16. Effects on Climate

16.1. Introduction

16.1.1. This chapter presents the assessment of the Proposed Scheme on climate during construction and operation. It identifies the study area, describes the methodology, presents baseline conditions, identifies the potential impacts on climate and presents suggested mitigation measures.

16.1.2. The Proposed Scheme has the potential to affect the Earth's climate by increasing the emissions of Greenhouse Gases (GHGs) into the atmosphere, which would occur during construction and operation. The earth absorbs energy from the sun and re-emits it as thermal infrared radiation. GHGs in the atmosphere absorb this radiation, preventing it from escaping into space. The higher the concentration of GHGs, the more heat energy is retained, and the higher global temperatures become. Due to human activities the concentration of GHGs in the atmosphere has increase dramatically, leading to global warming. This leads to myriad indirect impacts as the climate responds to the increased atmospheric temperature.

16.1.3. The UK and Scottish Government have made commitments to tackle the root cause of climate change by reducing GHG emissions, as well as to increase the resilience of development and infrastructure to the changing climate. The Climate Change (Emissions Reduction targets) (Scotland) Act 2019 sets a target to reduce net GHG emissions by at least 100% from 1990 levels by the year 2045.

16.1.4. The effective assessment and management of impacts on climate offers the opportunity to reduce the impact of projects on climate by minimising the magnitude of GHG emissions as far as possible.

16.2. Approach and Methods

16.2.1. The methodology for the assessment of the Proposed Scheme aligns with Design Manual for Roads and Bridges (DMRB) LA 114, the IEMA Guide: Assessing Greenhouse Gas Emission and Evaluating their Significance (referred (referred to hereafter as the IEMA 2022 guidance) and Publicly Available Specification (PAS) 2080: Carbon Management in Infrastructure and Buildings.

16.2.2. The approach and methods have been informed by the legislation, policy and guidance and that a full list of those that are relevant to the topic are contained in Volume 4 Appendix 16-1 Effects on Climate legislation, policy and guidance.

Study Area

16.2.3. The study area has been defined according to DMRB LA 114. For the construction and operational maintenance, the study area comprises the GHG emissions associated with project construction related activities/materials and their associated transport. The study area is not limited to the geographic extent of the Scheme itself, as many emissions would result from upstream and off-site activities such as raw material extraction and processing.

16.2.4. The activities for which emissions have been quantified in the assessment are detailed in Table A16-2.1 in Volume 4 Appendix 16-2 Effects on climate methodology.

Method of Baseline Collection

16.2.5. A desktop review of information on current GHG emissions has been undertaken to understand the baseline conditions in the effects on climate study area. The assessment for effects on climate has used online data sources that are publicly available. The following sources have been used:

- 2023 UK Provisional Greenhouse Gas Emissions (Department for Energy Security and Net Zero)
- 2022 UK Greenhouse Gas Emissions (Department for Energy Security and Net Zero)
- Scottish Greenhouse Gas Statistics 2021 (Scottish Government)
- UK local authority and regional greenhouse gas emissions national statistics: 2005-2021

Consultation

16.2.6. No specific consultation has been undertaken for the effects on climate assessment as no matters of concern have been identified.

16.2.7. Public consultation was undertaken between 26 May and 7 July 2023 which included four days of public exhibitions in Arrochar and Lochgilphead in June 2023 and the virtual exhibition online. Further public consultation was undertaken between 18 March and 10 May 2024 both online and at public exhibitions.

Assessment Methodology

16.2.8. The methodology for the assessment of the Proposed Scheme aligns with DMRB LA 114, IEMA 2022 guidance and PAS 2080: Carbon Management in Infrastructure and Buildings. A full breakdown of the methodology is found in Volume 4 Appendix 16-2 Effects on Climate Methodology.

16.2.9. It is key to note that whilst Effects on Climate is a wide-ranging topic in terms of potential sources, it is simple in terms of its receptors and impacts because:

- there is only one receptor, the atmosphere
- there is only one direct impact, climate change and
- all units of CO_2e can be considered to have the same impact no matter where they are emitted.

16.2.10. Therefore, assessment of the effects of the Proposed Scheme on climate has been limited to quantification of the magnitude of GHG emissions, from individual sources and in total, and comparison of these to the baseline. Different GHGs have different global warming potentials, and to account for this they have been reported throughout this assessment as their carbon dioxide equivalent (CO_2e) value.

16.2.11. The goal of the assessment was to calculate the emissions anticipated to be generated by the Proposed Scheme to:

- determine the magnitude of the Proposed Scheme's effect on climate, in comparison with the Do-Minimum Scenario
- assess the significance of the effect on climate by considering it in the context of the Scottish carbon reduction targets and
- enable identification of emissions hot spots within the Do Something Scenario to inform the identification of appropriate mitigation measures.

16.2.12. Emissions were primarily calculated by using the Transport Scotland's Roads Project Carbon Tool v1.4.

16.2.13. For this assessment, the Interim emission reduction targets for Scotland have been used. Additionally, as noted in DMRB LA114 Scotland National Application Annex, a comparison of the Proposed Scheme should be undertaken to the transportation sector's emissions envelope from the Scottish Government Climate Change Plan 2018-2032. Both of these are summarised in Volume 4, Appendix A16.1 Effects on Climate Legislation, Policy and Guidance.

16.2.14. It is noted that the Interim emission reduction targets for Scotland have been scrapped by the Scottish Government. However, in the absence of new targets, the Interim emission reduction targets have been used for this assessment.

Limitations of the Assessment

16.2.15. The key limitation of the assessment is that it has been based on a Preliminary design. Further refinement of the design will take place as part of the specimen and detailed design processes which will alter the quantity and types of materials used in the design and subsequently impact the GHG emissions assessments. This has required assumptions to be made, and some industry standard data to be used as a proxy.

16.2.16. The following assumptions have been made during the carbon assessment:

- construction of the Proposed Scheme will begin in 2026 and end in 2031
- the first year of operation will be 2032 and the Proposed Scheme will operate for at least 60 years
- all signage is made from aluminium
- all drainage pipework is made from High-density polyethylene
- all materials are transported via Heavy Good Vehicles to the site
- operational energy consumption will be 2.4 GWh per year and will operate from grid electricity
- the following replacement cycles are proposed for key materials within the Proposed Scheme:
  - structural concrete and steel will last the lifetime of the Proposed Scheme
  - asphalt will be replaced every 15 years
  - fencing, pavement components, traffic signs and drainage materials will be replaced every 25 years.
- carbon factors are drawn from the Transport Scotland Carbon calculator & assessment system roads projects carbon tool v1.4
- the total volume of peat to excavated is calculated to be 46,100m^3 (taken from Volume 4, appendix 12.6 – Outline Peat Management Plan)

- the entire carbon stock of a habitat is lost when a habitat area is lost
- the entire carbon stock of peat is lost when the peat is excavated or disturbed and
- the net annual emissions rate (tCO_2e/ha/year) for each habitat type remains the same for the entire 60-year operational appraisal period.

Sub-Topics Scoped Out of the Assessment

16.2.17. During operation, there is no anticipated change in speed band, fleet makeup or volume of traffic on the Proposed Scheme, nor a change in road alignment with the Proposed Scheme, therefore operational road-user emissions are scoped out of the DMRB Stage 3 EIA.

16.2.18. During construction, staff and contractors will travel to site. The number, distance and method of travel for these staff is not yet known and so has been scoped out of the assessment. GHG emissions from staff travel is considered to be negligible compared to the rest of the assessment.

16.2.19. There is no anticipated end-of-life date for the Proposed Scheme nor a planned decommissioning phase of the Proposed Scheme. Therefore, decommissioning emissions are scoped out of EIA.

16.3. Baseline Conditions

National emissions baseline

16.3.1. The UK's provisional GHG emissions from 2023 were 384.2 $MtCO_2e$, 5.4% lower than in 2022. The transport sector was the largest emitting sector, contributing 29% of emissions. The transport sector's emissions fell 1% from 2022 and has fallen 14% from 1990 levels. In 2022, the UK emitted 406.2 $MtCO_2e$, down 3.5% from 2021.

16.3.2. In 2021, the last reported year, Scotland emitted 41.6 $MtCO_2e$, up 2.4% from 2020 This is predominantly due to an increase in emissions from the domestic transport and residential sectors following the impact of the COVID-19 pandemic lockdown in 2020. Emissions have fallen by 49.9% since 1990, missing the interim target of a 51.1% reduction for 2021. The transport sector was the largest emitting sector, contributing 26% of emissions.

Regional emissions baseline

16.3.3. In 2021 (last reported year) emissions for Argyll and Bute were 256.7 $ktCO_2e$, a 51% reduction from 2005, but a 49% increase from 2020. This increase from 2020 to 2021 is primarily due to a decrease in the carbon sequestered through land-use.

16.3.4. Transportation is the second largest emitting sector, after agriculture, accounting for 23% of emissions (excluding emissions sequestered through land-use).

Site specific baseline

16.3.5. The site consists of the A83 and surrounding habitat as the road traverses through Glen Coe. Road-user emissions have not been calculated for the baseline as they have been scoped out of the assessment. The road has no street lighting and therefore no operational energy requirements.

16.3.6. It has been estimated that 6 tCO_2e of carbon is sequestered per year because of natural habitat within the Proposed Scheme Boundary, as identified from the habitat assessment included in Volume 2, Chapter 11: Biodiversity. It is assumed that this rate of sequestration will remain constant over the next 60 years.

16.3.7. Maintenance emissions for the baseline (Do-Minimum) have not been calculated as the frequent closure of the road due to landslips and damage means that maintenance requirements for the road are inconsistent and unique to the damage sustained rather than the road being subject to a regular maintenance schedule. Therefore, it is not possible to adequately calculate the site-specific baseline GHG emissions for the Proposed Scheme on a yearly basis as the emissions will vary greatly depending on the damage done to the road during that year. In line with best practice, as a worst-case scenario, it is assumed that site specific emissions from maintenance are 0 tCO_2e/year.

Future Baseline

16.3.8. If the Proposed Scheme is not constructed, then traffic flows at the site are anticipated to remain similar to existing traffic flows. Future traffic flows on the A83 would remain similar without significant development occurring either side of the Proposed Scheme that significantly increase traffic (i.e. housing development). Therefore, emissions would continue to decrease in line with the continued uptake of electric vehicles. It is anticipated that emissions at the site would reach net zero by 2045, in line with Transport Scotland's National Transport Strategy.

16.4. Embedded Mitigation

16.4.1. Embedded mitigation measures are those which are incorporated into the design to avoid or prevent GHG emissions. DMRB LA 114 notes that *"minimising GHG emissions through design is a core principle of the Government's Infrastructure Carbon Review and the Specification on infrastructure carbon management PAS 2080:2016"*. Mitigation measures which have been embedded into the design (as detailed in Chapter 4: The Proposed Scheme are shown in Table 16.1.

Table 16.1 - Embedded mitigation measures

Life cycle module	Mitigation measures
A4 – Transportation	Where aggregates for earthworks, drainage and pavement need to be imported, the current commitment is to procure these from sources local to the Proposed Scheme, such as authorised quarries (EC-Embed-1).
A1-3 Materials	A surplus earthworks balance of approximately 323,250m^3 is forecast. This material will be reused where practicable, both onsite and offsite (EC-Embed-2).

16.5. Potential Impacts

Construction impacts

16.5.1. The construction of the Proposed Scheme would lead to increased greenhouse gas emissions due to activities such as producing construction materials, transporting materials and workers to the site, and various construction-related activities like fuel combustion, land use change, and waste management. These emissions are likely to constitute only a small percentage of the Scottish Government's carbon reduction targets, and in isolation, is unlikely to affect the Government's ability to meet its carbon reduction targets.

16.5.2. The construction phase of the Proposed Scheme will generate 82,809 tCO_2e. As emissions from construction do not occur in the Do-Minimum scenario, it can be considered that the construction stage of the Proposed Scheme would have the impact of releasing an additional 82,809 tCO_2e into the atmosphere in the Do-Something scenario.

Table 16.2 - Construction phase (Do-Something) emissions

Category	Emissions (tCO_2e)
Materials	62,200
Material and waste transport	5,571
Waste treatment	239
Construction plant	11,606
Land-use change (including peat)	3,193
Total emissions	82,809

Operational impacts

16.5.3. The operation of the Proposed Scheme would lead to increased greenhouse gas emissions due to operational energy consumption, maintenance activities and replacement of components. These emissions are likely to constitute only a small percentage of the Scottish Government's carbon reduction targets, and in isolation, is unlikely to affect the Government's ability to meet its carbon reduction targets.

16.5.4. The calculated operational phase emissions for the Do-Something scenario, compared with the Do-Minimum, are shown in Table 16.3.

16.5.5. The Do-Something scenario of the Proposed Scheme will generate an additional 364 tCO_2e in the Opening Year and 12,750 tCO_2e over the 60-year operational period compared with the Do-Minimum.

Table 16.3 - Operational phase emissions (tCO_{2e})

Lifecycle	2032 Do-minimum	2032 Do-something	Difference	Total over 60-year operation* (Do-minimum)	Total over 60-year operation* (Do-something)	Difference
Maintenance and replacement	No data	No data	No data	0	10,019	10,019
Operational energy	0	358	358	0	2,371	2,371
Land-use and forestry	-6	0	-6	-360	0	-360
Total emissions	-6	358	364	-360	12,390	12,750

Table Note: Biodiversity Net-Gain sites have not been included in the Do-Something scenario

Comparison to Scottish Government carbon reduction targets

16.5.6. Table 16.4 shows the GHG emissions that the Proposed Scheme would contribute to the Scottish Government carbon reduction targets (as specified in Table A16-1.2 in Volume 4 Appendix 16-2 Effects on Climate Methodology) and the proportion of each target that the Proposed Scheme would contribute to.

16.5.7. It should be noted that the carbon reduction target for 2045 is 100%, i.e. Net-zero, however it is anticipated that a small level of residual emissions will remain which will be offset (via sequestration, carbon capture etc.). This offsetting will occur at a national level rather than a project level.

Table 16.4 - Comparison of the Proposed Scheme to Scottish Government carbon reduction targets

Project stage	Estimated total carbon (2026 – 2045) (tCO_2e)	Net CO_2 project GHG emissions (tCO_2e) (Do-Something – Do-Minimum)	2030 - 75.0% reduction	2035 - 82.5% reduction	2040 - 90.0% reduction	2045 - 100% reduction
Construction	82,809	82,809	13,802	No data	No data	No data
Operational	1,870	1,954	No data	177	69	48
Total	84,679	84,783	13,802	177	69	48
Percentage of carbon reduction target	Not Applicable	Not Applicable	0.068%	0.001%	0.001%	Not Applicable

Comparison to Scottish transportation sectoral emissions envelope

16.5.8. Table 16.5 shows the GHG emissions that the Proposed Scheme would contribute to the Scottish transportation sectoral emissions envelope (as specified in Table A16-1.3 in Volume 4 Appendix 16-2 Effects on Climate Methodology) and the proportion of each target that the Proposed Scheme would contribute to.

Table 16.5 - Comparison of the Proposed Scheme to Scottish transportation sectoral emissions envelope

Project stage	Sectoral emission budget (tCO_2e) 2026 (6.9 $MtCO_2e$)	Sectoral emission budget (tCO_2e) 2027 (6.6 $MtCO_2e$)	Sectoral emission budget (tCO_2e) 2028 (6.5 $MtCO_2e$)	Sectoral emission budget (tCO_2e) 2029 (6.5 $MtCO_2e$)	Sectoral emission budget (tCO_2e) 2030 (6.5 $MtCO_2e$)	Sectoral emission budget (tCO_2e) 2031 (6.5 $MtCO_2e$)	Sectoral emission budget (tCO_2e) 2032 (6.5 $MtCO_2e$)
Construction	13,802	13,802	13,802	13,802	13,802	13,802	No data
Operation	No data	No data	No data	No data	No data	No data	358
Total	13,802	13,802	13,802	13,802	13,802	13,802	358
Percentage of sectoral emission envelope	0.20%	0.21%	0.21%	0.21%	0.21%	0.21%	0.01%

Significant effects

16.5.9. Emissions have been calculated to contribute 84,783 tCO_2e net emissions towards the Scottish Government carbon reduction targets up until Net Zero is achieved in 2045. With the exception of the 2045 carbon reduction target, the Proposed Scheme would contribute no more than 0.068% to any Scottish Government carbon reduction target.

16.5.10. The 2045 target is 100% reduction (i.e. Net Zero) and therefore any GHG emissions would breach this target. However, it is expected that residual GHG emissions would still occur in 2045 and require offsetting. The requirement to offset these residual emissions from 2045 onwards will be managed at a national level to ensure that the Scottish Government net zero target is met and therefore there is no requirement to offset these residual emissions at a project level. The Proposed Scheme will emit only 48 tCO_2e in 2045, a negligible amount of emissions to offset.

16.5.11. Given the contribution of the Proposed Scheme to the carbon reduction targets it is considered the Proposed Scheme would not impact the Scottish Government's ability to any of its carbon reduction targets.

16.5.12. It is considered that this magnitude of emissions from the Proposed Scheme will not have a significant effect on climate.

16.5.13. This is in line with the position set out in DMRB LA 114 Note 2 which states "*it is considered unlikely that projects will in isolation conclude significant effects on climate*".

16.6. Mitigation

16.6.1. Further mitigation is not required to alter the outcome of the assessment, however DMRB LA 114 states that "*Projects shall seek to minimise carbon emissions in all cases to contribute to the UK's target for net reduction in carbon emissions*". This requirement applies whether or not the Scheme is anticipated to generate a significant effect on climate. Emissions are mitigated by applying the carbon reduction hierarchy set out in DMRB LA 114: Avoid / Prevent, Reduce, Remediate. Items at the top of the hierarchy have a greater potential to reduce emissions and are prioritised.

Table 16.6 - Mitigation measures

Mitigation reference	Mitigation Measures
EC1	The Appointed Contractor should commit to adhering to the principles of PAS 2080:2023 – Carbon Management in Buildings and Infrastructure. PAS 2080:2023 is a global standard for managing infrastructure carbon and looks at reducing carbon across the whole value chain through more design, construction and use. It also ensures that carbon is consistently and more transparently quantified at key points during the process, to inform decision making. The Appointed Contractor should report actual GHG emissions during construction of the Proposed Scheme.
EC2	The Appointed Contractor will produce a Carbon Management Plan (CMP) as part of their contract. The CMP will set out how GHG emissions will be managed and reduced over the lifetime of the Proposed Scheme. The Appointed Contractor should also set targets for GHG emissions reductions for each stage of the Proposed Scheme which will be included within the CMP.

Mitigation reference	Mitigation Measures
EC3	Materials should be sourced from as close as possible to the site to reduce the requirement for longer transportation distances. The same is applicable to construction waste in that it should be re-used, recycled or disposed of as close to the site as possible.
EC4	Use of electrical equipment (connected to the mains) should be promoted during construction of the Proposed Scheme to reduce the volume of diesel that is required during construction.
EC5	The use of onsite renewable energy sources should be considered to reduce the need for diesel generators and mains source electricity during construction.
EC6	Operational energy could be sourced from green energy tariff that verifies that the energy used on site is produced from low carbon / renewable energy sources.
EC7	Efforts should be made to minimise disturbance and excavation of peat as much as possible. Further information and mitigation is provided in the Outline Peat Management Plan (Volume 4, Appendix 12.6).

16.7. Residual Effects

Construction Impacts

16.7.1. In its current design, the release of GHG emissions from the construction of the Proposed Scheme is predicted to be minor and will not have a significant impact on the Scottish Government's ability to meet its emission reduction targets. Further mitigation measures should be encouraged to minimise GHG emissions from the Proposed Scheme as much as possible but these will not alter the outcome of the assessment. On this basis, there in unlikely to be a significant effect on climate due to the construction of the Proposed Scheme.

Table 16.7 - Construction Residual Effects Pre and Post Mitigation Measures

Reference	Pre-Mitigation Effect – Magnitude	Pre-Mitigation Effect – Significance	Mitigation Measures	Post-Mitigation Effect – Magnitude	Post-Mitigation Effect - Significance
EC – release of GHG emissions	Low	Not significant	EC1, EC2, EC3, EC4, EC5, EC7 The release of GHG emissions will be measured by the Appointed Contractor and monitored using a CMP (EC1, EC2). The CMP will identify further mitigation measures to reduce GHG emissions during construction and explore the implementation of EC3, EC4, EC5 and EC7 as suitable mitigation measures.	Low	Not significant

Operational Impacts

16.7.2. In its current design, the release of GHG emissions from the operation of the Proposed Scheme is predicted to be minor and will not have a significant impact on the Scottish Government's ability to meet its emission reduction targets. Further mitigation measures should be encouraged to minimise GHG emissions from the Proposed Scheme as much as possible but these will not alter the outcome of the assessment. On this basis, there in unlikely to be a significant effect on climate due to the operation of the Proposed Scheme.

Table 16.8 - Operational Residual Effects Pre and Post Mitigation Measures

Reference	Pre-Mitigation Effect – Magnitude	Pre-Mitigation Effect – Significance	Mitigation Measures	Post-Mitigation Effect – Magnitude	Post-Mitigation Effect - Significance
EC – release of GHG emissions	Low	Not significant	EC1, EC2, EC6 The release of GHG emissions will be measured by the Appointed Contractor and monitored using a CMP (EC1, EC2). The CMP will identify further mitigation measures to reduce GHG emissions during operation and explore the implementation of EC6 as a suitable mitigation measure.	Low	Not significant

Compliance with Planning Policy

16.7.3. Effects remaining after mitigation is in place are termed residual effects. It is not anticipated that any non-compliance with policy (as identified in in Volume 4, Appendix 16.1: Effects on Climate Legislation, Policy and Guidance) would result based on the assessment.