A20.0 Sustainability and climate change

This section describes the existing environment in relation to climate change and details the assessment of the potential impacts during the construction and operational phases of the proposed scheme. The section comprises a Greenhouse Gas (GHG) assessment and a qualitative Climate Change Resilience (CCR) assessment.

The GHG assessment predicts the contribution of the proposed scheme to regional GHG emissions, whilst the CCR assessment considers the resilience of the design and infrastructure associated with the proposed scheme to the projected effects of climate change over the lifespan of the project.

It should be noted that the assessment presented below does not take account of the electric vehicle provision which has been incorporated into the scheme design (I.e. the benefits arising from the use of electric vehicles have not been quantified). The reason for this is that there are uncertainties regarding the uptake of electric vehicles in the Falkland Islands; the assessment presented in **Section A20.4** with regards to GHG emissions from operational phase traffic flows is therefore a worst-case scenario, which assumes the use of petrol / diesel powered vehicles during operation.

A20.1 Methodology

A20.1.1 Greenhouse gas assessment

GHG emissions predicted to arise during construction and operation have been calculated. The GHG assessment has considered activities within a defined 'project boundary', which in this case includes the footprint of the proposed scheme and roads on the Falkland Islands used by vehicles travelling to and from the proposed scheme. The GHG assessment has calculated the release of GHG's that are likely to take place within the Falkland Islands, as emissions outside of this boundary would conventionally sit within a different regional or national GHG footprint.

The term 'GHG' in this assessment encompasses three gases, namely carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Emissions of other GHGs, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are not considered significant in the context of the proposed scheme and they are excluded from consideration. Where practicable, the results in this assessment are expressed in carbon dioxide equivalent (CO_2eq) which recognises that different gases have notably different global warming potential[18].

The methodology for calculating GHG emissions from activities in the construction and operational phases of the proposed scheme has been set out below.

A20.1.1.1 Construction phase

The construction phase GHG assessment has quantified emissions, considered to be net contributions to the global system, from the following sources:

- Embedded emissions in materials used on site.
- Fuel consumption from road vehicles.
- Fuel consumption by construction plant and equipment.
- Consumption of purchased electricity from the grid.

The approach to determining GHG emissions from each of the sources considered in the assessment is provided below.

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[18] Global Warming Potential of a GHG is a measure of how much heat is trapped by a certain amount of gas in the atmosphere relative to carbon dioxide.

Construction phase – embodied emissions in materials

Embodied GHGs are the total emissions generated to produce a built asset. 'Cradle to (factory) gate' GHG emissions, which encompass the extraction, manufacture and production of materials to the point at which they leave the factory gate, have been calculated for the main construction materials used during construction of the proposed scheme. GHG emissions have been derived from quantities or volumes of known materials that are predicted to be used during construction.

The relevant emission factors for the equipment proposed to be used during construction has been sourced from the Inventory of Carbon and Energy (ICE) database (ICE, 2019). The emission factors from the ICE database are 'cradle-to-factory' and, therefore, do not include the transportation of materials to site. Emissions associated with the movement of materials to the site once arrived at or sourced from the Falkland Islands were quantified using the information in **Section A14.0**. The assessment does not include any emissions associated with the transport of construction materials or plant from the UK to the Falkland Islands.

Construction phase – road vehicles

Road transport movements during the construction phase will be associated with workers travelling to the site via car (noting that this will be very small given the proposed location of the accommodation in relation to the main construction area) and HGV movements to transport construction materials. It has been assumed that 70% of construction vehicle movements would be to and from Pony Pass Quarry, situated approximately 10km to the south-west of the site. The remaining construction phase vehicle movements are assumed to travel an average distance of 1.5km.

Anticipated changes to the fleet make-up for light duty vehicles (in terms of fuel and Euro standards) have been incorporated into the assessment for the anticipated years of construction (2022-2024). The forecasted change in the fleet make-up has been obtained from the Department for Transport (DfT 2019) WebTAG data. It has been assumed that the fleet make-up on the Falkland Islands is the same as the WebTAG dataset. In the absence of suitable empirical data, it has been assumed that the fleet composition of HGVs will not change over the temporal scope of the assessment to provide a conservative scenario.

Emission factors for fuel consumption for light and heavy duty vehicles have been obtained from the Department for Business, Energy and Industrial Strategy (BEIS) (BEIS, 2020).

The construction phase traffic movements and emission factors used to calculate GHG emissions are provided in **Table 20.1**.

Table 20.1 Construction phase road vehicle movements and GHG emission factors

Vehicle	Total trips during construction	Average trip length	Total distance (km)	Emission factor (kgCO_2e/km)
Heavy Duty Vehicles	261,626	70% 10km (to and from the Pony Pass Quarry) 30% 1.5km	1,949,114	0.865
Light Duty Vehicles	7,126		53,089	0.167

Construction phase – on-site plant and equipment

GHG emissions have been calculated from the predicted consumption of fuel from on-site plant and equipment during construction. This includes earth-moving vehicles, cranes, generators to provide power to the site, marine vessels (required to support with removal of the surficial silt and dismantling of FIPASS) and on-site vehicles.

Emission factors for the assessment have been obtained from BEIS (2020) and are provided in **Table 20.2**.

Table 20.2 Fuels proposed to be used during construction and GHG emission factors

Fuel	Emission factor ($kgCO_2e$/litre)
Diesel	2.69
Diesel Engine Road Vehicle (DERV)	2.54
Gas Oil	2.76
Marine Gas Oil	2.78
Unleaded Petrol	2.17
Oil and Lubricants	3,181*
* Emission factor in units of $kgCO_2e$/ tonne	

Construction phase – electricity consumption

There are no emission factors available specific to the energy mix on the Falkland Islands. In 2017, 52.6% of energy production was generated by diesel generators at the Stanley Power Station, and 47.4% from renewable wind sources (Worldometer, 2021). Therefore, the GHG intensity of grid electricity on the Falkland Islands was calculated by applying the fuel oil emission factor from BEIS to the proportion of electricity from diesel generators. It has been assumed that the GHG intensity of renewable energy from wind power sources was zero.

A20.1.1.2 Operational phase

The operational phase GHG assessment has quantified emissions, considered to be net contributions to the global system, from the following sources:

- Marine vessels using auxiliary engines whilst berthed at the proposed scheme.
- Consumption of electricity at the proposed scheme.
- Road vehicle movements associated with the proposed scheme.

There are also likely to be emissions associated with the operation of non-electric powered port-related equipment. Fuel consumption data from this equipment was not available at the time of assessment and is likely to comprise a relatively small proportion of the overall GHG footprint of the proposed scheme compared to other sources considered in the assessment. Therefore, emissions from non-electric powered port related equipment have not been quantified in the assessment. The approach to determine GHG emissions from each of the sources considered in the assessment is provided below.

Operational phase – vessel movements

The proposed scheme is anticipated to increase the number of vessels calling at Port Stanley by approximately 200 per year (an increase from 300 to 500 calls). GHG emissions have been calculated from the additional number of vessels predicted to utilise the proposed scheme during operation. As the origin and departure of each vessel calling at the proposed scheme is not known, GHG emissions have been calculated from vessels using auxiliary engines whilst situated at the berths of the proposed scheme.

It has been assumed that the additional 200 vessel calls would be of a similar nature to those which already call at FIPASS, which includes cruise, tanker, cargo and fishing vessels (however the vessels are predicted to be larger for certain categories of vessel). The additional 200 vessels have been split proportionately between the frequency that these types of vessel currently visit FIPASS, which has been obtained from the Port Master Operational Plan (**Ref. 18**).

Typical engine sizes for the most frequent vessels predicted to call at the quay have been obtained. The calculation of emissions from vessels during the operational phase has been carried out in accordance with the Port Emissions Toolkit, published by the GloMEEP Project Coordination Unit (GloMEEP, 2018). This guidance document also includes load factors which have been utilised in the assessment. Typical berthing periods for each vessel type were obtained from the Port Master Operational Plan (**Ref. 18**). Emission factors for marine diesel oil have been obtained from the Department for BEIS (BEIS, 2020).

The data used to calculate GHG emissions from marine vessels during operation of the proposed scheme are provided in **Table 20.3**. The vessels detailed in **Table 20.3** are a combination of the largest and most frequently calling vessels expected to utilise the berth during the operational phase.

Table 20.3 Data used to calculate GHG emissions from marine vessels during operation

Type of vessel	Number of additional calls predicted annually	Auxiliary engine size (kW)	Engine load factor	Average berth time per call (hours)	Emission factor (kg CO_2e / kWh)
Fridtjof Nansen (Cruise Vessel)	29	4003 (1 engine)	29	11.6	0.279
Jason (Tanker)	11	480 (3 engines)	11	19.9	0.279
Scout (Cargo)	97	185 (3 engines)	97	31.3	0.279
New Polar (Fishing)	62	527 (1 engine)	62	23.0	0.279

Operational phase – consumption of electricity

Indirect GHG emissions will arise from the consumption of purchased electricity from the grid electricity supply during operation. The predicted electricity consumption figures during operation used in the assessed have allowed for a 25% increase for potential future growth associated with the proposed scheme. In 2017, 52.6% of energy production was generated by diesel generators at the Stanley Power Station, and 47.4% from renewable wind sources (Worldometer, 2021). Therefore, the GHG intensity of grid electricity on the Falkland Islands was calculated by applying the fuel oil emission factor from BEIS to the proportion of electricity from diesel generators. It has been assumed that the GHG intensity of renewable energy from wind power sources was zero.

Operational phase – road vehicles

Road transport movements during the operational phase will be associated with workers travelling to the site via car and HGVs transporting goods and materials. Total vehicle movements predicted during the operational phase are detailed in **Section A14.0**. It has been assumed that the average distance for an operational phase vehicle movements would be 5km.

Anticipated changes to the fleet make-up for light duty vehicles (in terms of fuel and Euro standards) have been incorporated into the assessment for 2025, the anticipated first year of operation of the proposed scheme. The forecasted change in the fleet make up has been obtained from the Department for Transport (DfT 2019) WebTAG data. It has been assumed that the fleet make-up on the Falkland Islands is the same as the WebTAG dataset. In the absence of suitable empirical data, it has been assumed that the fleet composition of HGVs will not change over the temporal scope of the assessment to provide a conservative scenario.

Emission factors have been obtained from the Department for BEIS (BEIS, 2020).

The operational phase traffic movements and emission factors used to calculate GHG emissions are provided in **Table 20.4.**

Table 20.4 Predicted operational phase traffic movements and emission factors

Vehicle	Trips per year during operation	Average trip length (km)	Total distance (km)	Emission factor ($kgCO_2e/km$)
Heavy Duty Vehicles	20,046	5	100,230	0.865
Light Duty Vehicles	31,354		156,770	0.165

A20.1.1.3 GHG assessment significance criteria

There is no single preferred method to evaluate the significance of GHG emissions arising from a 'project'. IEMA guidance advises that all releases of GHGs might be considered to be significant, but professional judgement should be used to contextualise a project's GHG budget (IEMA, 2017). The rationale for this approach is that any additional GHG release to the atmosphere contributes to the global greenhouse effect and could compromise the ability to meet regional or national carbon budgets and reduction targets.

In the absence of sector-based or local emission budgets, the current level of GHG emissions within the Falkland Islands was used to contextualise emissions arising from the proposed scheme. Current GHG emissions within the Falkland Islands are presented in **Section A20.2.1**.

Emissions from construction and operational activities have been considered to be significant if they contributed more than 1% of annual GHG emissions on the Falkland Islands. The 1% threshold figure was derived from the PAS 2050 Specification, which advises that minor emission sources can be excluded from emission inventories if they contribute less than 1% of the total inventory.

A20.1.2 Climate Change Resilience (CCR) assessment

An assessment of the resilience and vulnerability of the proposed scheme to the projected effects of climate change has been undertaken over the operational lifespan of the proposed scheme. This assessment has identified the likelihood of climate hazards occurring within the study area and has highlighted the consequences of the potential impact.

A20.1.2.1 Approach

A four-step methodology has been adopted for the CCR assessment. The initial stages of the assessment aim to identify the climate variables to which the proposed scheme could be vulnerable to during its lifetime. A more detailed risk assessment has then been undertaken following the identification of influencing climate variables, to assess the level of risk associated with the hazards posed by the predicted changes in climate variables.

The approach carried out for each step of the CCR assessment is provided below.

Step 1: Identifying climate variables

The first step of the CCR assessment is to identify the receptors which may potentially be impacted by climate change hazards. Those receptors identified include both known receptors (such as receptors reported / known to have already experienced a climate-related event (i.e. flooding)) and unknown receptors which are yet to be impacted according to available data and literature.

Step 2: Climate vulnerability assessment

Stage 2 has consisted of a qualitative assessment (informed by professional judgement and supporting literature) of the proposed scheme to changes in the climate variables. Vulnerability is considered to be a function of:

- the sensitivity of the proposed scheme and any associated infrastructure to climate variables; and,
- the exposure (both spatially and temporally) of the proposed scheme and its associated infrastructure to climate variables.

Both the sensitivity and the exposure of the proposed scheme and its associated infrastructure to climate variables have been considered in the vulnerability assessment. This approach attributes either a high, moderate or low sensitivity / exposure categorisation to each vulnerability.

Overall vulnerability is determined by considering the interrelationship between the exposure and the receptor sensitivity, as set out in **Table 20.5**.

Table 20.5 Sensitivity / exposure matrix for determining vulnerability rating

Sensitivity	Exposure		
	Low	Moderate	High
Low	Low vulnerability	Low vulnerability	Low vulnerability
Moderate	Low vulnerability	Medium vulnerability	Medium vulnerability
High	Low vulnerability	Medium vulnerability	High vulnerability

Climate change projection data has been obtained for the Falkland Islands, and is provided in **Section A20.4.2**. This data was used to determine the potential changes to climate parameters over the lifespan of the proposed scheme.

Cross reference to information presented in **Section A17.0** has been made to source information regarding the vulnerability of the proposed scheme to the projected effects of climate change.

For those vulnerabilities categorised as medium or high, the risk of climate change to the design and infrastructure of the proposed scheme, and consequently to its operation, has been determined through Steps 3 and 4 of the assessment process.

Stage 3: Risk assessment

For those vulnerabilities categorised as medium or high, climate-related hazards have been identified through professional judgement. The risks of the proposed scheme and its associated infrastructure to the occurrence of a hazard event have been qualitatively identified through a hazard likelihood and consequence matrix, as detailed in **Table 20.6**. The descriptors of likelihood and consequence are provided in **Table 20.7** and **Table 20.8**.

Table 20.6 Likelihood / consequence matrix for determining risk rating

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Low	Medium	High	Extreme
Moderate	Low	Low	Medium	High	Extreme
Unlikely	Low	Low	Medium	Medium	High
Very unlikely	Low	Low	Low	Low	Medium

Table 20.7 Descriptors of likelihood for climate variables

Likelihood rating	Description
Almost certain	The climate variable is likely to occur numerous times during the anticipated operational lifespan of the proposed scheme
Likely	The climate variable is likely to occur on several occasions during the anticipated operational lifespan of the proposed scheme
Moderate	The climate variable will occur on limited occasions during the anticipated operational lifespan of the proposed scheme
Unlikely	The climate variable will occur infrequently during the anticipated operational lifespan of the proposed scheme
Very unlikely	The climate variable may occur once during the anticipated operational lifespan of the proposed scheme

Table 20.8 Descriptors of consequence as a result of climate variables

Consequence rating	Description
Insignificant	No damage to infrastructure or the ability of the proposed scheme to function. No adverse effect to the surrounding environs
Minor	Small and localised damage to infrastructure and a minor effect to the proposed scheme to function. Potential for slight adverse effect to the surrounding environs
Moderate	Limited damage to infrastructure requiring maintenance or minor repair, resulting in a potential effect to the proposed scheme to function. Adverse effect to the surrounding environs
Major	Extensive damage to infrastructure requiring major repairs and maintenance, resulting in a severe effect to the proposed scheme to function. Significant adverse effect to the surrounding environs
Catastrophic	Permanent damage to infrastructure, resulting in a severe lasting effect to the proposed scheme to function. Very significant adverse effect to the surrounding environs requiring remediation and restoration

Stage 4: Mitigation

For climate risks to the proposed scheme or its associated infrastructure identified as 'medium' or higher, further mitigation measures have been identified. With the proposed mitigation measures taken into consideration, a residual risk has been assessed.

For each hazard, a resilience rating is identified as one of the following:

- High – strong degree of climate resilience. Remedial action or adaptation may be required but is not a priority.
- Moderate – a moderate degree of climate resilience. Remedial action or adaptation is recommended.
- Low – a low level of climate resilience. Remedial action or adaptation is required as a priority.

A20.1.2.2 CCR assessment significance criteria

The significance of the CCR assessment has been determined through consideration of the residual risk (identified in Step 3) and resilience rating (identified in Step 4) applied to each hazard identified. **Table 20.9** presents the matrix used to identify the overall significance of climate change resilience.

Table 20.9 Significance Criteria

Risk rating	Resilience rating		
	High	Moderate	Low
Extreme	Significant	Significant	Significant
High	Not significant	Significant	Significant
Medium	Not significant	Not significant	Significant
Low	Not significant	Not significant	Not significant

A20.2 Baseline conditions

A20.2.1 GHG emissions

In 2016, CO_2 emissions in the Falkland Islands were 48,568 tonnes, with the power industry forming the largest contributing sector, responsible for approximately 79.4% of emissions (Worldometer, undated), which at the time of assessment was the latest available full year of emissions data. The principal power source on the Falkland Islands is the Stanley Power Station, which has an installed capacity of 6.6 MW, provided by eight diesel generators.

F.I.G. has been seeking to increase its renewable energy supplies, including the Sand Bay Wind Farm which has displaced fuel consumption at the Stanley Power Station to an average of 35 – 40%. Furthermore, alternative forms of renewable energy are being considered, including hydroelectric and solar power, as well as energy storage and heat pump technologies.

The Falkland Islands are not included as part of the domestic UK carbon budgets set under the UK Climate Change Act 2008 and the 2019 amendment order. However, the Falkland Islands have ratified the Kyoto Protocol, and the UK's progress against the Kyoto Protocol includes the Islands.

A20.2.2 Current climate

The climate in the Falkland Islands can be described as cool and temperate, with an annual average temperature of 5.6ºC. Average monthly temperatures fluctuate from 9ºC in the summer months to 2ºC in the winter months. The predominant wind is from the west (a wind rose for the Falkland Islands is presented in **Section 7**); average conditions on the island are relatively windy, with frequent gales particularly in the winter months. Rainfall occurs throughout the year, though annual precipitation volumes are relatively low due to its location to the east of South America and the shielding effect of the Andes mountains. Annual average rainfall in Stanley is 630mm (FIG, 2008).

The future climate in the Falkland Islands is anticipated to be cooler, with more rain and cloud cover, due to melting Antarctic Ice resulting in cooler air from the south. Storms are also predicted to increase in frequency and intensity.

"A climate change risk assessment for the Falkland Islands was completed as part of EU funded project title 'Terrestrial ecosystem response to potential of climate change in the Falkland Islands (TEFRA). The key risks that were identified are:

- drier conditions due to drying soils;
- increased risk from invasive plant species, pests and diseases;
- loss of native plants; and,
- increased risk of fire.

In addition, the Falkland Islands are also considered to be vulnerable to hazards such as sea level rise and storm surges.

A20.3 Potential impacts during construction

A20.3.1 Construction phase GHG assessment

GHG emissions predicted to arise over the duration of the construction phase from the activities considered in the assessment are provided in **Table 20.10**. It should be noted that the assessment presented below has been undertaken on the originally designed quay, which is both longer and wider than that currently proposed; the assessment presented below therefore overestimates the potential impacts on climate change.

Table 20.10 Predicted GHG emissions during construction of the proposed scheme

Source	GHG emissions (Tonnes CO_2e)
Embodied GHGs in construction materials	21,080
Construction plant and equipment	16,584
Electricity consumption	37
Road traffic	1,696
Total	**39,396**

As noted in **Table 20.10**, it is estimated that 39,396 tonnes of CO_2e will be released from the activities considered in the construction phase GHG assessment. The largest source of emissions is predicted to be those embodied in materials to be used on site (54%). Use of construction plant and equipment is predicted to release 16,584 tonnes of CO_2e during construction (42%), mainly due to the proposed consumption of diesel. It should be noted that the machinery and equipment transported to the Falklands Islands by the contractor will comply with the UK emissions standards. It is assumed that the fleet or lorries used to transport rock from the quarry to the construction site by PWD will comply with UK emissions standards. It should also be noted that the quarrying and transport of rock to the site from Pony's Pass quarry is to be undertaken by PWD; this minimises the requirement to import quarrying equipment and haulage plant to the Falkland Islands which has a beneficial impact from a climate change and sustainability perspective.

Collaborative working between the project team, key stakeholders and F.I.G. has resulted in the quay being reduced in size compared to that originally proposed, whilst still meeting the objectives of the project. Specifically, the quay has been reduced from 400m in length to 300m, with a reduction in width at the eastern end of the quay from 50m to 40m. This reduction in quay size has been achieved through the design of very efficient berthing arrangements, with berthing provision on three faces of the quay. This has significantly reduced the volume of construction materials required when compared with the initial design, resulting in a very significant carbon saving in the construction phase.

Predicted GHG emissions during the construction phase are estimated to be approximately 41% of total GHG emissions per year of construction in the Falkland Islands, when compared to a 2016 baseline. This represents a notable increase in GHG emissions within the Falkland Islands, albeit of a temporary nature. The emissions to be generated are not expected to significantly affect the long-term emission reduction targets on the Falkland Islands.

A20.3.1.1 Mitigation and residual impact

The largest sources of GHG emissions during construction are predicted to be those embodied in materials to be used during construction, and the consumption of fuel by plant and equipment. Mitigation will therefore be focused on reducing emissions from these sources during construction.

The proposed scheme will use a significant amount of material from the nearby Pony Pass Quarry, which will result in an emissions saving when compared to importing the materials via vessel, or using a quarry at a greater distance from the site. It is therefore considered unlikely that a reduction in emissions associated with use and transport of construction materials to the site would be practicable.

Further mitigation measures that could be adopted to reduce GHG emissions during construction are listed below:

- Further design iteration to reduce the absolute quantities of construction materials through efficient design, and use materials with a lower GHG intensity where possible.
- Application of circular economy principles to maximise the quantity of recycled and reused materials.
- Preference to use materials and components which are locally sourced to minimise transport distances.
- Use of lower emission vehicles for transporting materials to site where possible.
- Implement a CTMP to minimise the number of journeys required.
- The concrete specification will maximise the use of cement replacements where possible.

The measures listed above have the potential to reduce GHG emissions arising from construction of the proposed scheme. However, the nature of the proposed scheme requires significant volumes of construction materials and associated construction-related emissions through fuel consumption. The resulting emissions are therefore an unavoidable consequence of the proposed scheme.

Given the nature of the proposed scheme, it is expected that there will be substantial residual construction-related emissions, even after the adoption of mitigation. However, these emissions are temporary for the approximately two year duration of the proposed construction phase and are not, therefore, expected to significantly affect long-term emission reduction targets on the Falkland Islands.

A20.4 Potential impacts during operation

A20.4.1 Operational phase GHG emissions assessment

Annual GHG emissions predicted to arise during the operational phase of the proposed scheme from the activities considered in the assessment are provided in **Table 20.11**. The results presented are for the opening year (2025) of operation of the proposed scheme. As reported in **Section A20.3.1**, the assessment presented below is an overestimate of the GHG emissions during operation as the assessment has been undertaken based on a quay which is both longer and wider than that currently proposed.

Table 20.11 Predicted annual GHG emissions during operation of the proposed scheme

Source	GHG emissions (Tonnes CO_2e)
Marine vessels	416
Road vehicles	113
Electricity consumption	509
Total	**1,037**

Predicted GHG emissions during operation of the proposed scheme are 1,037 tonnes per year. The largest source during the operational phase is predicted to be from the consumption of electricity (49%). Electricity consumption figures were elevated by 25% to account for future growth at the quay, therefore presenting a conservative scenario.

Predicted annual GHG emissions arising from operation of the proposed scheme are approximately 2% of total GHG emissions in the Falkland Islands, when compared to a 2016 baseline.

This is not a negligible contribution, but must be considered in the context of the overall scale of the proposed scheme and assumptions made to predict annual GHG emissions during operation. It should also be considered in light of the fact that FIPASS will be generating its own GHG emissions which the proposed scheme will replace.

Consumption of electricity is predicted to be the largest source of emissions associated with the proposed scheme and this has been calculated using an emission factor based on the estimated current GHG intensity of grid electricity on the Falkland Islands. The Falklands Islands is seeking to further decarbonise its power supply (with approximately one third of its power already coming from renewable sources), therefore any additional provision of renewable energy within the grid will have a beneficial reduction in GHG emissions arising from the proposed scheme.

It should be noted that the following sustainability and climate change measures have already been incorporated into the scheme design:

- Buildings will be of modular construction with good levels of insulation.
- Electric vehicle charging points will be installed at the gatehouse and on the port.
- Energy efficient light-emitting diode (LED) lighting is to be used on the port and in port buildings.
- Peat excavated to construct the new access road will be re-used to enhance soil conditions nearby.
- Swales are to be adopted to drain the new access road, which will provide natural drainage attenuation and minimise construction material use.
- Foul water to be generated on the port will be treated using low energy package sewage treatment plants before discharging clean water into the harbour.
- Encouraging the procurement of energy efficient equipment within the proposed scheme.

Approximately 30% of electricity within the Falkland Islands is currently provided by renewable sources (wind). It is F.I.G.'s intention to increase this ratio of renewable energy in the future, resulting in a further decrease in GHG emissions in the operational phase (note this is not modelled in the EIS). Emissions during the operational phase of the new port facility would not compromise the future emission reduction targets in the Falkland Islands.

Based on the above, it is considered that the GHG emissions to be generated during operation have been minimised as far as practicable through the scheme design. A number of measures to enhance the sustainability of the proposed scheme have also been included in the design. In the global context, the GHG emissions to be generated during the operational phase of the proposed scheme are not considered to be significant.

A20.4.1.1 Mitigation and residual impact

The largest source of GHG emissions during operation of the proposed scheme is expected to be from the consumption of electricity. FIDC and the Falklands Islands Government are seeking to increase the provision of renewable energy on the Islands, particularly through the provision of wind power. The provision of an onshore windfarm resulted in the displacement of fuel consumption at the Stanley Power station by an average of 35 – 40%. A further increase in renewable energy provision within the Falkland Islands energy mix would also reduce GHG emissions arising from the proposed scheme.

Although further measures to offset / minimise GHG emissions are not considered necessary based on the assessment presented above, the following measures could be adopted in the future:

- Implementation of an energy strategy that includes the installation of low and zero GHG technologies.
- Development of transport measures to reduce the reliance on cars by staff, and to encourage active and low carbon transport choices.

Measures to minimise the long term carbon footprint of the proposed scheme (beyond the provision of electric vehicle charging) were recommended for inclusion into the scheme during the design process. Such recommended measures included use of photovoltaic arrays . These measures were not taken forward by F.I.G. as part of the scheme design, however could be added in at a later date when the proposed new power station allows connection to the electrical grid.

It is considered that the residual impact is not significant.

A20.4.2 Vulnerability and resilience of the proposed scheme to the projected effects of climate change

Step 1: Identifying climate variables

Taking into account of the nature and location of the proposed scheme footprint, the following climate variables are considered to have potential to impact the operation of the proposed scheme:

- Wind speed.
- Precipitation.
- Storm surges.
- Sea level rise.

As the proposed scheme is contained within one 'site', the development as a whole has been considered as the receptor for the CCR assessment.

Step 2: Climate vulnerability assessment

The vulnerability of the proposed scheme to the identified climate variables has been identified in accordance with the criteria set out in **Table 20.5**, and is provided in **Table 20.12**.

Table 20.12 Climate vulnerability assessment

Climate variable	Potential impacts	Exposure	Sensitivity	Vulnerability
Wind speed	Disruption to services at the proposed scheme, or closure of the port. Damage to assets and infrastructure	Moderate	Low	Low
Precipitation	Surface water flooding preventing access to the site. Surface water flooding resulting in damage to assets and infrastructure.	Low	Moderate	Low
Storm surges	Overtopping of infrastructure associated with the proposed scheme.	High	High	High

Climate variable	Potential impacts	Exposure	Sensitivity	Vulnerability
	Disruption to services at the proposed scheme, or closure of the port.			
Sea level rise	Overtopping of infrastructure associated with the proposed scheme. Disruption to services at the proposed scheme, or closure of the port.	High	High	High

The climate vulnerability assessment identified that the proposed scheme has a high vulnerability to storm surges and sea level rise. Therefore, an assessment of the impacts and associated risks of an increase in these climate variables was considered in Step 3 of the CCR assessment. The proposed scheme is considered to have low vulnerability to an increase in wind speed and precipitation, therefore these climate variables have not been considered further in the assessment.

Stage 3: Risk assessment

The risks to the proposed scheme from sea level rise and storm surges have been qualitatively identified below and summarised in **Table 20.13** through the hazard likelihood and consequence matrix detailed in **Table 20.7**.

The IPCC recommends various allowances for sea level rise depending on the effectiveness of efforts to control global warming. The proposed scheme assumes the RCP8.5 scenario (Representative Concentration Pathways 8.5 is the most pessimistic 'greenhouse gas emissions scenario') for the proposed design life of 50 years. The 50th percentile value yields a sea level rise under RCP8.5 of 400mm over this timespan. This has been factored into the design for the proposed scheme.

The sheltered location of the proposed scheme means that wave heights are low at the shoreline. An overtopping study has been completed for a deck level set at 4.0m CD and found this to be satisfactory, assuming certain mitigation measures were built into the design to take account of the overtopping risk. Such mitigation which has been built into the design to make it resistant to damage from overtopping comprises moving equipment away from the quay edge where possible, having services in covered pits and including the ability to electrically isolate outdoor equipment for safety.

Therefore, it is considered very unlikely that impacts to the proposed scheme associated with sea level rise would occur. The consequence of overtopping and damage to the proposed scheme in the event of a storm surge or sea level rise is considered to be minor based on the incorporation of measures into the design to make the scheme resistant to the effects of overtopping.

Table 20.13 Climate vulnerability assessment

Climate variable	Potential impacts	Likelihood	Consequence	Risk rating
Storm surges	Overtopping of infrastructure associated with the proposed scheme	Moderate	Minor (due to measures built into the scheme design)	Low
Sea level rise	Disruption to services at the proposed scheme, or closure of the port	Very unlikely	Major	Low

Due to the adopted design criteria, the risk rating of the proposed scheme from sea level rise and storm surges was considered to be **low** in accordance with the matrix detailed in **Table 20.13**.

Stage 4: Mitigation

As the risk rating for refurbishment scheme from sea level rise and storm surges was determined to be low, no further mitigation is required beyond that already built into the scheme design (refer to **Section A4.3.1.7**). The climate resilience rating is determined to be high, where the proposed scheme has a strong degree of climate resilience.

Therefore, in accordance with the significance criteria detailed in **Table 20.9**, the projected effects of climate change to the refurbishment scheme are considered to be not significant.