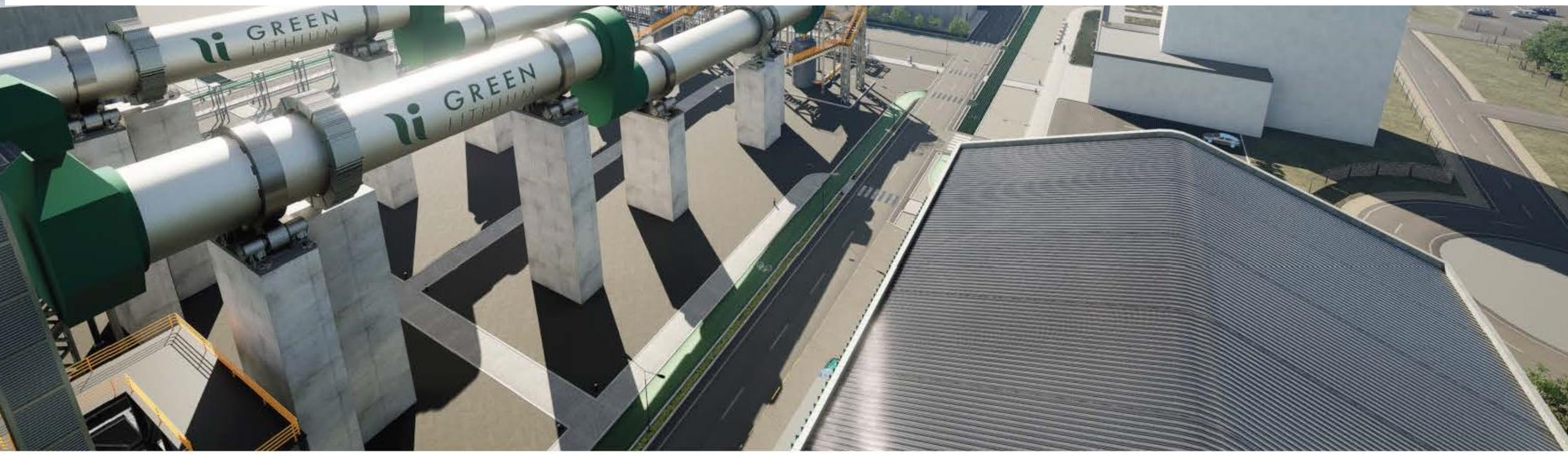
CHAPTER 13 CLIMATE CHANGE & CARBON



13. CLIMATE CHANGE & CARBON

13.1. This chapter of the ES considers the possible climate change impacts derived from the Proposed Development of the application site.

13.2. The chapter follows IEMA Guidance for *Assessing Greenhouse Gas Emissions and Evaluating their significance*. As noted in previous chapters, full details of the development proposals are set out in Chapter 5: The Proposed Development.

13.3. Other aspects of climate change, such as the susceptibility of the plant to future climate change effects, are addressed within other chapters within the ES. As such, the 'Mitigation', 'Screening Process', and 'Scoping Process' stages of the guidance has been clarified and discussed within the accompanying technical chapters of the ES. Therefore, this chapter focusses on the remaining stages of the guidance, namely; 'GHG Emissions Assessment', 'Significance', and 'Communications/Reporting'.

13.4. The applicant proposed to develop a chemical plant for the production of battery-quality LHM, using imported spodumene concentrate feedstock. This process will use a combination of metallurgical processes to separate lithium from the spodumene concentrate and converting it to LHM.

13.5. The potential impact of the proposed LHM Production Plant on climate change, and the potential impact of climate change on the Proposed Development have been considered throughout the design of the proposal.

13.6. It is key to note that the principal Climate Changes benefits of the proposed scheme, come primarily through the provision of new regional infrastructure to produce battery-grade Lithium Hydrate Monohydrate and the most modern and best available technology relating to the treatment of Spodumene.

13.7. Secondary benefits from manufacturing LHM is the potential use in electric vehicles, displacing transport-associated fossil fuels such as diesel and petroleum.

13.8. To quantify the impact on climate change from the Proposed Development, an ISO 14040/14044 compliant LCA emissions calculation was conducted, to assess and compare the Global Warming Potential (GWP) of the proposed LHM Production Facility with existing production scenario for this chemical type and current Lithium refinery.

13.9. The results of the life cycle assessment on production of LHM are presented as Global Warming Potential (GWP).

13.10. This chapter of the ES has been prepared by Naomi Rumley of Sol Environment Ltd. Sol Environment are established low carbon and sustainability consultants. Naomi achieved an MSc in Sustainability & Consultancy and has 3 years' experience working in the construction sector. In addition, Naomi is an IEMA Practitioner member and a qualified ISO 14064 Lead Auditor Greenhouse Gas Lead Verifier.

PLANNING POLICY AND GUIDANCE

13.11. There are a number of underlying key national planning policy and guidance documents that underpin and support the current proposal. These policies are discussed in detail in the main planning statement that accompanies this ES.

13.12. The principal Directives and policies that are considered applicable are provided below:

- UK Climate Change Act 2008: Which sets legally binding targets for greenhouse gas emissions through action in the UK and abroad of at least 80% by 2050, and reductions in CO_2 emissions of at least 26% by 2020, against a 1990 baseline. In June 2019, the Climate Change Act was amended to reduce the UK's net emissions of greenhouse gases by 100% relative to 1990 levels by 2050.
- The White Paper "*Meeting the Energy Challenge*" (published 23rd May 2007): Sets out the UK Government's international and domestic energy strategy. It addresses the long-term energy challenges the UK faces and delivers energy policy goal of cutting carbon dioxide emissions.
- The UK Low Carbon Transition Plan (published 15th July 2009): A published strategy for the UK's transition to become a low carbon country. The White Paper sets out the Transition Plan to 2020 for transforming the power sector; homes and workplaces; transport; farming and the way waste is managed to meet carbon budgets.
- UK Renewable Energy Strategy 2009: A strategy to help tackle climate change, reducing the UK's emissions of carbon dioxide and promote security of energy supplies.
- National Planning Policy Framework (Re-published in 2019): Provides a strong presumption in favour of sustainable development together with strong encouragement to projects that would lead to a reduction in greenhouse gases.
- Redcar and Cleveland Borough Council – The Council have a number of pledges and commitments in place to reduce the climate change of their operations and to achieve a carbon neutral Redcar and Cleveland by 2030. It is recognised within their policies that it is more important than ever to develop adaptation strategies to reduce the future impact of severe weather events and a changing climate.

SCOPE OF ASSESSMENT

13.13. The assessment follows IEMA Guidance for *Assessing Greenhouse Gas Emissions and Evaluating their significance*. The assessment presented in this chapter covers the impacts of the project on climate through the quantification of GWP resulting from the Proposed Development.

13.14. An ISO 14040/14044 compliant LCA carbon emissions assessment has been completed by Minviro. This assessment has been used for emissions calculations to inform this chapter.

13.15. This assessment includes a comparison of the baseline and the proposed scenario, assessing the climate change impact from the proposed LHM production facility (operational) against existing processing options (baseline), following the ISO 14040 and 14044 Standards.

13.16. The LCA models the production of LHM from spodumene concentrate at the future Green Lithium Refining Limited chemical plant. The life cycle impacts of all stages of the chemical process have been modelled.

13.17. The primary input and output of the refining process can be found below and assumes the baseline operational scenario of.

- **Primary Raw Material Input:** Spodumene ore - 510,000 tonnes per annum (TPA), typically sourced from Western Australia; and
- **Primary Product Output:** LHM ($LiOH{\cdot}H_2O$) - 75,000 tonnes per annum (TPA), typically exported to the UK domestic market.

13.18. The LCA also includes production of the feedstock and transportation impacts of importing raw materials and chemical reagents to the plant. Other reagents used in the process are transported to Teesside by a mixture of sea, road and rail from both within the UK and continental Europe.

13.19. This assessment focuses on the process design (refinery) and transport. Emissions from construction materials were not included in the assessment as they have been considered earlier in the design phase and will be subject to separate sustainability [BREEAM] Appraisal. These emissions will be discussed at the end of this chapter in the Mitigation and Limitations sections.

13.20. The temporal scope of the assessment is for one operational year. This is assumed to be 2026 for the projected first full year of operation of the Green Lithium Refining Limited production plant.

ASSESSMENT METHODOLOGY

13.21. The ISO Standards 14040 and 14044 for Life Cycle Assessments (LCAs) have been utilised to assess and model the potential environmental impacts and benefits of the proposal.

13.22. The aim of this assessment was to complete a GHG assessment for the operation of the proposed facility and compare these assessment results with the baseline scenario.

13.23. Results are presented as GHG emissions expressed as carbon dioxide equivalent (kg CO_2e) and carbon dioxide equivalent per kilogram of LHM (kg CO_2e / kg $LiOH.H_2O$).

13.24. Mitigation opportunities will be considered following the results of the above scenarios.

13.25. The significance of the Climate Change impacts from the Proposed Development will then be concluded.

SCENARIOS AND BASELINE

13.26. The baseline scenario is the current processing of lithium, whereby Lithium is sourced from Australia where it is concentrated, and then transported and refined in China by traditional methods and then imported into the UK for use.

13.27. In the operational scenario, this is the processing of lithium, which is still sourced and concentrated in Australia, but refined in the UK at the proposed Green Lithium Refining Limited plant.

13.28. Both scenarios were assessed from mining to production and include the Global Warming Potential (GWP) of the chemical plant processes and the transport of raw materials and reagents. A contribution analysis for the chemical plant was carried out as part of the assessment and breakdown of the reagents and process impacts are listed below.

- Spodumene Concentration
- Electricity
- Natural Gas (Calcination)
- Natural Gas (steam)
- Sodium Carbonate
- Calcium Oxide
- Sodium Phosphate
- Sodium Hydroxide
- Hydrochloric Acid
- Sulphuric Acid
- Nitrogen
- Carbon Dioxide
- Transport

RESULTS

13.29. In accordance with the IEMA GHG assessment guidance, the assessment quantifies the difference in GHG emissions between the proposed project operational and the baseline scenarios. This reflects the difference in emissions between these scenarios and the affect the proposed facility would have on emissions.

13.30. The headline results are included in Table 13.1 below.

Table 13.1: Assessment Results for GWP

Scenario	GWP (kgCO_2e per kg $LiOH{\cdot}H_2O$)	GWP (TCO_2e/PA)
Baseline	16.2	1,215,000
Operational	12.1 (see table 13.1A for breakdown)	907,500

Table 13.1A: Breakdown of Operation Scenario Carbon

Component	Specific GWP
Spodumene Concentrate	3.4 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Electricity	1.5 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Natural Gas (Calcination)	2.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Natural Gas (Steam)	1.5 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Sodium Carbonate	0.5 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Calcium Oxide	1.3 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Sodium Phosphate	0.2 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Sodium Hydroxide (50%)	$<$ 0.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Hydrochloric Acid (32%)	0.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Sulphuric Acid (98%)	$<$ 0.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Nitrogen	0.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$

Carbon Dioxide	0.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Transport	0.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$
Total	**12.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$**

13.31. The results clearly show the GWP benefits from the construction of the proposed Lithium Refinery Facility compared to the current baseline scenario. A contribution analysis of the impacts can be found in Figure 13.1 for the Baseline, and 13.2 for the Operational scenario.

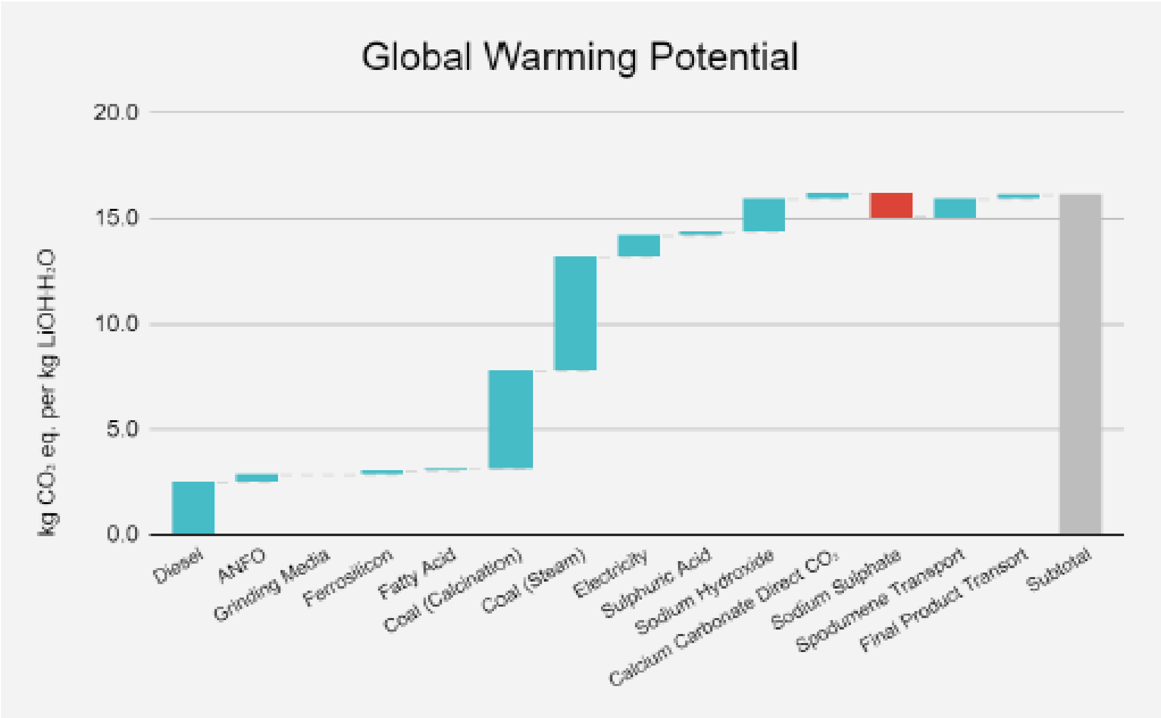


Figure 13.1: Global Warming Potential Contribution Analysis – Baseline Scenario

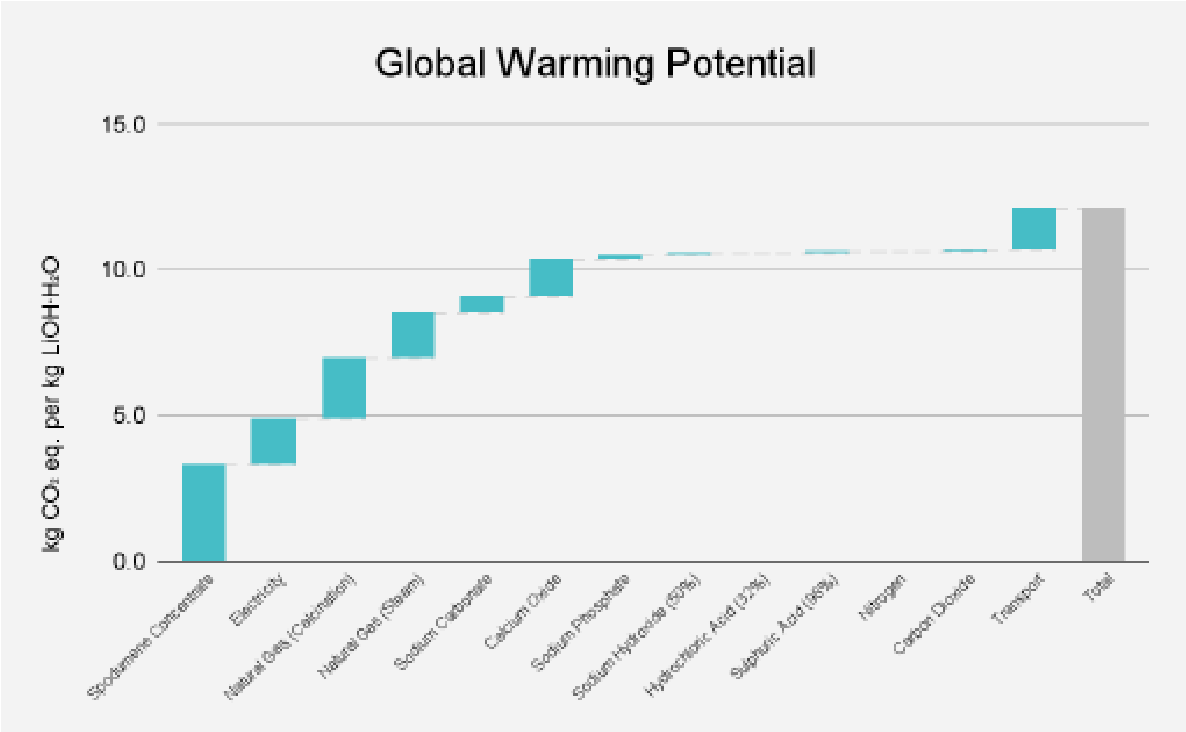


Figure 13.2. Global Warming Potential Contribution Analysis – Operational Scenario

13.32. The **baseline scenario** results in an **annual global emissions of 1,215,000 T CO_2e** predominantly from the process of Lithium refinery.

13.33. The **operational scenario** reduced this figure by **307,500 tonnes CO_2e** and results in **net annual emissions of 907,000 T CO_2e** through the use of gas fired calciners (as opposed to coal), the use of alkali leaching technologies (as opposed to acid leaching), and the lack of any direct releases of CO_2 as a result of the reaction chemistry of calcium carbonate.

13.34. The net emissions from the Green Lithium Refining Limited scenario are currently 75% of the current baseline scenario, with the potential to reduce the emissions by a further 42% (5.1 kg CO_2 eq. per kg $LiOH·H_2O$) due to the future displacement of natural gas with hydrogen once an industrial scale supply is established within Teesside and the import and use of certified renewable grid electrical generation sources.

Mitigation

13.35. Mitigation has been considered at all stages of the facility's design development and technology selection. The mitigation measures for energy, transport, and materials detailed in this section are in line with IEMA's GHG management hierarchy principles, Table 13.2.

Table 13.2: IEMA GHG Mitigation Hierarchy	
Principle	**Description**
Do Not Build	Evaluate the basic need for the proposed project and explore alternative approaches to achieve the desired outcome/s
Build Less	Realise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required
Design Clever	Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption and embodied carbon during the construction, operation, user's use of the project, and at end-of-life The process technology selection has been chosen due to its lower intrinsic carbon emissions, ability to operate using hydrogen fuels, and access to the Teesside carbon capture network. The combustion technology is located within adjacent to the proposed Teesside carbon capture and storage scheme and can be connected in the event that the necessary hydrogen infrastructure is not developed or available.
Construct Efficiently	Use techniques (e.g., during construction and operation) that reduce resource consumption and associated GHG emissions over the life cycle of the project
Offset and Remove Emissions	As a complementary strategy to the above, adopt off-site or on-site means to offset and/or sequester GHG emissions to compensate for GHG emissions arising from the project. The contract, import and use of certified renewable energy sources for all process related electrical uses.

13.36. The mitigation opportunities below were unable to be considered in this GHG assessment due to unknown variables and limited available data.

Energy

13.37. Key mitigation measures adopted by the Proposed Development to minimise GHG emissions from energy use over the building's operational phase include the following:

- Renewable Energy generated through roof-mounted PV array
- Heat recovery from the process used for the building.

13.38. The processes uses natural gas, which has been demonstrated as a major driver of operational emissions. Green Lithium Refining Limited have designed the process to be able to be operated solely on hydrogen as a low carbon substitute to natural gas for both the calcination and steam production process. The transition to hydrogen is dependent on a development of the necessary hydrogen infrastructure at

Teesside, which despite being a key part of the industrial aspirations of the wider Teesside regeneration scheme, is beyond the control of the applicant.

13.39. In the event that the necessary hydrogen infrastructure is neither constructed nor available, due to the proximity of the development site to the proposed Teesside Carbon Capture and Storage scheme, connection is considered both feasible and desirable.

13.40. The combination of fuel switching to hydrogen and the import and use certified renewable electricity to power the process, it is possible to reduce the over Scope 1 and 2 GHG emissions to near zero.

13.41. Once there is a better understanding of site detailed energy demand, future H_2 capacity and CCUS development timescales and demands, further detailed renewable energy, low and zero carbon energy strategies will be developed.

13.42. It is therefore proposed that each development phase of the project is accompanied by a detailed energy strategy that outlines the specific measures to ensure that the project achieves the lowest possible operational carbon impact.

Transport

13.43. Mitigation of transport impacts was considered in Minviro's Life Cycle Assessment. Comparison was made between the impacts of different global producers of spodumene for the process. Potential sources of spodumene ore included in the comparison were Brazil, Canada and Ghana. The impacts can be found in Table 13.3 below.

Table 13.3: Ranges of Impacts for Different Spodumene Concentrate Products

Spodumene Scenario	GWP for Spodumene Concentrate (kg CO_2 eq. per kg of Spodumene Concentrate)
Western Australia (Base Case)	0.68
Minas Gerais, Brazil	0.57
Quebec, Canada	0.38
Central Region, Ghana	0.32

13.44. Another potential mitigation is the use of biodiesel or electric vehicles for the various transport stages of the process. At this stage the vehicles are unknown for use, so therefore the model assumes the worst case scenario that all vehicles are diesel fuelled.

Design and Materials

13.45. The design and materials used on the project follow the *Design Clever* principles.

13.46. The materials proposed for the facility, such as steel, glass, and aluminium can be recycled with almost no loss of performance. Materials which contain CFCs or use them in their manufacture will be avoided. Recycled aggregate and masonry will be used where practicable, including base material for the construction of the access road for the facility.

13.47. Ground Granulated Blast Furnace Slag (GGBS) would be considered for all concrete works as a replacement for Portland cement in concrete mixes to reduce carbon emissions.

13.48. Established principles of low energy design have been used in the design of the building. These include:

- The construction methods and systems used would keep air leakage to a minimum. The building envelope would be to, or in excess of, the new airtight standards required by the building regulations;
- Using locally sourced materials and suppliers. This requirement would be built into the employers’ requirements; and
- Using materials with a high recycled content and high sustainability / low embedded carbon content.

DATA LIMITATIONS

13.49. There were various limitations to the scope and results due to unknown aspects of the project. Summarily, these are:

- Data used to produce the Life Cycle Impacts of the baseline scenario have been obtained from public sources and do not refer to specific operators or process technologies. The data was gathered from generic datasets developed by Minviro.
- The scope of the Life Cycle Assessment excludes the energy intensive spodumene extraction process from the system boundary.
- The study allocates all impacts to the production of LHM. Green Lithium Refining Limited have specifically designed their process to be able to produce an analcime sand by-product that can be used as a direct raw materials replacement within the cement and construction sector.

The production and use of this by-product has the potential to significantly reduce the Scope 3 GHG impacts of the process.

- The study excludes the displacement of emissions from diesel and petroleum vehicles as a result of manufacturing electric vehicles using the battery-grade product.

SIGNIFICANCE CRITERIA

13.50. The UK has set a legally binding GHG reduction target for 2050 with interim five-yearly carbon budgets which define a trajectory towards net zero. The 2050 target (and interim budgets set to date) are, according to the CCC, compatible with the required magnitude and rate of GHG emissions reductions required in the UK to meet the goals of the Paris Agreement, thereby limiting severe adverse effects.

13.51. To meet the 2050 target and interim budgets, action is required to reduce GHG emissions from all sectors, including projects in the built and natural environment. EIA for any proposed project must therefore give proportionate consideration to whether and how that project will contribute to or jeopardise the achievement of these targets.

13.52. The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050.

13.53. The principles in Table 13.4 overleaf are a guide to determining significance of GHG emissions.

13.54. When taking into account the full contribution that the project makes towards reducing development and global roll out of zero emissions vehicles, the adaptability of the technology to operate using hydrogen, plus the production of a usable low carbon aggregate by-product the overall project's net GHG impacts are below zero.

13.55. The conclusion of this assessment is that project, when fully developed and operational will lead to a material reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. Therefore, the project is considered to be **Beneficial**.

Table 13.4 Significance Principles	
Level of Significance	Definition
Major Adverse	The project's 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. 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.
Moderate Adverse	The project's 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. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.
Minor Adverse	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.
Negligible	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. 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.
Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

CONCLUSIONS

13.56. The development of the proposed project of a regional LMH Production facility would deliver carbon benefits over the current management method (baseline scenario) involving the transport of Australian-sourced spodumene to a traditional Lithium refinery.

13.57. Based on the baseline emissions and design scenario, the proposed facility will provide a 307,000 TCO_2e reduction in carbon emissions per year, equivalent to savings of more than 25% compared with current manufacturing techniques.

13.58. In the event that the Proposed Development transitions to both hydrogen and renewable electrical supplies, the potential Scope 1 and 2 GHG emission savings would reduce by a further 42% (5.1 kg CO_2 eq. per kg $LiOH{\cdot}H_2O$) and tending towards zero.

13.59. Additional reductions from the manufacture of usable aggregate by-products (analcime sands) further reduce the Scope 3 GHG emissions.

13.60. The impact of the resulting GHG emissions from the project are considered to be Beneficial, as the results of the assessment demonstrate that the project will achieve the definition provided by IEMA.

13.61. The project's GHG impacts cause a reduction in atmospheric GHG concentration, 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.

13.62. When the Green Lithium Refining Limited refinery process is compared directly to the current refinery route it is far better in terms of GWP and improves on the results discussed above even further. The operational scenario would reduce the baseline atmospheric carbon emissions by 307,500 TCO_2e per annum when compared with the baseline scenario of 1,215,000 T CO_2e.

REFERENCES

NONE