Chapter N
Climate Change and Resilience

Milton Keynes East Environmental Statement

Chapter N: Climate Change and Resilience

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N1.0 Introduction

N1.1 This chapter forms part of the Milton Keynes East Environmental Statement ('ES') which sets out the findings of an Environmental Impact Assessment ('EIA') of the proposed development of a sustainable urban extension to Milton Keynes. It relates to land to the east of the M1 motorway and to the south of Newport Pagnell. A description of the background to the proposal; the relationship of this chapter to the wider ES; and a description of the site and the development is provided at Chapters A to C of this ES.

N1.2 This chapter reports the likely significant effects of the Proposed Development on the site and the surrounding area in terms of climate change matters. Where appropriate, it also identifiesproposed mitigation measures to prevent, minimise or control likely negative effects arising from the Proposed Development and the subsequent anticipated residual effects.

N1.3 The effects of the Proposed Development are considered during construction and operation.

N1.4 The main issue covered in this chapter include the assessment of greenhouse gas ('GHG') emissions expected to be generated by the Proposed Development during both construction and operation and the effect on global climate.

N1.5 The chapter is not accompanied by any technical appendices.

About the Author

N1.6 This assessment has been undertaken by Hodkinson Consultancy.

N1.7 Hodkinson Consultancy is a specialist energy and environmental consultancy, working with a wide range of housing developers, housing associations, strategic land developers, commercial developers and contractors. Hodkinson Consultancy has been established for 20 years and specialises in formulating detailed energy and heating strategies, calculating detailed electricity and carbon emissions.

N2.0 Policy Context

N2.1 The following national and local planning policy and guidance is of relevance to the assessment of the effects of the Proposed Development in relation to climate change.

National

N2.2 The following national level policy and guidance documents are of relevance to the Proposed Development:

National Planning Policy Framework (2019)

N2.3 The National Planning Policy Framework (NPPF) [Ref 1] 2019 Chapter 14 describes ways in which the challenge of climate change can be met. Paragraph 150 states that new developments should be planned in ways that:

1 Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

2 Can help to reduce GHG emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

N2.4 Paragraph 151 – To help increase the use and supply of renewable and low carbon energy heat, plans should:

1 Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

2 Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

3 Identifying opportunities for development to draw its supply from decentralised, renewable or low carbon energy supply systems and co-locating potential heat customers and suppliers.

Planning Practice Guidance (2019)

N2.5 Planning Practice Guidance (PPG) supports the NPPF. Climate change PPF states:

"In addition to supporting the delivery of appropriately sited green energy, effective spatial planning is an important part of a successful response to climate change as it can influence the emission of greenhouse gases. In doing so, local planning authorities should ensure that protecting the local environment is properly considered alongside the broader issues of protecting the global environment. Planning can also help increase reliance to climate change impact through the location, mix and design of development."

Local

N2.6 The following local level policy and guidance documents are of relevance to the Proposed Development:

Milton Keynes Local Plan

N2.7 Milton Keynes Local Plan document 'Plan:MK' was adopted in March 2019. The following policies relate to climate change.

N2.8 Policy SC1 – Sustainable Construction: Energy and Climate.

a Implement the Energy Hierarchy within the design of new buildings by prioritising fabric first, passive design and landscaping measures to minimise energy demand for heating, lighting, and cooling.

b Review the opportunities to provide energy storage and demand management so as to tie in with local and national energy security priorities.

c The design of buildings and the wider built environment is resilient to the ongoing and predicted impacts of climate change.

d Development proposals for 11 or more dwellings and non-residential development with a floor space of 1,000 sqm or more will be required to submit an Energy and Climate Statement that demonstrates how the proposal will achieve the applicable requirements below:

i Achieve a 19% carbon reduction improvement upon the requirements within Building Regulations [Ref 2] Approved Document Part L 2013, or achieve any higher standard than this that is required under new national planning policy [Ref 1] or Building Regulations [Ref 2].

ii Provide on-site renewable energy generation, or connection to a renewable or low carbon community energy scheme, that contributes to a further 20% reduction in the residual carbon emissions subsequent to (1) above.

iii Make financial contributions to the Council's carbon offset fund to enable the residual carbon emissions subsequent to the (1) and (2) above to be offset by other local initiatives.

iv Calculate Indoor Air Quality and Overheating Risk performance for proposed new dwellings.

v Implement a recognised quality regime that ensures the 'as built' performance (energy use, carbon emissions, indoor air quality and overheating risk) matches the calculated design performance of all dwellings in (4) above.

vi Put in place a recognised monitoring regime to allow the assessment of energy use, indoor air quality and overheating risk for 10% of the proposed dwellings for the first five years of their occupancy and ensure that the information recovered is provided to the applicable occupiers and the planning authority.

N3.0 Assessment Methodology & Significance Criteria

Assessment Methodology

N3.1 The following section outlines the methodologies applied to identify and assess the potential impacts and likely effects to result from the Proposed Development.

N3.2 An ES Scoping Report was provided to Milton Keynes Council in October 2020 (Appendix B1 to this ES). Milton Keynes Council issued the MKE Scoping Opinion in November 2020 (Appendix B2 to this ES), confirming that the approach outlined in the Scoping Report for Climate Change & Resilience was agreed. The following potential effects were scoped into the assessment:

- Greenhouse Gas Emissions.

Extent of The Study Area

N3.3 The extent of the study area includes the red-line boundary of the Proposed Development. However, some of the GHG emissions occur beyond the boundary of the Development Site, for example embodied GHG emissions from materials used.

Method of Baseline Calculation

N3.4 The baseline GHG emissions will be calculated from existing activities of the Development Site.

Demolition, Construction and Operational Phase

N3.5 The assessment uses a project lifecycle approach to identify particular 'hot spots' of GHG emissions (i.e. the development stages and primary emission sources likely to generate the largest amount of GHG emissions) and therefore enables priority areas for mitigation to be identified. See Table N3.1 below. This approach is consistent with the principles set out in IEMA (2017) Guidance [Ref 3].

Table N3.1: Key Anticipated GHG Emissions Sources

Development Stage	Activity	Primary GHG emission sources
Production	Raw material extraction and product manufacturing.	Embodied carbon in construction materials.
Construction	Onsite construction activity. Transport of construction materials. On-site vehicle movements. Disposal and transport of on-site waste generation.	Plant and vehicle use. Transport.
Operation	Regulated and unregulated building energy consumption. Building and services maintenance. Vehicle trips.	Maintenance equipment.
End of Life	Deconstruction or refurbishment of the Proposed Development.	

One Click LCA

N3.6 OneClick LCA consists of a large database of generic and average Life Cycle Indicator (LCI) data, and global Environmental Product Declaration (EPDs). The most suitable option for each

material (where available) will be chosen from the database in OneClick. The material LCI data has been chosen to be representative of the typical UK supply chain.

N3.7 The OneClick LCA default values for distances travelled to site for the construction materials will be used for each material item. The following life cycle stages are included within the assessment as standard:

1 A1-A3 construction materials.

2 A4 transport.

3 A5 construction site impacts.

4 B1-B7 use, maintenance, replacements and refurbishment, operational energy and water.

5 C1-C4 end of life.

6 D Benefits and Loads

Significance Criteria

N3.8 The assessment of the potential impacts and likely effects as a result of the Proposed Development has taken into account both the Demolition and Construction Phases and Operational Phases. The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Development and the sensitivity of the affected receptor/receiving environmental to change.

N3.9 Magnitude of change and sensitivity of the affected receptor are assessed on a scale of high, medium, low and negligible (as chosen in Chapter B: Scope and Methodology).

Effect Significance

N3.10 For the purpose of this assessment, it has been considered that the impact of any increase in GHG emissions compared to the baseline is considered to be significant due to the high sensitivity of the global climate increase in GHG emissions. This is consistent with the IEMA guidance which states that all GHG emissions have the potential to be significant. As opposed to other ES topics, sensitivity is only considered for a single receptor (i.e. Milton Keynes and wider UK GHG emissions) and therefore it is appropriate to base the assessment on professional judgement, and in a qualitative manner.

N3.11 The following terms have been used to define the significance of effects identified:

1 Substantial beneficial – considerable effects (by extent, duration or magnitude) of or of more than local significance or exceeding identified standards of policy.

2 Moderate beneficial – limited effects which may be considered significant.

3 Minor beneficial – slight, very short highly localised effects.

4 Neutral/negligible.

5 Minor adverse - slight, very short highly localised effects.

6 Moderate adverse – limited effects which may be considered significant.

7 Substantial adverse – considerable effects (by extent, duration or magnitude) of or of more than local significance or breaching identified standards of policy.

N3.12 There are a number of approaches that can be taken to consider the calculated GHG emissions from the Proposed Development in the context of wider emissions. In this instance, the total emissions will be compared with data from the UK local authority and regional carbon dioxide emissions national statistics: 2005-2017, which was published in June 2019.

N3.13 The global climate is the receptor for GHG emissions. All development has a cumulative effect on GHG concentrations and climate change and as such, the assessment is inherently cumulative and therefore a separate cumulative assessment is not required.

Consultation

N3.14 Consideration has been given to the formal ES Scoping Opinion provided by Milton Keynes Council and consultees and any additional consultation that may have occurred during the design period of the Proposed Development.

N3.15 No additional consultation relating to the Greenhouse Gas Emissions Assessment was undertaken.

Assumptions and Limitations

N3.16 At this stage, where limited information on material specification is available, the benchmarks proposed by OneClick can be used to estimate the embodied carbon of a building, according to the building type. It is acknowledged that there is an expected level of inaccuracy in the benchmarks due to the small dataset and the assessment boundaries not always being identified. Nonetheless, the benchmarks will provide sufficient guidance at this stage of the project.

N3.17 As the Proposed Development is currently at Masterplan stage, the exact detail of the dwellings and buildings is not yet known. Therefore, Whole Life Cycle Carbon Assessments have been undertaken on representative dwelling and building types and the results have been extrapolated upwards based on the latest accommodation schedule for up to 4,600 homes.

N4.0 Baseline Conditions

Existing Conditions

N4.1 It is noted that the existing site is currently predominantly greenfield land. Current baseline represents any existing GHG emissions from the project boundary site prior to demolition, construction and operation. It is not always possible to report on current baseline emissions, particularly with projects situated in areas with very limited physical development similar to Milton Keynes East; in this instance it is assumed that there would be zero GHG emissions to report, in accordance with the principles set out in IEMA (2017) Guidance

Future Baseline

N4.2 The future baseline will include both operational and in use Greenhouse Gas Emissions (i.e. direct and indirect emissions).

N4.3 Considering recent global trends and the adoption of planning policies which support the reduction of GHG emissions (such as decarbonisation of the National Grid, electric vehicle usage and the use of renewable energies), it is anticipated that there will be a reduction of carbon dioxide emissions over the next 20 years. Notwithstanding, as the Development Site is considered to be predominantly greenfield land, there is no scope for emissions to be reduced under the future baseline scenario.

N5.0 Potential Effects

N5.1 The total construction and operational carbon expected from the Proposed Development is expected to be 1,614,677,596 $kgCO_{2e}$/over 60 years. This is based on a total floor area of approximately 1,566,798m^2. This is approximately 1,030$kgCO_2$/per m^2.

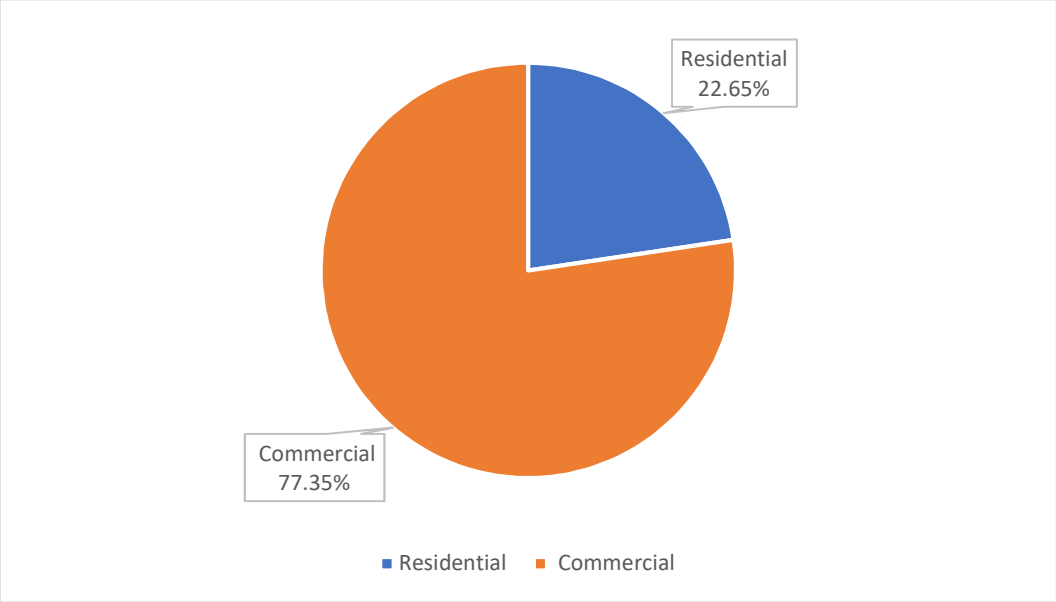
N5.2 The split between residential and commercial parts of the Proposed Development and the contribution to the overall carbon impact is shown below in Table N5.1.

Table N5.1: Total GHG emissions

Building Type	Total $kgCO_{2e}$/60 years	Total $kgCO_{2e}$/Floor Area
Residential	365,654,235	800.80
Commercial	1,249,023,361	1125.06

N5.3 This is also demonstrated in Figure N5.1 below:-

Figure N5.1 Total kg CO_2e – Split between residential and commercial spaces



During Construction

N5.4 This section identified and assessed the scale and nature of the main effects arising from the Proposed Development during the construction phases.

N5.5 The primary GHG emissions sources and the breakdown of the calculated GHG emissions are shown in Table N5.2 below. The reference study period (RSP) is 60 years, this is based on the principles outlined in BS EN 15978:2011, section 7.3 and the RICS guidance.

N5.6 GHG Emissions created by the transportation of materials to site and operation of on-site plant and machinery have been calculated using guidance from the Building Research Establish (BRE), which is 1,400kg of CO_{2e} per £100,000 of project value.

N5.7 The emissions have been reported below on a unit-by-unit basis based on the construction value provided by the applicant.

Table N5.2: Construction Phase GHG Emissions

Building Type	A5 Emissions (kg CO_{2e}/60 years) – based on construction value
Residential Houses – approx. 140m^2	4,760
Residential Flats – approx. 50.5m^2	
Industrial Units – approx. 13,330m^2	126,560
Schools – approx. 3,500m^2	37,380
Commercial Space – approx. 780m^2	3,920

N5.8 The construction emissions (A5) typically make up between 1.4% and 5% of the overall emissions.

Embodied Carbon

N5.9 Embodied carbon is the carbon footprint of a material; it considers the GHG emissions released throughout the life cycle of the development. Table N5.3 indicates the predicted embodied carbon (modules A1 – A3) for the different use types at the Proposed Development. The figures are reported on a unit-by-unit basis.

Table N5.3: Embodied Carbon

Building Type	A1 – A3 Emissions (kg CO_{2e}/60 years) – Average per type
Residential Houses – approx. 140m^2	17,153
Residential Flats – approx. 50.5m^2	14,212
Industrial Units – approx. 13,330m^2	9,012,909
Schools – approx. 3,500m^2	1,351,669
Commercial Space – approx. 780m^2	207,372

During Operation

N5.10 This section identifies and assesses the scale and nature of the main effects arising from the Proposed Development during operation.

Operational Carbon

N5.11 Operational energy is the inputted energy required for all heating and power needs. It can be split into regulated emissions which are assessed using the Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM), and unregulated emissions which is energy use as a direct result of user behaviour such as plug in electrical loads and white goods.

N5.12 Both regulated and unregulated emissions have been accounted for in the Whole Life Cycle Carbon Assessment. Table N5.4 below indicates the predicted operational energy for the Proposed Development. It should be noted that as unregulated energy demands are largely reliant on the behaviour of the occupants, they have been considered a fixed entity in the calculations.

Table N5.4: Operational Energy

Building Type	kWh
Residential Houses – approx. 140m^2	66,186
Residential Flats – approx. 50.5m^2	7,970
Industrial Units – approx. 13,330m^2	12,192,631
Schools – approx. 3,500m^2	3,224,137
Commercial Space – approx. 780m^2	3,279

N5.13 Figure N5.2 and Figure N5.3 below indicates that B6 Operational Energy is considered to have the highest kg CO_2e of all the lifecycle modules. The figures below show one of the industrial units (average size of 13,330m²) and one typical dwelling (average size of 140m²).

Figure N5.2 Total kg CO_2e – Life Cycle Stages – Industrial

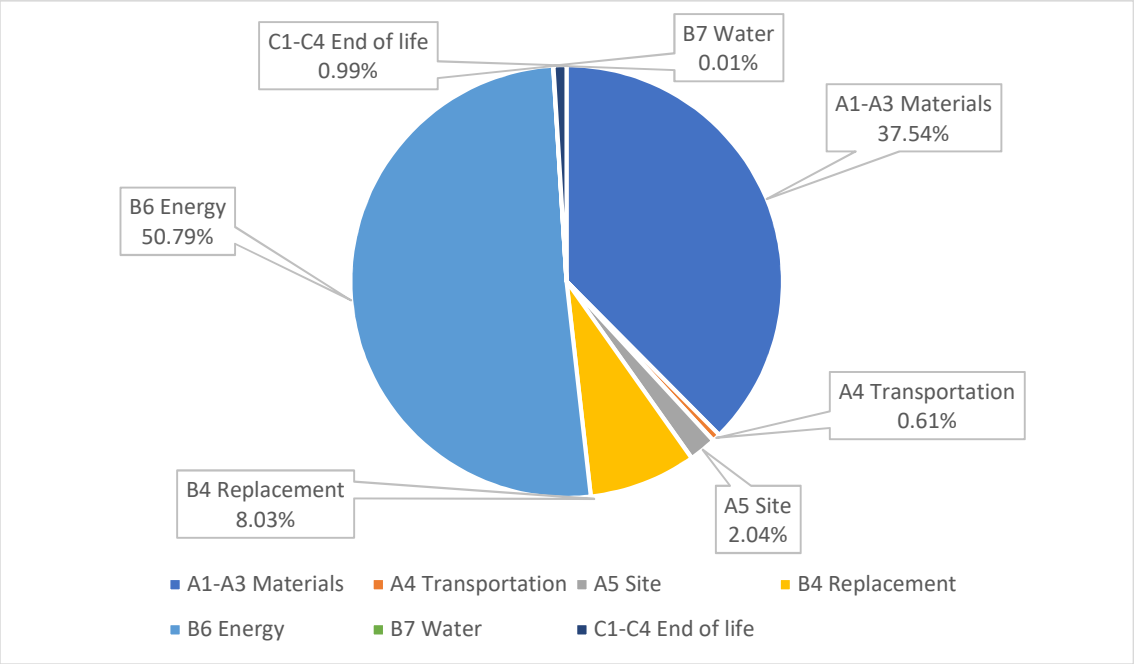
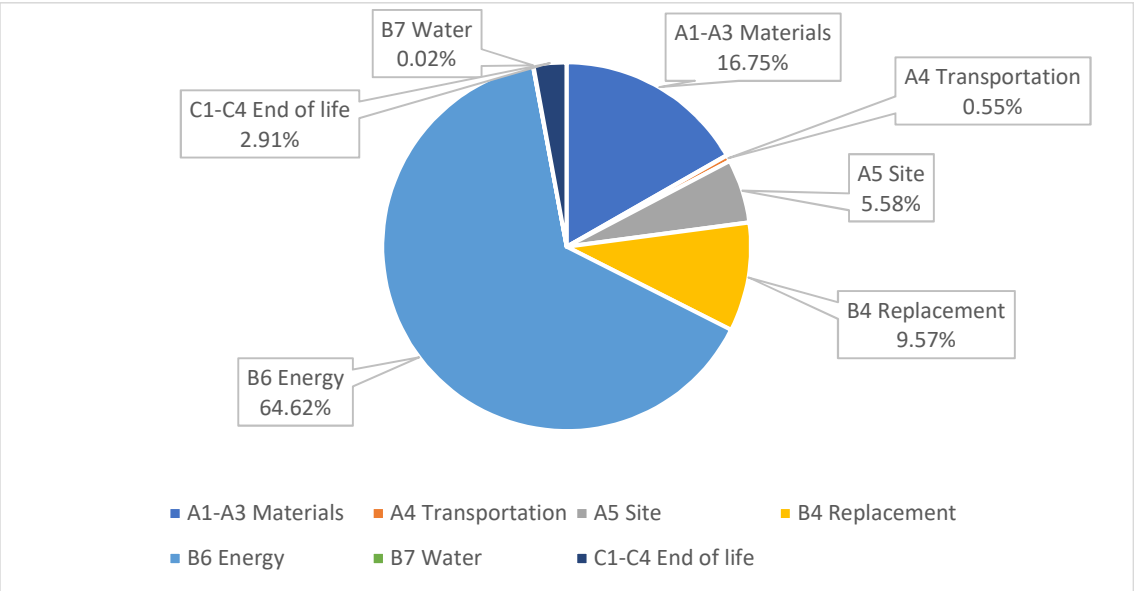


Figure N5.3 Total kg CO_2e – Life Cycle Stages – Typical Dwelling



End of Life Phase

N5.14 The end-of-life GHG emissions are indicated in table N5.5 below. The emissions have been reported below on a unit-by-unit basis based on floor areas noted in table N5.5.

Table N5.5: End of Life GHG Emissions

Building Type	Emissions (kg CO_{2e})
Residential Houses – approx. 140m^2	2,984
Residential Flats – approx. 50.5m^2	2,290
Industrial Units – approx. 13,330m^2	17,446
Schools – approx. 3,500m^2	62,639
Commercial Space – approx. 780m^2	8,715

UK Local Authority and Regional Carbon Dioxide Emissions national statistics: 2005-2017

N5.15 Using the most recent GHG emissions data from UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2017, the total contribution of the Proposed Development GHG emissions over 1 year as a proportion of the Milton Keynes Council GHG footprint is 19.50%. The total contribution of the Proposed Development GHG emissions over 1 year as a proportion of the UK GHG footprint is 0.077%.

N5.16 The figures below assume that the Proposed Development is constructed in 1 year. This is not the case and therefore exaggerates the impacts of the Proposed Development. The total GHG emissions are correct, however the amount emitted per year will be significantly less. This is dependent on the Proposed Development timeframe.

Table N5.6: Total Proposed Development GHG emissions over 1 year as a proportion of 2017 emissions

Area	GHG Emissions (kt CO_2) 2017	Proposed Development %
Milton Keynes	1,379.99	19.50%
National (UK)	351,501.26	0.077%

N6.0 Mitigation and Monitoring

During Construction and Operation

N6.1 It should be recognised that the IEMA (2017) Guidance states 'i*n the absence of any significance criteria or a defined threshold, it might be considered that all GHG emissions are significant and an EIA should ensure the project addressed their occurrence by taking mitigation action.*'

N6.2 Certain mitigation measures are embedded into the scheme design, such as using materials with lower embodied carbon and the provision of electrical vehicle charging points. Additional measures which are not embedded into the scheme design are measures such as the use of more efficient plant equipment and following the Construction Environmental Management Plan (CEMP).

N6.3 The long timeframe of the Proposed Development has been taken into account when formulating the energy strategy. It is envisaged that all homes will be fitted with air source heat pumps (ASHPs) for the provision of heating and hot water requirements.

N6.4 The initial plots will comply with interim Part L 2021 (31% reduction over Part L 2013) and later plots will comply with Future Homes Standard 2025 (75-80% reduction over Part L 2013). Berkeley Group have Sustainability Standard targets set for all sites, set at a Dwelling Emission Rate (DER) of 7.0 for all homes to be achieved by 2030. This is expected to exceed the requirement of Policy SC1 in Milton Keynes Local Plan.

N6.5 Berkeley Group use Science Based Targets which have been calculated against the overarching aim of limiting global warming to 1.5°C, therefore aligning with the Milton Keynes Sustainability Strategy. The following targets will be implemented on all sites, including the Proposed Development:

1 40% reduction in operational energy use by 2030 over a 2019 baseline.

2 40% reduction in whole life carbon by 2030 over a 2019 baseline.

N6.6 Table N6.1 below provides a summary of the mitigation and residual effects associated with climate change mitigation in relation to Greenhouse Gas Emissions.

Table N6.1: Mitigation and Residual Effects

Description of Effect	Potential Impact including Significance	Mitigation
During Construction		
Embodied carbon in building materials (across project lifespan)	Moderate adverse.	Embedded into scheme design: Re-use of materials and recycled materials where possible. Whole Life Cycle Carbon Assessments to be carried out once design is more detailed to assist in specifying materials with low impact. Additional measures: Use of low environmental impact, responsibly sourced materials.
Carbon emissions from construction plant	Moderate adverse.	Additional measures: Consider using more efficient plant equipment. Avoid the use of diesel or petrol-powered generators and using mains electricity or battery powered equipment.

Description of Effect	Potential Impact including Significance	Mitigation
		Use ultra-low sulphur fuels in plant and vehicles. Ensure that all vehicles and plant on site are not left running unnecessarily to prevent exhaust emissions.
Carbon emissions from construction traffic	Moderate adverse.	Source products locally to reduce the distance travelled and use more efficient vehicles. Vehicles to be 100% loaded when deliveries are being made to site.
During Operation		
Regulated energy use	Moderate adverse.	Embedded into scheme design: Envisaged that all homes will be fitted with air source heat pumps (ASHPs) for the provision of heating and hot water requirements. Implementing the energy hierarchy within the design of new homes. Initial plots to comply with interim Part L 2021 (31% reduction over Part L 2013) and later plots will comply with Future Homes Standard 2025 (75-80% reduction over Part L 2013). Berkeley Group have Sustainability Standard targets set for all sites, set at a Dwelling Emission Rate (DER) of 7.0 for all homes to be achieved by 2030. Carbon Offset Payments to Milton Keynes Council.
Unregulated energy use	Neutral/negligible.	Additional measures: Install energy efficient equipment and fittings.
Operational traffic emissions	Moderate adverse.	Additional measures: Encourage the use of public transport and active travel modes such as cycling and walking.

N7.0 Residual Effects

During Construction and Operation

N7.1 The mitigation measures described in the previous section will be implemented to minimise the GHG emissions during construction and throughout the lifetime of the Proposed Development, however a net increase in GHG emissions against the baseline will remain.

N7.2 It is expected that the GHG emissions will reduce throughout the Proposed Development's lifetime due to the decarbonisation of the electricity grid, tighter energy strategy requirements and an increase in low emission vehicles.

N7.3 IEMA guidance makes clear that any increase in GHG emissions should be considered significant, however the residual emissions are a small component in the context of the regional and national GHG emissions (see Table N5.6) and the mitigation measures follow best practice and are in accordance with local and national policy on climate change.

N7.4 It is therefore judged that although the residual effects are described as significant, these have been minimised and will continue to be minimised as the detailed design progresses through an appropriate degree of mitigation consistent with best practice and IEMA guidance.

N8.0 Summary & Conclusions

N8.1 This chapter has considered both how the Proposed Development can mitigate its effect on climate change by reducing Greenhouse Gas Emissions throughout its lifecycle, and how it can adapt to a changing climate over its life cycle.

N8.2 A range of measures will be incorporated into the Proposed Development to minimise Greenhouse Gas Emissions. These include the following:

1 The use of building materials with lower embodied carbon.

2 Sourcing products locally, where possible.

3 Re-use of materials, where possible.

4 Using more efficient plant equipment and avoiding the use of diesel or petrol powered generators on Site.

5 Incorporate the energy hierarchy into the energy strategy and install low zero carbon technology.

6 Installing energy efficiency equipment and fittings.

7 Berkeley Group target of 40% reduction in whole life carbon by 2030 over a 2019 baseline.

8 Encouraging the use of active travel modes.

Table N8.1 Summary Table

Description of significant effects	Receptor	Significance of Effects	Summary of Mitigation/Enhancement Measures	Significance of Residual
During Construction				
Greenhouse Gas Emissions from building materials, transport and construction plant emissions	Milton Keynes and wider UK Climate	Moderate adverse	Re-use of materials and recycled materials where possible. Whole Life Cycle Carbon Assessments to be carried out once design is more detailed to assist in specifying materials with low impact. Use of low environmental impact, responsibly sourced materials. Consider using more efficient plant equipment. Avoid the use of diesel or petrol-powered generators and using mains electricity or battery powered equipment. Use ultra-low sulphur fuels in plant and vehicles. Ensure that all vehicles and plant on site are not left running unnecessarily to prevent exhaust emissions. Source products locally to reduce the distance travelled and use more efficient vehicles. Vehicles to be 100% loaded when deliveries are being made to site.	Moderate adverse

Description of significant effects	Receptor	Significance of Effects	Summary of Mitigation/Enhancement Measures	Significance of Residual
Operation				
Greenhouse Gas Emissions from regulated and unregulated energy usage	Milton Keynes and wider UK Climate	Moderate adverse	Envisaged that all homes will be fitted with air source heat pumps (ASHPs) for the provision of heating and hot water requirements. Implementing the energy hierarchy within the design of new homes. Initial plots to comply with interim Part L 2021 (31% reduction over Part L 2013) and later plots will comply with Future Homes Standard 2025 (75-80% reduction over Part L 2013). Berkeley Group have Sustainability Standard targets set for all sites, set at a Dwelling Emission Rate (DER) of 7.0 for all homes to be achieved by 2030. Carbon Offset Payments to Milton Keynes Council. Install energy efficient equipment and fittings. Encourage the use of public transport and active travel modes such as cycling and walking.	Moderate adverse

N9.0 Abbreviations & Definitions

- CO_2 – Carbon Dioxide
- DER – Dwelling Emission Rate
- EIA – Environmental Impact Assessment
- ES – Environmental Statement
- GHG – Greenhouse Gas Emissions
- IEMA – Institute of Environmental Management and Assessment
- NPPF – National Planning Policy Framework
- PPG – Planning Practice Guidance
- SAP - Standard Assessment Procedure
- SBEM - Simplified Building Energy Model

N10.0 References

1 Ministry of Housing, Communities & Local Government (2019) National Planning Policy Framework. MHCLG: London.

2 HM Government (2016) The Building Regulations Approved Document L1A: Conservation of Fuel and Power. NBS: London.

3 IEMA (2017) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance