **Chapter 1: Introduction** and **Chapter 2: Approach to EIA**. As a result, it has been necessary to review the scope of assessment proposed.

10.10 As such, this section provides a review, validation and update, where necessary, on the scope of the assessment presented within this Chapter.

Effects Not Considered to be Significant

10.11 The following effects were not considered significant as part of the EIA Scoping Report (**Appendix 2.1**) and are not considered further in this Chapter (with detailed justification provided within the EIA Scoping Report):

- Increased risk of flooding;
- Heat stress during construction; and
- Extreme weather.

10.12 Following the EIA Scoping Process, the following additional effect(s) are now not considered significant and the evidence to support this determination is outlined below.

Water availability for site buildings and processes

10.13 All water demand for the process will be met via water abstracted from the Dock, and the process will not therefore be reliant on mains water and hence potential constraints to mains water availability. Also, water is generated as by-product of the ethanol dehydration reaction. This water is cleaned from potential contaminants and re-used within the process as boiler feed water for steam generation and cooling water make-up. This measure significantly minimises the amount of water that is required.

10.14 Potable water efficiency for occupied buildings equivalent to a minimum of 2 credits under BREEAM issue *Wat 01 Water Consumption* is targeted, which requires a 25% reduction on baseline water consumption.

10.15 As a result of these mains water resilience measures in building and process operations, mains water is considered unlikely to have a significant effect on building use and site processes and is not considered further in this chapter.

Summertime overheating in buildings

10.16 Following issue of the EIA Scoping Report, the Applicant has confirmed that dynamic modelling for thermal comfort will be undertaken for occupied buildings in accordance with BREEAM credit *Hea 04 Thermal Comfort*. The assessment will take account of building design and occupation and establish what if any mitigation measures are necessary to ensure suitable internal thermal conditions through the year. Such measures may include glazing design and/or specification, internal / external shading, ventilation and passive / active cooling and will ensure significant effects are avoided.

10.17 As result of these measures summertime overheating in occupied buildings is considered unlikely to be significant and is not considered further in this chapter.

Changes to seasonal weather including temperature and rainfall

10.18 As set out in **Chapter 4: Development Specification**, the Proposed Scheme includes limited on-site landscaping, due to the need to align with operational health and safety requirements, specifically fire risk. The landscaping proposed looks to emulate habitat that is common across the wider dock area, and reflective of the industrial and post-industrial nature of the docks, with corresponding species. The proposed habitat has been selected with relative tolerance to a changing climate, whilst ensuring the habitat is important for key local species. Overall, changes to seasonal weather including temporary and rainfall upon the on-site habitat is considered not to be significant and will not be considered further in this Chapter.

Effects Considered Likely to be Significant

10.19 The following effects (**Table 10.1**) were considered likely to be significant at the EIA Scoping stage and have been assessed and reported within this Chapter:

Table 10.1: Effects Considered Likely to be Significant

Likely Significant Effect	Receptors	Applicable Development Stage
Net GHG emissions	Global climate system	Construction and Operation

10.20 As part of the EIA Scoping Report (**Appendix 2.1**) three effects were considered in relation to GHG emissions – those arising from construction, operation, and then an overall 'net' emission which would also consider the savings realised from the use of the SAF product and Renewable Diesel (RD) co-product, but also the downstream emissions associated with the production of the ethanol feedstock (see *'Assessment Methodology'* for more details). Given the focus on the net emissions, a single level of effect and significance has been reported which considered all GHG emissions collectively. Nonetheless, the direct emissions arising from the construction stage and operational stage of the Proposed Scheme have been reported within the Chapter, in terms of tonnes of carbon dioxide equivalent and corresponding magnitude of change. However, a level of effect and significance has not been reported in isolation, but only for context. Further details on the approach and how emissions associated with each stage are fully accounted for is set out in *'Assessment Methodology'*.

Assessment Methodology

Legislative Framework, Policy and Guidance

10.21 The following guidance has informed the assessment of effects within this Chapter:

- IEMA EIA Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022)[1]; and
- IEMA EIA Guide to: Climate Change Resilience & Adaptation (2020)[2].

10.22 In conjunction with the above, the following legislation and policy have informed the evaluation of the contribution of the Proposed Scheme to the UK's science-based 2050 net zero carbon target as required by IEMA guidance:

National Policy and Legislation

- *The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017*[3] requires consideration of the impact of the Proposed Scheme on climate change, and also the vulnerability of the Proposed Scheme itself to climate change;

- *Planning Policy Wales, Edition 11 (2021)*[4] recognises the vital role that planning has to play in making development resilient to climate change, decarbonising society and developing a circular economy for the benefit of the built and natural environment and to contribute to the achievement of the well-being goals;

- *The Environment (Wales) Act 2016*[5] requires the Welsh Government to reduce GHG emissions in Wales to net zero for the year 2050 and implement a system of interim emissions targets and carbon budgets. Under Section 39 of the Act, Welsh Ministers must prepare and publish a report for each budgetary period setting out their policies and proposals for meeting the carbon budget for that period;

- *Prosperity for All: A Low Carbon Wales (2019)*[6] sets the foundations for Wales to transition to a low carbon nation in order to bring opportunities around clean growth for business, as well as wider benefits for people and the environment;

- *Net Zero Wales Carbon Budget 2 (2021-25) (2021)*[7] represents the next phase in Wales' decarbonisation journey with a new net zero target alongside various policies, proposals and commitments for action across the economy. This report notes that aviation policy is not devolved, and that UK Government must bring forward proposals to drive fuel efficiency, the development of new zero emission aircraft and accelerating the supply and uptake of sustainable aviation fuels (SAF);

- *Future Wales, the National Plan 2040 (2021)*[8] sets out strategy for addressing key national priorities through the planning system including achieving decarbonisation and climate-resilience; and

- The creation of a new body *Net Zero Industry Wales* was announced in March 2022 by the Welsh Minister for the Economy during a visit to Port Talbot Steelworks[9]. It aims to accelerate the decarbonisation of Welsh businesses and industry and support the exploration of new economic growth opportunities by becoming a world-leader in low-carbon manufacturing.

UK Policy

- UK Government's *Net Zero Strategy: Build Back Greener (October 2021)*[10] lays out a commitment for the UK to become a leader in zero-emission flight, kick-starting commercialisation of UK sustainable aviation fuels (SAF) to enable the delivery of 10% SAF by 2030;

- UK Government's *Jet Zero Consultation (July 2021)*[11] further set out the key role that Sustainable Aviation Fuel (SAF) can play in decarbonising aviation whilst also representing an industrial leadership opportunity for the UK, generating between £0.7–£1.6bn Gross Value Added (GVA) per year and creating between 5,000 and 11,000 green jobs;

- The Department for Transport launched the *Advanced Fuels Fund* in July 2022 to support these aims and UK Government's subsequent commitment to have at least 5 commercial scale SAF plants under construction in the UK by 2025 through the allocation of up to £165 million in competitive grant funding. LanzaTech UK Ltd was awarded £24.9 million in December 2022 through the Advanced Fuels Fund for the Proposed Scheme[12];

- The *Renewable Transport Fuel Obligation (RTFO)*[13] supports UK Government policy on decarbonising transport by encouraging the production and use of renewable fuels that do not damage the environment; and

- The *Carbon Budget Delivery Plan*[14] informs Parliament and the public on the Government's proposals and policies to enable carbon budgets to be met. It includes projected GHG emissions savings across UK carbon budgets for a range of Government decarbonisation proposals and policies, including Proposal 145 for the International Aviation & Shipping Sector (IAS) "Increasing the Take Up of Sustainable Aviation Fuels".

Local Policy

- *Neath Port Talbot Local Development Plan 2011-26 (January 2016)*[15] guides the future development of the Neath Port Talbot County Borough. It sets out a range of key issues including 'KI 1' relating to the need to address both the causes and consequences of climate change. Corresponding overarching objective 'OB 1' and Policy 'SP 1 Climate Change' relate to the need to reduce GHG emissions and adapt to climate change through consideration of its effects in the design and location of new development.

Defining the Study Area

10.23 As identified through the EIA Scoping Report (**Appendix 2.1**), the Site forms the principal study area. Nonetheless, as set out within **Chapter 2: Approach to EIA**, the assessment of GHG emissions has considered upstream and downstream emissions associated with the Proposed Scheme, as well as those direct emissions associated with construction and operation of the Proposed Scheme (see *'Assessment Process'* for more details). As such the GHG emissions assessment is not restricted to a specific geographical scale or defined study area.

Background Studies to Inform the ES / Establishing the Baseline

10.24 **Table 10.2** summarises all studies/surveys/analysis/evaluations undertaken to inform the assessment presented within this Chapter.

Table 10.2: Background Studies / Surveys / Evaluations /Analysis

Study / Survey / Analysis / Evaluation	Overview	Date of Completion
Lifecycle assessment (LCA) of SAF GHG emissions for the DfT's Advanced Fuel Fund	Lifecycle GHG assessment undertaken on behalf of the Applicant to secure funding as part of the DfT's AFF. The AFF LCA evaluates upstream GHG emissions associated	2023

Study / Survey / Analysis / Evaluation	Overview	Date of Completion
(AFF) award (E4tech)[a] ("AFF LCA")	with ethanol feedstock production and transport, emission from on-site processes to create the SAF (e.g. mains electricity and gas consumption), downstream emissions from the transport of the SAF to aircraft, and GHG saving thresholds necessary to designate the product as SAF, in line with the AFF guidance set out by the DfT.	

Assessment Process

GHG Emissions, Savings and Net GHG Effect

10.25 To assess the level of effect and whether it is significant, it is necessary to establish the magnitude of the change occurring i.e. the changes to the baseline conditions as a result of the Proposed Scheme, and the sensitivity or importance of the receiving environment or receptor.

10.26 The approach taken is to estimate GHG emissions from the construction and operation of the Proposed Scheme, as well as GHG savings from use of the SAF product and RD co-product relative to traditional fossil fuel equivalents. In this way the net GHG effect of the Proposed Scheme can be established in accordance with IEMA's GHG guidance which sets the following GHG quantification and related principles:

- GHG quantification within EIA should follow the principles outlined in key documents such as the *GHG Protocol Corporate Standard*[16] in terms of relevance, completeness, consistency, transparency and accuracy;
- The assessment should seek to quantify the difference in GHG emissions between the proposed project and the baseline scenario (e.g. no development scenario) and reflect the difference in whole life net GHG emissions between the two options;
- The assessment must include all material emissions, direct or indirect, during the whole life of the proposed project. The boundary of the assessment should be clearly defined, in alignment with best practice;
- The assessment should seek to present a reasonable worst case;

[a] Given the confidentiality of this document, it has not been made publicly available. Instead the key relevant information and data from it that inform this Chapter is presented in this Chapter were possible.

- Any exclusions, limitations, assumptions and uncertainties should be justified and reported where appropriate; and

- GHG benefits beyond the asset lifecycle can be considered.

10.27 The AFF LCA is the key source of information used in the GHG assessment. As summarised in **Table 10.2** the AFF LCA provides information on key GHG emissions producing inputs to the SAF production process to which this application relates including mains electricity and gas consumption. This information has been used to quantify operational GHG emissions from the Proposed Scheme.

10.28 The AFF LCA also covers various GHG emissions producing activities 'upstream' and 'downstream' of the Proposed Scheme, with the former including the production and inbound transport of the ethanol feedstock, and the latter including the outbound transport of the SAF product and RD co-product. This ensures that GHG savings quantified from the use of these products relative to conventional fossil fuels take due account of all appropriate lifecycle GHG emissions of the SAF (and beyond that of the Proposed Scheme) as required by the AFF.

10.29 The magnitude of GHG emissions and saving have been provided in the context of baseline GHG emissions from the Site, local authority administrative area (NPT), Wales and UK, as well as to future carbon budgets for NPT, Wales and the UK, including Government projections of GHG emissions to be saved through SAF uptake. It should be noted that comparing the GHG performance of the Proposed Scheme to these various contexts is provided voluntarily in line with IEMA guidance and not in response to specific policy requirements.

10.30 IEMA's GHG guidance also states that, in addition to establishing the magnitude of GHG emissions and/or savings, a key further consideration is whether the project makes an appropriate contribution to the national trajectory to a science-based 1.5°C net zero target by 2050.

10.31 The applied methodology process therefore comprises the following components:

- Establish UK, national and local legislation, policy and guidance relating to climate change mitigation (further details are provided in '*Legislative Framework, Policy and Guidance'*);

- Establish baseline conditions with respect to GHG emissions at the Site, NPT administrative area, Wales and UK (further details of baseline emissions are set out in '*Baseline Conditions'*);

- Establish future baseline conditions with respect to GHG emissions from future carbon budgets for NPT, Wales and UK, and also Government projections of GHG savings from SAF uptake across UK carbon budgets (further details of baseline emissions are set out in '*Baseline Conditions'*);

- Estimate GHG emissions resulting from the construction and operation of the Proposed Scheme (see '*Assessment Methodology'* and *'Assessment of Effects, Secondary Mitigation and Residual Effects'*);

- Estimate GHG emissions savings resulting from use of the SAF and SPD products (see '*Assessment Methodology'* and *'Assessment of Effects, Secondary Mitigation and Residual Effects'*);

- Establish the Proposed Scheme's net GHG effect over its lifecycle (see '*Assessment Methodology'* and *'Assessment of Effects, Secondary Mitigation and Residual Effects'*);

- Evaluate primary and tertiary GHG mitigation measures in place for the Proposed Scheme (considered within '*Primary and Tertiary Mitigation*';

- Evaluate project GHG emissions and savings in the context of baseline emissions and future carbon budgets to establish their context and magnitude (see '*Assessment Methodology'* and *'Assessment of Effects, Secondary Mitigation and Residual Effects'*);

- Appraise the contribution of the Proposed Scheme to NPT's, Wales', the UK's net zero trajectory and Government's projected GHG savings from SAF uptake (see '*Assessment Methodology'* and *'Assessment of Effects, Secondary Mitigation and Residual Effects'*);

- Establish whether secondary mitigation is required to reduce adverse effects or enhance beneficial effects; and

- Establish the level of effect in relation to GHG and whether it is significant (see '*Assessment Methodology'* and *'Assessment of Effects, Secondary Mitigation and Residual Effects'*).

Direct Construction GHG Emissions

10.32 Construction of the Proposed Scheme will result in direct GHG emissions, both on- and off-site, from a range of activities including the manufacture of construction materials (i.e. embodied carbon), the transport of materials, workers and waste on and off-site, the consumption of fossil fuels and electricity by plant and vehicles on site, and the treatment of residual construction wastes.

10.33 Unlike standard built environment developments such as housing or office space where benchmarks are readily available to estimate construction carbon emissions for that building type, the industrial nature of the Proposed Scheme means this approach is not available. Instead, construction stage emissions are estimated by applying the *Department of Environment, Food and Rural Affairs' (DEFRA) Indirect Emissions from the Supply Chain (2019)*[17] factor for Standard Industrial Classification (SIC) '42.1-2 Constructions and construction works for civil engineering' including refinery construction to the estimated upper capital cost provided by the Applicant[b].

Direct Operational GHG Emissions

10.34 Direct operational GHG emissions from the Proposed Scheme are assessed by drawing data on key operational inputs from the AFF LCA as follows:

- Energy (electricity and steam) inputs to SAF and RD conversion and upgrading stages; and

[b] The specific value is commercially sensitive and not provided.

- Energy (electricity and natural gas) inputs to the SAF and RD upgrading stage.

10.35 Other aspects of the SAF lifecycle GHG emissions that occur upstream (e.g. ethanol feedstock production and transport) or downstream (e.g. SAF distribution and storage) are not accounted for as part of direct emission from the operational stage of the Proposed Scheme, instead they form part of the AFF LCA and hence are considered in the lifecycle assessment of the GHG performance of the SAF and RD products (i.e. accounted for as part of the consideration of 'savings').

Net GHG Emission and Savings

10.36 To assessment of net GHG emissions and savings associated with upstream and downstream emissions has been informed by the Applicants AFF LCA and data within it associated with the ethanol feedstock and the savings requirements required for the SAF to be considered a sustainable aviation fuel in line with DfT guidance. These aspects have then been considered alongside the direct emissions from construction and operation (set out above) when determining the net GHG emissions.

10.37 The AFF LCA considered the following two potential ethanol feedstock routes and therefore corresponding savings necessary to be achieved through the LCA, which have therefore been considered as part of the assessment of net GHG emission and reported in this Chapter:

(i) steel mill off-gas – a Recycled Carbon Fuel (RCF) for which lifecycle GHG emissions not exceeding 39.6 gCO_2e / megajoule lower heating value (MJHV) are required in 2027 (the first full year of production) for the resulting SAF, equating to a minimum 58% lifecycle GHG reduction relative to a fossil fuel comparator (94.0 gCO_2e/MJLHV); and

(ii) waste starch ethanol – a biomass feedstock required to qualify under the RTFO for which lifecycle GHG emissions not exceeding 31.0 gCO_2e/MJHV are required for the resulting SAF, equating to a minimum 67% lifecycle GHG reduction relative to a fossil fuel comparator.

Climate Resilience

Current Baseline

10.38 Baseline GHG emissions for the NPT administrative area, Wales and UK for the most recent year available (2021) are sourced from *UK Government's Local Authority & Regional CO_2 Emissions Statistics*[18].

Future Baseline

10.39 Future carbon budgets are effectively a future baseline of GHG emissions necessary to achieve net zero and are considered reasonable to apply as an indicator of likely future baseline GHG emissions.

UK Carbon Budgets

10.40 The *Climate Change Act 2008* was amended in 2019[19] to include a 100 % carbon reduction target by 2050 ('net zero'). It is the duty of the Secretary of State to set for each succeeding period of five years (beginning with the period 2008 to 2012) an amount for the net UK carbon account (the 'carbon budget') and to ensure the net quantity of emissions does not exceed the carbon budget. The Sixth Carbon Budget was implemented in April 2021, enshrining in law a new target to reduce GHG emissions by 78% by 2035 and for the first

time incorporating the UK's share of international aviation and shipping emissions. GHG emissions, savings and net GHG effect quantified for the Proposed Scheme are compared against the Fourth (2023-27), Fifth (2028-32) and Sixth (2033-37) UK carbon budgets.

Wales Carbon Budgets

10.41 In March 2021 Welsh Government approved a net zero target for 2050 together with carbon budgets and interim targets for 2030 and 2040 against a 1990 baseline[20].

NPT Carbon Budgets

10.42 Manchester University's Tyndall Centre has worked with NPT to set future carbon budgets for their administrative area. *Setting Climate Commitments for Neath Port Talbot (May 2023)*[21] sets out proposed carbon budgets for NPT up to the year 2100.

Project Timescales

10.43 For the purpose of comparing GHG emissions to the above identified budgets, it is necessary to define project timescales, which are set out within **Table 10.3.**

Table 10.3: Assessed Project Timescales

Development Phase	First year	Completion / Assessment period	Summary
Construction	2024	2026	Construction of the Proposed Scheme is assumed to commence in 2023, the first full year of construction occur in 2024, and construction be completed in 2026 (3 years).
Operation	2027	2046	Operation of the Proposed Scheme is to commence in 2026 with the first full year of operation in 2027. Operational GHG emissions are assessed up to the end of 2046 in order to cover an assumed 20 year lifespan for the facility.

Reporting of the Environmental Effect and Significance Criteria

10.44 The assessment of likely significant environmental effects as a result of the Proposed Scheme has taken into account the construction stage and operational stage. The following sections define the approach adopted within the assessment for the determination of sensitivity (or value/importance), magnitude of change (or impact), the level of effect and significance.

10.45 The duration of the effect has been assessed as either 'short-term', 'medium-term' or 'long-term'. Short-term is considered to be up to 1 year, medium-term is considered to be between 1 and 10 years and long-term is considered to be greater than 10 years.

10.46 Carbon dioxide equivalency (CO_2e) is a quantity that describes, for a given mixture and amount of GHG, the amount of CO_2 that would have the same global warming potential (GWP), when measured over a specified timescale (generally, 100 years). In view of this timescale and the findings of the *Intergovernmental Panel on Climate Change (IPCC) 1.5°C Report*[22] that some effects from climate change may be long-lasting or irreversible, the duration of effect of the built elements of the Proposed Scheme is assumed to be **long-term**.

Determining Sensitivity of Receptor

10.47 The sensitivity of affected receptors has been considered on a scale of **high**, **medium**, **low** or **negligible**. IEMA's EIA guide to climate change adaptation and resilience recommends use of the Met Office UKCP18 high emissions scenarios (known as RCP8.5), unless the case can be made for using a different, lower emissions scenario. The RCP 8.5 scenario is considered most appropriate for this assessment and as a result the sensitivity of the global climate system is considered to be **high**.

Determining the Magnitude of Change

10.48 The magnitude of change has been considered as the change experienced from the current baseline conditions at the sensitive receptor and has been considered on a scale of **large**, **medium**, **small** or **negligible**.

10.49 There are currently no agreed significance criteria for evaluating GHG emissions in EIA. Therefore, the magnitude of change of GHG emissions / savings estimated from the Proposed Scheme is determined by establishing their scale relative to baseline GHG emissions from the Site, NPT administrative area, Wales and UK, and also to future carbon budgets proposed for NPT, Wales and UK and Government's GHG savings projections from SAF uptake, as presented in **Table 10.4**, together with professional judgement.

10.50 In line with the overall approach to the assessment of net GHG emissions, a magnitude of change has been reported for construction and operation emissions, as well as the overall net GHG emissions.

Table 10.4: Determining Magnitude of Change

Magnitude of Change	Description of Change
Large	A large increase / decrease in GHG emissions (e.g. >10%) relative to baseline emissions and/or future carbon budgets
Medium	A medium increase / decrease in GHG emissions (e.g. 5 to 10%) relative baseline emissions and/or future carbon budgets
Small	A small increase / decrease in GHG emissions (e.g. 1 to 5%) relative to baseline emissions and/or future carbon budgets
Negligible	A negligible increase / decrease in GHG emissions (e.g. <1%) relative to baseline emissions and/or future carbon budgets

Determining the Level of Effect

10.51 The level of effect has been informed by the magnitude of change due to the Proposed Scheme and the evaluation of the sensitivity of the affected receptor. The level of effect has been determined using professional judgement and **Table 10.5** has been a tool which has assisted with this process.

10.52 Whilst **Table 10.5** provides ranges, the level of effect is confirmed as a single level and not a range, informed by professional judgement. For each effect, it has been concluded whether the effect is '*beneficial*' or '*adverse*'.

Table 10.5: Matrix to Support Determining the Level of Effect

		Sensitivity (or value / importance)			
		High	Medium	Low	Negligible
Magnitude of Change	Large	Major	Moderate to Major	Minor to Moderate	Negligible
	Medium	Moderate to Major	Moderate	Minor	Negligible
	Small	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

10.53 A concluding level of effect has only been determined for the overall net GHG emissions and not the individual construction and operational stage emissions. However, within the assessment of direct construction and operational emissions an equivalent level of effect has been set out for context.

10.54 The magnitude of net GHG emissions (or savings) from a project, how this effect changes (or otherwise) baseline conditions at the local, regional and national level are important components when establishing the magnitude of change which feeds into determining the level of effect. However, how the project contributes (or otherwise) to the UK's net zero trajectory is a critical additional component as recognised by the latest IEMA Guidance. The following terms have therefore been used to define the level of effect:

- **Major effect**: GHG mitigation measures are not in line with a science-based 1.5°C aligned transition to net zero for that project type, and net GHG emissions equate to a large increase (e.g. ≥10%) relative to baseline local/regional/national emissions and/or future local carbon budgets. A project with major adverse effects is locking in GHG emissions and does not make a meaningful contribution to the national trajectory to net zero.

- **Moderate effect**: GHG mitigation measures are partly in line with a science-based 1.5°C aligned transition to net zero for that project type, and net GHG emissions equate to a medium increase (e.g. >5%) relative to baseline local/regional/national emissions and/or future local carbon budgets. A project with moderate adverse effects complies with some up-to-date policy and good practice but is locking in some emissions and makes only a partial contribution to the national trajectory to net zero.

- **Minor effect**: GHG mitigation measures are in line with a science-based 1.5°C aligned transition to net zero for that project type, and net GHG emissions equate to a small increase (e.g. <5%) relative to baseline local/regional/national emissions and/or future local carbon budgets. A project with minor adverse effects complies with up-to-date and emerging policy and good practice reduction measures and makes a contribution to the national trajectory to net zero.

- **Negligible**: GHG mitigation measures are in line with a science-based 1.5°C aligned transition to net zero for that project type, with minimal residual emissions. A project

with negligible effects complies with up-to-date and emerging policy and best practice and plays a part in achieving the rate of transition required by nationally set policy e.g. net zero..

- **Beneficial:** net GHG impacts are below zero and the project results in a reduction in atmospheric GHG concentrations, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

Determining Significance

10.55 For each effect, a statement has been made as to whether the level of effect is '**Significant**' or '**Not Significant**'. This determination has been based on professional judgement and/or relevant guidance/legislation where applicable.

10.56 Significance has only been concluded for residual effects (i.e. following the identification of secondary mitigation).

Baseline Conditions

Current Baseline

Site GHG Emissions

10.57 The Site is currently largely unused and vacant previously developed land that has been colonised by vegetation especially at the Production Development Zone (PDZ), although some former structures are still present in TCA East. As such any existing GHG emissions or sequestration occurring is considered likely to be limited. For the purposes of the assessment, baseline GHG emissions from the Site are assumed to be zero.

Local, National & UK GHG Emissions

10.58 **Table 10.6** presents baseline GHG emissions for the NPT administrative area, Wales and UK, and assumed baseline GHG from the Site.

Table 10.6: Baseline Site, Local, National & UK GHG Emissions

Geographical Area	2020 GHG Emissions (kilo tonnes CO_2)
Site	0.0 (assumed)
NPT	6,921.2
Wales	27,303.0
UK	377,680.0

Future Baseline

UK Carbon Budgets

10.59 UK carbon budgets are presented in **Table 10.7**. Carbon budgets for the UK beyond 2037 are not yet set.

Table 10.7: UK Carbon Budgets

Period	Carbon Budget ($ktCO_2e$)
2023-2027 (Fourth Carbon Budget)	1,950,000.0
2028-2032 (Fifth Carbon Budget)	1,725,000.0
2033-2037 (Sixth Carbon Budget)	965,000.0

Wales Carbon Budgets

10.60 Welsh carbon budgets and targets are shown in **Table 10.8**.

Table 10.8: Wales Carbon Budgets & Targets

Budget/Target	Amount (1990 Baseline)
Carbon Budget 2 (2021-2025)	Average 37% reduction
Carbon Budget 3 (2026-2030)	Average 58% reduction
2030 target	63% reduction
2040 target	89% reduction
2050 target	At least 100% reduction (net zero)

10.61 **Table 10.9** presents estimated GHG emissions for the two Wales carbon budgets and for subsequent 5-year periods based on the 1990 baseline (55,636 $ktCO_2e$). Average reductions for the 5-year periods following the second carbon budget 2026-2030 are derived by assuming 2035 and 2045 targets mid-way between the 2030, 2040 and 2050 targets and average reductions between the proposed and these assumed interim targets.

Table 10.9: Wales Carbon Budgets Estimates

Period	Average Reduction on 1990 Baseline	Carbon Budget ($ktCO_2e$)
2021-2025	37.00%	175,253.4
2026-2030	58.00%	116,835.6
2031-2035	69.50%	84,844.9
2036-2040	82.50%	48,681.5
2041-2045	91.75%	22,949.9
2046-2050	97.25%	7,649.9

NPT Carbon Budgets

10.62 Carbon budgets proposed for NPT up to the year 2100 are shown in **Table 10.10**. It should be noted that unlike for UK and Wales, NPT's carbon budgets relate to emissions from the energy system only which is assumed to mean that emissions from other sources such as agriculture / land use and transport etc are excluded.

Table 10.10: Proposed NPT Carbon Budgets

Period	Carbon Budget ($ktCO_2e$)
2023 – 2027	14,500
2028 – 2032	6,700
2033 – 2037	3,100
2038 – 2042	1,400
2043 – 2047	600
2048 - 2100	500

Projected GHG Emissions from Increased Uptake of SAFs

10.63 **Table 10.11** presents GHG savings projected by Government for each UK Carbon Budgets as a result of policy to increase the take up of SAFs, as taken from the *Carbon Budget Delivery Plan*.

Table 10.11: Projected GHG Savings from Increased Update of SAFs

UK Carbon Budget	Annual Average Savings ($MtCO_2e$)
2023 – 2027 (Fourth Carbon Budget)	0.9
2028 – 2032 (Fifth Carbon Budget)	2.7
2033 – 2037 (Sixth Carbon Budget)	3.8

Primary and Tertiary Mitigation

10.64 The Proposed Scheme is a 'first of a kind' (FOAK) SAF production facility to support the decarbonisation of the aviation sector in accordance with Wales and UK Government net zero strategy. As such it is use of the SAF product and RD co-product resulting from the Proposed Scheme that represents the key mitigation measure of the proposals in relation to GHG emissions.

Construction Stage

10.65 Efforts will be made to reduce construction stage GHG emissions where possible through plant design and sourcing and materials selection etc, and through the implementation of a Construction Environmental Management Plan (CEMP) and Site Waste Management Plan (SWMP). However, the FOAK nature of the proposals and overriding process engineering and health and safety considerations, the GHG reduction effect of such measures may be relatively limited and no mitigation in relation to construction stage GHG emissions has been assumed as the applied Government SIC expenditure factor for specialist construction emissions is assumed to relate to the 'business as usual' scenario.

Operational Stage

10.66 In addition to the water savings measures set out previously (see *'Scope of Assessment'* section), the Proposed Scheme also looks to re-use waste heat within the main process modules. Heat is required as part of the 'catalytic dehydration' state, that takes the ethanol feedstock and converts it to ethylene (see **Chapter 4: Development Specification**). Whereas,

as part of the 'oligomerisation and hydrogenation' stages of the process heat is generated. Therefore, the Proposed Scheme incorporates heat capture and exchange systems to utilise waste heat to supplement the stages where it is required. The process water and heat efficiency measures are incorporated into the AFF LCA and therefore considered by this assessment.

Assessment of Effects, Secondary Mitigation and Residual Effects

Direct GHG Emissions from Construction Stage

10.67 **Table 10.12** presents construction stage GHG emissions estimated for the Proposed Scheme, in line with the assessment methodology set out previously (see *'Assessment Process'*).

Table 10.12: Construction GHG Emissions

Parameter	Value
Total GHG emissions	122,400 tCO_2e
Annual average GHG emissions (3 years)	40,800 tCO_2e

10.68 Total construction stage GHG emissions of 122,400 tCO_2e are estimated, equating to annual average construction emissions of 40,800 tCO_2e across the 3-year construction phase (2024-26). **Table 10.13** presents these emissions within the context of baseline emissions from the Site, NPT, Wales and UK, and also to future NPT, Wales and UK carbon budgets.

Table 10.13: Construction GHG Emissions in Context

Parameter			
Annual average construction emissions		**40,800 tCO_2e**	
As a percentage of NPT baseline emissions		0.58949%	
As a percentage of Wales baseline emissions		0.14943%	
As a percentage of UK baseline emissions		0.01080%	
Total construction emissions		**122,400**	
As a percentage of NPT, Wales & UK Carbon Budgets			
Period	**NPT**	**Wales**	**UK**
2021-2025	--	0.04656%	--
2023-2027	0.84414%	--	0.00628%
2026-2030	--	0.03492%	--
2028-2032	0.0000%	--	0.0000%
2031-2035	--	0.0000%	--
2033-2037	0.0000%	--	0.0000%
2036-2040	--	0.0000%	--
2038-2042	0.0000%	--	--

Parameter			Value
2041-2045	--	0.0000%	--
2043-2048	0.0000%	--	--
2046-2050	--	0.0000%	--
2048-2100	0.0000%	--	--

10.69 Annual average construction stage emissions equate to 0.58949%, 0.14943% and 0.01080% of baseline GHG emissions from NPT, Wales and UK respectively.

10.70 Total GHG emissions across the 2024-2026 construction period equate to a maximum of 0.84414% of NPT's carbon budgets (for the period 2023-27), a maximum of 0.04656% of Wales carbon budgets (for the period 2021-2025), and a maximum of 0.00628% of UK carbon budgets (for the period 2023-2027).

10.71 The magnitude of change is considered to be negligible as all increases in GHG emissions are <1% relative to baseline emissions and/or future carbon budgets. Although this assessment does not look to determine a level of effect for direct construction stage emissions, given the high sensitivity of the global climate system, this would be equivalent to a negligible level of effect.

Direct GHG Emissions from Operational Stage

10.72 **Table 10.14** presents GHG emissions estimated for the first full year of operation (2027) as derived from the AFF LCA. This data covers all key inputs to the Proposed Scheme that result in the release of GHG emissions, and its use will therefore ensure an accurate assessment of operational GHG emissions which aligns with the Applicant's successful AFF award.

Table 10.14: Operational GHG Emissions

Annual Input	GHG Emissions (tCO_2e/year) [1]
Electricity	92,608[2]
Steam	25,283 [3]
Water	400 [3]
Natural gas	21,724 [3]
Total GHG Emissions	**140,014**

Notes
[1] Annual input values have been sourced from the Applicant's AFF LCA and not provided as they are considered confidential at this time.
[2] Grid electricity factor used to determine emissions was derived relevant guidance for 2027 (first year of operation of the Proposed Scheme).
[3] Conversion factors used to determine emissions have been sourced from relevant UK Government reporting

10.73 Total operational GHG emissions of 140,014 tCO_2e are forecast in 2027, the first full year of operation. Operational GHG emissions will reduce in subsequent years as the electricity grid

continues to decarbonise, as recognised by the DfT's AFF guidance[23] from which the data in **Table 10.15** is obtained.

Table 10.15: DfT AFF UK Grid Decarbonisation Projection

Year	UK grid electricity intensity (gCO_2e/MJ_e)
2027	39.64
2028	33.53
2029	24.72
2030	20.46
2031	18.92
2032	17.71
2033	14.06
2034	11.13
2035	9.62
2036	8.36
2037	7.59
2038	6.77

10.74 **Table 10.16** applies the above grid decarbonisation projection to the process annual electricity input in order to derive future operational GHG emissions from the Proposed Scheme beyond year 1 against future carbon budgets of NPT, Wales and UK. Year 1 (2027) operational emissions are also reported as a worst case in the context of baseline NPT, Wales and UK emissions.

Table 10.16: Operational GHG Emissions in Context

Parameter	Value
Year 1 (2027) operational emissions	**140,014 tCO_2e**
As a percentage of NPT baseline emissions	2.02297%
As a percentage of Wales baseline emissions	0.51281%
As a percentage of UK baseline emissions	0.03707%
Total Operational Emissions 2027-2046	**1,571,118 tCO_2e**

As a percentage of NPT, Wales & UK Carbon Budgets

Period	Operational GHG Emissions (tCO_2e)	NPT	Wales	UK
2021-2025	0	--	0.00000%	--

Parameter				Value
2023-2027	140,014	0.96561%	--	0.00718%
2026-2030	466,115	--	0.39895%	--
2028-2032	506,489	7.55953%	--	0.02936%
2031-2035	403,929	--	0.47608%	--
2033-2037	355,616	11.47149%	--	0.03685%
2036-2040	321,741	--	0.66091%	--
2038-2042	316,111	22.57933%	--	--
2041-2045	316,111	--	1.37740%	--
2043-2048	252,889	42.14809%	--	--
2046-2050	63,222	--	0.82644%	--
2048-2100	0	0.0000%	--	--

10.75 Year 1 (2027) operational emissions of 140,014 tCO_2e are forecast equating to ~2.02%, ~0.51% and ~0.04% of NPT, Wales and UK baseline emissions respectively. These Year 1 (2027) emissions represent peak annual operational emissions given the grid is forecast to decarbonise over time.

10.76 Figures in the 'Operational GHG Emissions (tCO_2e)' column of **Table 10.16** relate to total operational GHG emissions during each 5 year period. There is only one year of full operation (2027) in the first 5 year period, which is why this figure is low than those for subsequent periods up to 2043-48. Ongoing decarbonisation of the UK electricity grid accounts for the reduction in GHG emissions over time.

10.77 Total operational emissions of 1,571,118 tCO_2e are forecast across the 20-year operational lifespan (2027-2046) assumed for the project for the purpose of assessment. Operational emissions equate to a maximum of ~42.15% of NTP's carbon budgets (for the period 2043-2048), ~1.38% of Wales carbon budgets (for the period 2041-2045) and ~0.04% of UK carbon budgets (for the period 2033-2037).

10.78 The magnitude of change is considered to be small in relation to baseline NPT emissions (i.e. between 1% and 5%) and negligible in relation to Wales and UK baseline emissions (i.e. <1%). The magnitude of change is considered to be large in relation NTP carbon budgets from 2033-2037 onwards (i.e. >10%), small in relation to Wales carbon budgets (i.e. between 1% and 5%) and negligible in relation to UK carbon budgets (i.e. <1%). Although this assessment does not look to determine a level of effect for direct operational stage emissions, given the high sensitivity of the global climate system, this would be equivalent to a minor adverse level of effect with respect to NPT baseline emissions, a negligible level of effect with respect to Wales and UK baseline emissions. However, it would correspond to a major adverse effect in terms of NPT onward carbon budgets and minor adverse in terms of Wales and UK onward carbon budgets.

10.79 The majority of operational emissions relate to the generation at a power station of grid electricity consumed by the Proposed Scheme and as such may occur outside of NPT, Wales

and potentially even UK boundaries depending on national grid operations including grid interconnection with other countries.

Net GHG Emissions

10.80 In order to assess indirect effects and the net GHG emissions of the Proposed Scheme in line with IEMA guidance, it is necessary to quantify GHG savings resulting from use of the SAF product and RD co-product relative to standard fossil fuels they will replace. These calculations are presented in **Table 10.17** based on data provided by the AFF LCA. Results are presented for two potential ethanol feedstock routes: steel-mill off gas (RCF) and waste starch (RTFO).

Table 10.17: GHG Savings from Use of SAF and RD Products

Parameter	Value
1a. SAF Product (steel mill off gas, RCF)	
SAF production	79,040 tonnes/year(1)
Lifecycle SAF GHG emissions	38.88 gCO_2e/MJ(1)
AFF RCF SAF Threshold (2027)	39.6 gCO_2e/MJ(1)
Fossil fuel comparator	94.0 gCO_2e/MJ(1)
% GHG saving achieved by SAF vs fossil fuel comparator	58.6%(1)
Carbon intensity of aviation turbine fuel(2)	3,178.4 $kgCO_2e$/tonne
GHG emissions from 79,040 tonnes of aviation turbine fuel (i.e. standard fossil fuel aviation fuel)	251,218 tCO_2e
GHG emissions from 79,040 tonnes of SAF (58.6% reduction)	103,908 tCO_2e
GHG savings from SAF product	**147,310 tCO_2e/year**
1b. SAF Product (waste starch ethanol, RTFO)	
SAF production	79,040 tonnes/year(1)
Lifecycle SAF GHG emissions	18.00 gCO_2e/MJ(1)
AFF RTFO SAF Threshold	31.0 gCO_2e/MJ(1)
Fossil fuel comparator	94.0 gCO_2e/MJ(1)
% GHG saving achieved by SAF vs fossil fuel comparator	80.9%(1)
Carbon intensity of aviation turbine fuel(2)	3,178.4 $kgCO_2e$/tonne
GHG emissions from 79,040 tonnes of aviation turbine fuel (i.e. standard fossil fuel aviation fuel)	251,218 tCO_2e
GHG emissions from 79,040 tonnes of SAF (80.9% reduction)	48,106 tCO_2e
GHG savings from SAF product	**203,112 tCO_2e/year**
2. RD Co-Product	
RD production	8,800 tonnes/year(1)
Lifecycle RD GHG emissions	38.88 gCO_2e/MJ(1)

Parameter	Value
Fossil fuel comparator	94.0 gCO_2e/MJ[(1)]
% GHG saving achieved	58.6%[(1)]
Carbon intensity of diesel fuel[(2)]	3,203.9 $kgCO_2e$/tonne
GHG emissions from 8,800 tonnes of diesel fuel (i.e. standard fossil fuel diesel fuel)	28,194 tCO_2e
GHG emissions from 8,800 tonnes of RD (58.6% reduction)	11,662 tCO_2e
GHG savings from RD co-product	**16,533 tCO_2e/year**
TOTAL GHG SAVINGS FROM SAF (STEEL MILL OFF GAS) & RD USE	**163,843 tCO_2e/year**
TOTAL GHG SAVINGS FROM SAF (WASTE STARCH) & RD USE	**219,645 tCO_2e/year**

Notes
[(1)] Sourced from the Applicant's AFF LCA.
[(2)] Soured from UK Government Conversion Factors for Company Reporting (2023)

10.81 In summary, the AFF LCA demonstrates that SAF produced from the steel mill off-gas ethanol feedstock route has lifecycle GHG emissions of 38.88 gCO_2e/MJ, below the AFF RCF threshold for 2027 of 39.6 gCO_2e/MJ and thereby meeting the AFF requirements for an RCF SAF. Compared to the fossil fuel comparator (i.e. fossil aviation fuel) of 94.0 gCO_2e/MJ, this RCF SAF therefore achieves lifecycle GHG savings of 58.6%.

10.82 For SAF produced from waste starch ethanol feedstock, the AFF LCA demonstrates lifecycle GHG emissions of 18.00 gCO_2e/MJ, below the RTFO threshold of 31.0 gCO_2e/MJ and thereby meeting the AFF requirements for an RTFO SAF. Compared to the fossil fuel comparator (i.e. fossil aviation fuel) of 94.0 gCO_2e/MJ, this RTFO SAF therefore achieves lifecycle GHG savings of 80.9%.

10.83 Reasons for a lower lifecycle GHG emissions saving for the steel mill off gas relative to the waste starch ethanol include a requirement for the AFF LCA to include a 'displaced energy counterfactual' for the steel mill off gas ethanol which recognises that alternative energy sources are likely to be required at a steel mill to make up for exported off-gas ethanol.

10.84 Regarding the RD co-product, the AFF LCA reports the same lifecycle GHG savings as for the steel mill off gas ethanol feedstock route (58.6%)

10.85 Based on these lifecycle GHG saving figures for the two ethanol feedstock routes relative to fossil fuel and the annual SAF production forecast for the Proposed Scheme, total annual GHG savings of 163,843 tCO_2e and 219,645 tCO_2e are forecast for the combined use of the SAF product and RD co-product for the steel mill off-gas and waste starch ethanol feedstock routes respectively. These GHG savings are achieved by the replacement of fossil fuel aviation and diesel fuel and as a result will be maintained year on year across the operational lifetime of the Proposed Scheme. This is in contrast to operational GHG emissions from the Proposed Scheme which will reduce year on year as the national grid continues to decarbonise.

10.86 **Table 10.18** presents the above GHG savings forecast from the SAF product only under the two ethanol feedstock routes as a percentage contribution to Government's projected GHG savings across UK carbon budgets from increased SAF uptake.

Table 10.18: Forecast GHG Savings from SAF produced by the Proposed Scheme in the Context of Government Projections of GHG Savings from Increased Take Up of SAFs

UK Carbon Budget	Government Projected Annual Average Savings from SAF take up ($MtCO_2e$)	Contribution of the Proposed Scheme to Government GHG saving projections	
		Steel mill off gas ethanol	Waste starch ethanol
2023 – 2027 (Fourth Carbon Budget)	0.9	16.4%	22.6%
2028 – 2032 (Fifth Carbon Budget)	2.7	5.5%	7.5%
2033 – 2037 (Sixth Carbon Budget)	3.8	3.9%	5.3%

10.87 In summary, annual GHG savings achieved by the SAF product in the steel mill off gas ethanol feedstock route relative to fossil aviation fuel (147,310 tCO_2e) represent 16.4% of Government's projected annual average savings from SAF uptake during the Fourth UK Carbon Budget (2023-27), reducing to 5.5% of annual average savings projected during the Fifth Carbon Budget (2028-32) and 3.9% for the Sixth Carbon Budget (2933-37), as additional SAF production facilities come online.

10.88 For the SAF product in the waste starch ethanol feedstock route, annual GHG savings (203,112 tCO_2e) represent 22.6% of Government projected annual average savings for the Fourth UK Carbon Budget (2023-27), reducing to 7.5% for the Fifth Carbon Budget (2028-32) and 5.3% for the Sixth Carbon Budget (2033-37).

10.89 The magnitude of GHG savings forecast from use of SAF product from the Proposed Scheme is considered to be large in relation to the Fourth Carbon Budget (i.e. >10%) irrespective of ethanol feedstock route, medium (i.e. >5% to 10%) for the Fifth Carbon Budget irrespective of ethanol feedstock route, medium for the Sixth Carbon Budget in the waste starch ethanol feedstock route, and small (i.e. >1% to 5) for the Sixth Carbon Budget in the steel mill off gas ethanol feedstock route.

10.90 By combining GHG emissions from construction and operation of the Proposed Scheme with GHG savings from use of the SAF and RD products relative to conventional fossil fuels, the net GHG effect of the Proposed Scheme can be established and reported in the context of future carbon budgets. **Tables 10.19** and **10.20** present the net GHG effect for the steel mill off-gas and waste starch ethanol feedstock routes respectively.

Table 10.19: Net GHG Emissions (Steel Mill Off-Gas)

Parameter			Value	
Total Net GHG Emissions (2024-2046)			**-1,583,336 tCO_2e**	
Period	**Net GHG Emissions (tCO_2e)**	**NPT**	**Wales**	**UK**
2021-2025	81,600	--	0.04656%	--
2023-2027	98,571	0.67980%	--	0.00505%
2026-2030	-148,456	--	-0.12706%	--
2028-2032	-312,725	-4.66753%	--	-0.01813%
2031-2035	-415,284	--	-0.48946%	--
2033-2037	-463,597	-14.95475%	--	-0.04804%
2036-2040	-497,472	--	-1.02189%	--
2038-2042	-503,103	-35.93591%	--	--
2041-2045	-503,103	--	-2.19218%	--
2043-2048	-402,482	-67.08036%	--	--
2046-2050	-100,621	--	-1.31531%	--
2048-2100	0	0.00000%	--	--

10.91 Total net GHG emissions of -1,583,336 tCO_2e (i.e. savings) are forecast across the 2024-2046 construction and operational time period of the Proposed Scheme in the steel-mill off gas ethanol feedstock scenario (i.e. a saving of 1,583,336 tCO_2e).

10.92 Net GHG emissions accumulate to a maximum (saving) of ~-67.08% of NTP's carbon budgets (for the period 2043-2048), ~-2.19% of Wales carbon budgets (for the period 2041-2045) and ~-0.05% of UK carbon budgets (for the periods 2023-2027 and 2033-2037). The magnitude of change is considered to be large in relation NTP carbon budgets from 2033-2037 onwards (i.e. >10%), small in relation to Wales carbon budgets (i.e. between 1% and 5%) and negligible in relation to UK carbon budgets (i.e. <1%).

10.93 The GHG emissions savings will occur at locations where the SAF and RD products are used in place of fossil fuels.

Table 10.20: Net GHG Effect (Waste Starch Ethanol)

Parameter			Value	
Total Net GHG Emissions (2024-2046)			**- 2,699,385 tCO_2e**	
Period	**Net GHG Emissions (tCO_2e)**	**NPT**	**Wales**	**UK**
2021-2025	81,600	--	0.04656%	--
2023-2027	42,768	0.29495%	--	0.00219%

Parameter			Value	
2026-2030	-371,666	--	-0.31811%	--
2028-2032	-591,737	-8.83189%	--	-0.03430%
2031-2035	-694,297	--	-0.81831%	--
2033-2037	-742,610	-23.95515%	--	-0.07695%
2036-2040	-776,485	--	-1.59503%	--
2038-2042	-782,115	-55.86536%	--	--
2041-2045	-782,115	--	-3.40793%	--
2043-2048	-625,692	-104.28201%	--	--
2046-2050	-156,423	--	-2.04476%	--
2048-2100	0	0.00000%	--	--

10.94 Total net GHG emissions of -2,699,385 tCO_2e are forecast across the 2024-2046 construction and operational time period of the Proposed Scheme in the waste starch ethanol feedstock scenario (i.e. a saving of 2,699,385 tCO_2e). This increased net saving relative to steel mill off-gas is due to the higher lifecycle GHG savings relative to fossil fuels (81.0% saving vs 58.6% saving).

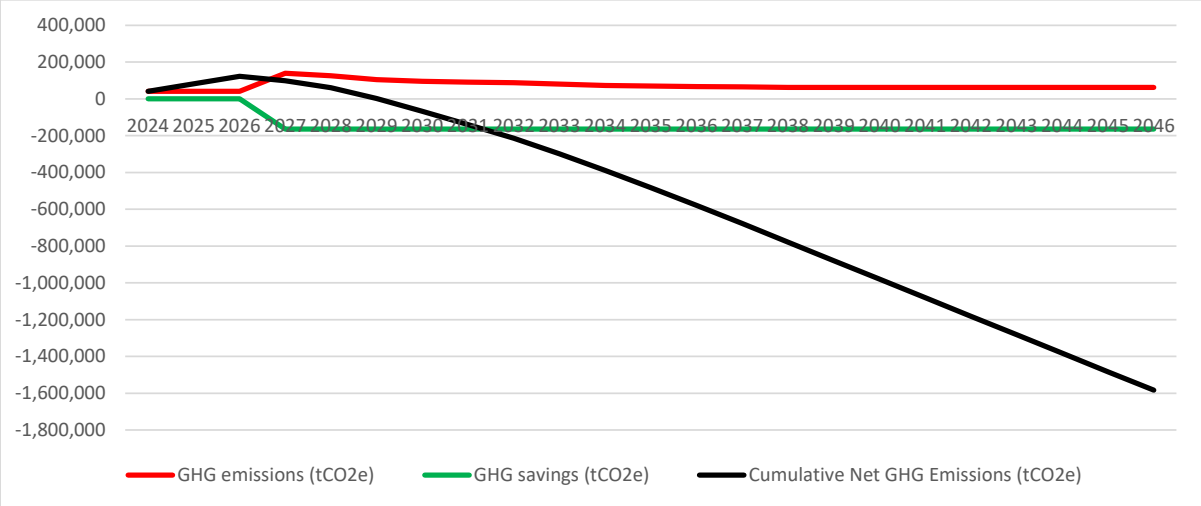
10.95 Net GHG emissions (savings) equate to a maximum of ~-104.28% of NTP's carbon budgets (for the period 2043-2048), ~-3.41% of Wales carbon budgets (for the period 2041-2045) and ~-0.08% of UK carbon budgets (for the period 2033-2037).

10.96 The magnitude of change is considered to be large in relation to NTP carbon budgets from 2033-2037 onwards (i.e. >10%), small in relation to Wales carbon budgets (i.e. >1% to 5%) and negligible in relation to UK carbon budgets (i.e. <1%).

10.97 The GHG emissions savings will occur at locations where the SAF and SPD products are used in place of fossil fuels.

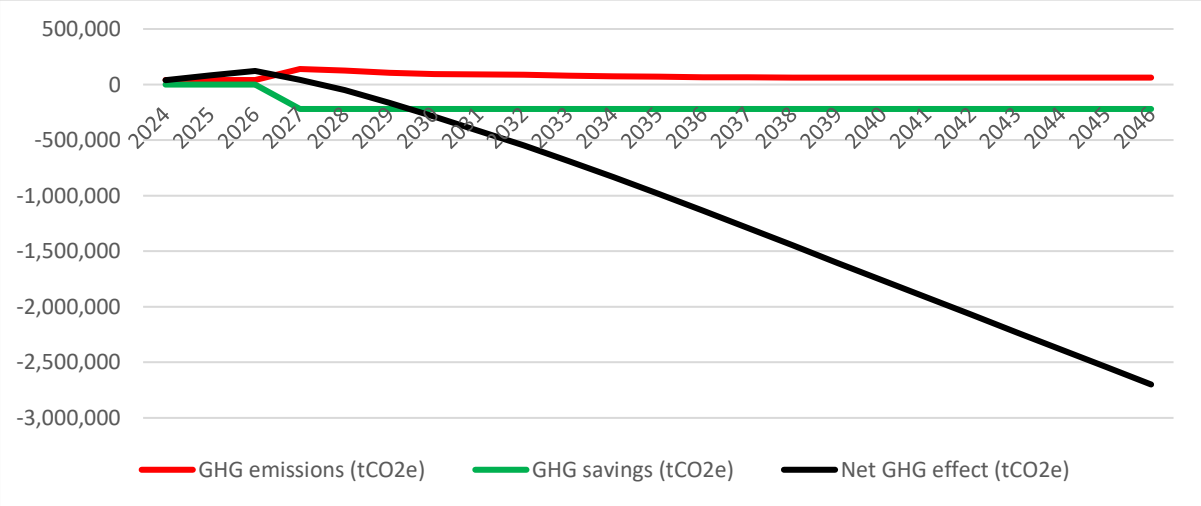
10.98 **Graphs 1** and **2** present GHG emissions, GHG savings and compounding net GHG emissions across the 2024 to 2046 construction and operational periods for the steel mill off-gas and waste starch ethanol feedstocks respectively.

Graph 1: Annual GHG emissions, GHG savings and compounding Net GHG emissions (tCO_2e, Steel Mill Off-Gas)



10.99 In the steel mill off-gas ethanol feedstock scenario, net GHG savings (i.e. the point at which GHG savings from SAF and RD use offset GHG emissions from construction and operation) are forecast to occur during 2030 i.e. within 4 years of the Proposed Scheme becoming operational. This is referred to as the carbon payback or balance period and is the point on the above graph where the black compounding net GHG emissions line cross the x axis (i.e. zero cumulative net GHG emissions). Total compounding net GHG emissions of 1,583,336 tCO_2e are forecast across the assumed 20-year lifespan of the Proposed Scheme in this scenario.

Graph 2: Annual GHG emissions, GHG savings and compounding Net GHG emissions (tCO_2e, Waste Starch)



10.100 In the waste starch ethanol feedstock scenario, net GHG savings (i.e. the point at which GHG savings from SAF and RD use offset GHG emissions from construction and operation) are forecast to occur during 2028 i.e. within 2 years of the Proposed Scheme becoming operational due to the greater lifecycle GHG savings of the SAF and RD products relative to the steel mill off-gas scenario. Total compounding net GHG emissions of 2,699,385 tCO_2e are forecast across the assumed 20-year lifespan of the Proposed Scheme in this scenario.

Summary

10.101 The sensitivity of the global climate system is considered to be high. The magnitude of net GHG effect (saving) is considered to be large (i.e. >10%) in relation to NPT's baseline emissions, future carbon budgets proposed for NPT and also contribution to Government forecast GHG savings from SAF update for the UK Fourth Carbon Budget, irrespective of ethanol feedstock route.

10.102 The magnitude of net GHG effect (saving) is considered to be medium (i.e. >5% to 10%) in relation to the contribution to Government GHG savings projections from SAF uptake during the Fifth Carbon Budget irrespective of ethanol feedstock route, and also medium for the Sixth Carbon Budget in the waste starch ethanol feedstock route.

10.103 The magnitude of net GHG effect (saving) is considered to be small (i.e. >1% to 5) in relation to Wales carbon budgets irrespective of ethanol feedstock route, and also in terms of contribution to Government GHG savings from SAF uptake in the Sixth Carbon Budget in the steel mill off gas ethanol feedstock route.

10.104 The magnitude of net GHG effect (saving) is considered to be negligible (i.e. <1%) in relation to all UK carbon budgets irrespective of ethanol feedstock route.

10.105 Government's GHG reduction projections from SAF uptake are considered the most appropriate context to aid the determination of significance given these projections are relevant to the Proposed Scheme in terms of both decarbonisation sector (i.e. aviation) and technology (i.e. SAF production).

10.106 The Proposed Scheme provides a large (i.e. >10%) contribution to these Government projections during the current (fourth) carbon budget, however only for a single year (2027, the first full year of operation). On balance, therefore it is the moderate (i.e. >5% to 10%) contribution to Government projected GHG savings from SAF uptake over the whole next (fifth) carbon budget that is deemed most appropriate to support the evaluation of significance.

10.107 In addition to this contribution of the Proposed Scheme towards Government GHG savings projections from SAF uptake, the Committee on Climate Change report *The Sixth Carbon Budget: Aviation (2020)*[24] includes a key policy recommendation to support the near-term construction of commercial SAF production facilities in the UK.

10.108 On this basis the Proposed Scheme is concluded to make an appropriate and early contribution to the UK net zero trajectory for this issue.

10.109 Therefore, there is likely to be a direct, permanent, long-term beneficial effect which is considered to be moderate.

Secondary Mitigation or Enhancement

10.110 No secondary mitigation or enhancement has been considered.

Residual Effect

10.111 In the absence of secondary mitigation, the residual effect remains as reported above for net GHG emissions.

10.112 The effect of net greenhouse gas emissions is considered to be Significant.

Limitations and Assumptions

10.113 To ensure transparency within the EIA process, the following limitations and assumptions have been identified.

- The assessment of GHG emissions has been based on a number of parameters and information contained within the Applicants AFF LCA, which is commercial sensitive and therefore not provided in full, or in limited detail. Nonetheless, given the LCA was undertaken in line with DfT guidance and requirements, confidence can be placed on the content and applicability of it as part of this assessment, including those elements of upstream and downstream emissions and savings from the use of SAF;

- Upstream GHG emissions associated with the ethanol feedstock have been based on the two possible options considered as part of the AFF LCA prepared by the Applicant. The sources are not restrictive and are considered representative of potential options of ethanol feedstock. Furthermore, as set out within this Chapter, the two sources include a series of assumptions in and around the production of the ethanol (i.e. transportation), again determined in line with DfT guidance and requirements, as well as information available to the Applicant;

- Use of the DEFRA SIC code supply chain factor has the potential to over or under-estimate construction stage GHG emissions;

- The process water and heat efficiency measures are incorporated into the AFF LCA calculations and therefore considered by this assessment;

- GHG emissions from decommissioning of the Proposed Scheme are excluded given the significant challenges and inherent uncertainty of estimating. That said, much of the facilities' process plant and wide infrastructure is likely to include high proportions of steel and other metals that are highly recyclable and as a result GHG emissions are considered likely to be significantly lower than those estimated during construction; and

- GHG emissions associated with the demolition of buildings within TCA East have not been considered within this assessment and calculations. However, such emissions are not perceived to fundamentally change the assessment outputs given the relatively minor level of demolition works proposed.

Summary

10.114 **Table 10.19** provides a summary of the effects, receptors, residual effects and conclusions of significance considered within the Chapter.

10.115 The table only provides a summary of the residual effects identified within the assessment and details of all primary, secondary and tertiary mitigation that has been taken into account is set out in detail within the Chapter and summarised within the Environmental Management Plan included within **Volume 3: Environmental Management Plan**.

Table 10.21: Summary of Residual and Significant Effects

Effect	Receptor	Residual Effect	Is the Effect Significant?
Construction & Operational Stage			
Net GHG Effect	Global Climate System	Moderate Beneficial	YES

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