Huntingdonshire

Climate Change Evidence Base

Document D: Assessment of spatial strategy options

Huntingdonshire District Council

Final report

Prepared by Aether and LUC

December 2024

Version	Status	Prepared	Checked	Approved	Date
1	Draft	Aether: A James, H Robertson, K May LUC: C. King, R. Myerscough	T. Berliner	D. McNab	15.08.24
2	Revised Draft	Aether: H Robertson LUC: C. King	T. Berliner	D. McNab	20.11.24
3	Final Draft	Aether: H Robertson LUC: C. King	T. Berliner	D. McNab	05.12.24

EMS566057 FS566056 OHS627041

Land Use Consultants Limited

Registered in England. Registered number 2549296. Registered office: 250 Waterloo Road, London SE1 8RD. Printed on 100% recycled paper

Contents

Glossary of key terms 5

Executive Summary 8
Overview 8

Chapter 1 17
Introduction 17

Chapter 2 19
Methodology 19

Chapter 3 43
Results & Discussion 43

Appendix A 73
Spatial Strategy options 73

Appendix B 85
Derivation of benchmarks for buildings 85

Appendix C 91
Derivation of Transport Emissions 91

References 108

Glossary of key terms

Activity: an action that leads to emissions of greenhouse gases. Examples include combustion of fossil fuels for heat, generation of electricity and transport, treatment of waste and wastewater, industrial processes. Activity data represent how much of this activity is taking place and has a variety of different units e.g. kWh, passenger kilometres, tonnes of waste etc.

Carbon dioxide equivalent (CO_2e): carbon dioxide equivalent is a measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, the global warming potential for methane over 100 years is 28. Therefore 1 tonne of methane released is equivalent to 28 tonnes of CO_2 (measured on a 100-year time horizon). Therefore, CO_2e works as a single ‘currency’ for greenhouse gases.

Carbon emissions: often used as a shorthand to refer to greenhouse gas (GHG) emissions that are included in the Kyoto Treaty. Carbon dioxide is the most common GHG and other gases can be measured in relation to it (see CO_2e).

Carbon neutral: the balancing of carbon emissions against carbon removals and/or carbon offsetting with the net result being zero (see also net zero carbon).

Carbon reduction: an activity that reduces carbon emissions compared to a baseline scenario.

Climate change: the large-scale, long-term shift in the planet's weather patterns or average temperatures.

Climate change mitigation: action taken to reduce the release of greenhouse gas emissions or increase the removal of emissions by enhancing sinks (e.g. increasing the area of forests).

Decarbonisation: usually refers to the electricity sector and refers to reducing the carbon intensity of electricity generated (emissions per kWh) by increasing efficiency of supply or changing the generation fuel mix from fossil fuel to renewables and low carbon sources.

Emission factor: the average emissions of a given GHG for a particular activity. Emission factors are also expressed as the average combination of GHGs for a particular activity, in units of $kgCO_2e$.

Global warming: refers to the recent and ongoing rise in global average temperature near Earth's surface. It is caused mostly by increasing concentrations of greenhouse gases in the atmosphere. Global warming is causing climate patterns to change. However, global warming itself represents only one aspect of climate change.

Greenhouse Gas (GHG): a gas in our atmosphere that absorbs and emits radiation within the thermal infrared range. There are naturally occurring greenhouse gases in our atmosphere which maintain surface temperatures in a range conducive to life. However, since the industrial revolution, anthropogenic sources of GHGs have increased hugely, leading to 40% increase in atmospheric concentration of carbon dioxide. This is causing increases in surface temperatures and is the main cause of climate change. There are seven GHGs covered by the Kyoto Treaty, but the main ones are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and action needs to be taken to reduce emissions of these.

Greenhouse Gas Protocol: a joint initiative of the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), the GHG Protocol provides global standard frameworks for the measurement and management of greenhouse gas emissions.

Net zero carbon: the balancing of carbon emissions against carbon removals and/or carbon offsetting with the net result being zero (see also carbon neutral).

Project lifetime: anticipated lifetime of an energy efficiency technology or low carbon behaviour, used to calculate lifetime savings.

Removals: CO_2 removals refer to a set of techniques that aim to remove CO_2 directly from the atmosphere by either increasing natural sinks for carbon or using chemical engineering to remove the CO_2, with the intent of reducing the atmospheric CO_2 concentration.

Scope: a way of categorising emission sources in relation to the reporting organisation, used as a way of providing transparency in emissions accounting, making it clear the type of emission source and the level of control of the reporting organisation over the source. Three levels of scope have been defined and used on a global basis.

Sequestration: a natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form. The uptake of atmospheric carbon by plants and the growth of wood or increase of peat volume are examples of biological sequestration. Also see removals.

Executive Summary

Overview

This document has assessed the greenhouse gas (GHG) implications of the different spatial strategy options proposed by HDC and provided a clear recommendation on the most appropriate option to minimise carbon emissions from growth.

There is a requirement to provide at least 13,500 new homes over the Local Plan period (not including existing commitments), in addition to over 400,000 square metres (m^2) of new employment floorspace, and this will have an inevitable impact on increased carbon emissions.

HDC provided the consultant team with five spatial strategies to analyse. These were presented as high-level descriptions of the potential pattern for growth, as at the time of assessment HDC were not in a position to provide specific site allocations. These are summarised below:

Scenario	Description
1	Strategic expansions to existing towns
2	Public transport corridor focussed – This would include A428/A421 which has ambitions to provide a guided bus route and East West Rail and the proposal to reroute the A141 and provide a public transport corridor
3	Development concentrated around the Strategic road network
4	Two new settlements plus dispersed growth
5	Continuation of Local Plan strategy – This currently focusses on 75% growth in Spatial Planning Areas and 25% elsewhere e.g. Key Service Centres and Small Settlements.

Assessments

This document assesses the five spatial strategies in two ways:

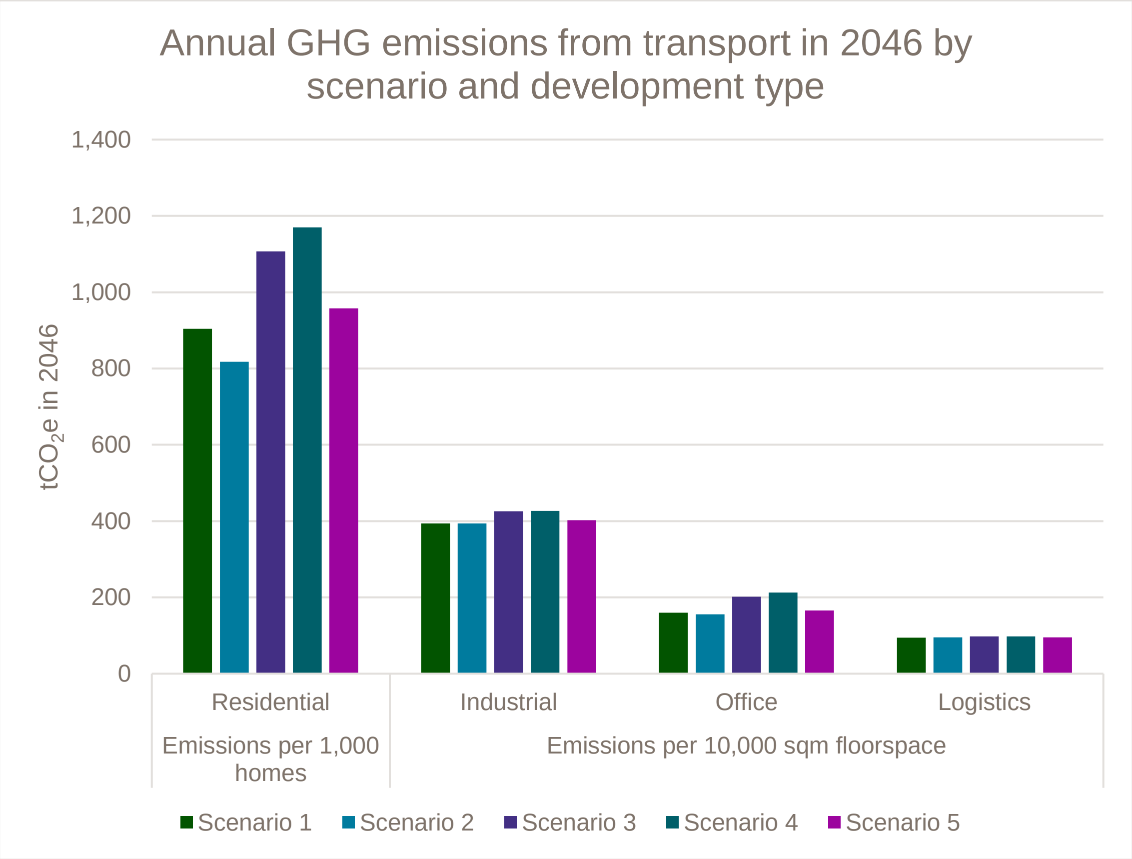
- Overall Assessment (total GHG emissions):
  - Considers the different spatial strategies based around high-level estimates of the achievable development quantum under each Scenario, and high-level descriptions of patterns for growth.
  - This first assessment was necessary to consider the Scenarios based on these best estimates at this stage of the Local Plan-making process, as each Scenario considers different locations, and different numbers of sites that could be developed. This has provided an overall analysis of GHG emissions considering all elements (location and quantum) holistically.
- Standardised Assessment (GHG intensity):
  - Considers the impact of the spatial patterns in isolation, removing the variable of number of sites / achievable m^2 / residential units. This considers the amount of GHG generated for every 1,000 residential units and every 10,000 m^2 of employment floorspace.

In short, the Overall Assessment reflects the fact that different spatial strategies will unlock different levels of growth and the Standardised Assessment assumes that they all deliver the same amount of growth.

Emissions from different spatial strategies

The Standardised Assessment indicates that if the quantity and type of development are held constant across all scenarios, emissions from buildings will be the same in all scenarios, but emissions from transport will vary depending on the spatial strategy selected. For transport emissions, **Scenario 2 is likely to be the least carbon-intensive** because it provides the best public transport accessibility, followed by Scenario 1, as shown in the graph below.

Figure 0.1: Annual GHG emissions from transport in 2046 by scenario and development type



Note: This chart should not be used for drawing comparisons between GHG emissions for residential and employment uses. Results are presented per 1,000 homes, and per 10,000 m^2 of employment floorspace. This does not directly correlate.

The findings of the Standardised Assessment are:

- Scenario 2 (Public transport corridor focussed) provides the lowest GHG emissions per 1,000 residential units, and the lowest per 10,000 m^2 of employment space.
- There is significantly more variation in the residential GHG emissions than the employment space. This is because residential vehicle demand is predominantly influenced by residents' daily travel habits. These are

influenced by individual site connectivity and therefore mode choice; with more accessible sites encouraging a higher non-car more share.

- Office floor space behaves similarly to residential in how it is influenced by location, and demonstrates more variation between the scenarios generating the highest and lowest GHG emissions (Scenarios 4 and 2 respectively)

- Conversely, the warehousing and industrial land uses experience less variation across the scenarios when considered on a standardised basis. This is because the emissions generated by vehicles are dominated by operational LGV and HGV movements, rather than commuting habits. These are significantly less influenced by location than by the unit's operational requirements.

- Scenario 4 generates the highest level of GHG emissions per 1,000 homes / per 10,000 m^2 of employment space. This scenario considers dispersed growth and two new settlements.

  - It is important to note that when modelling future mode share for this scenario, proxy settlements were used within Huntingdonshire that were considered to have similar accessibility, and host similar numbers of facilities to what may be achievable in the new settlements.

  - The outputs for this Scenario are therefore considered robust based on the current policy landscape. With the right policy framework within the Local Plan allocations, there is potential for this Scenario to perform more favourably. The new settlements would require highly ambitious, low car policies and be supported by a wide range of facilities following the 20-minute neighbourhood principles. However, even with these policies in place, this scenario would still include a high level of dispersed rural growth which would lead to higher vehicle mode shares.

By comparison, the Overall Assessment considers the Spatial Strategy including the high-level estimates of the achievable development quantum under each Scenario, and high-level descriptions of patterns of growth. This results in Scenario 4 producing the highest transport-related GHG emissions, followed by Scenario 2. This is because these scenarios achieve the highest quantum of warehousing and logistics floorspace. Scenario 1 is likely to produce the lowest overall GHG emissions. However, it should be noted the floorspaces used in the Overall Assessment are based on the best estimates of achievable development quantum based on what is known at this stage of the Local Plan-making process, and these are subject to change.

Impact of HDC's proposed policies for buildings

In addition to considering the GHG impacts of the choice of spatial strategy, this analysis also considers two different policy options for new buildings. These are summarised in the table below.

Source of emissions	Policy Off	Policy On
Operational emissions from buildings	Meet Building Regulations	100% reduction in regulated operational emissions from buildings
Embodied carbon of buildings	No cap on embodied carbon	Major residential developments: A requirement to assess and mitigate embodied carbon is introduced, along with a quantitative limit on upfront embodied carbon (900 $kgCO_2e/m^2$), which is assumed to reduce the carbon intensity of new homes by c. 50 $kgCO_2e/m^2$ on average.

The Overall Assessment suggests that adopting the above policies would achieve the following benefits:

- Over the course of the Local Plan period, the proposed policies would potentially reduce cumulative GHG emissions from new buildings by c. 70-80 ktCO_2e.
- Most of this improvement is due to the reduction in embodied carbon that is assumed to occur as a result of developers on major housing sites being required to assess and reduce embodied carbon. Readers should be aware that there is less evidence available on embodied carbon than operational carbon; this analysis is based on widely-used benchmarks (see Appendix B) and the results are considered to provide a realistic order-of-magnitude estimate.
- Regulated operational emissions from buildings would decrease by 100%, as this is part of the way the policy is defined. This could be achieved through different combinations of energy efficiency and on-site renewables, but for residents of new homes, it would potentially cut their electricity bills by up to 2/3^{rds}, which is a significant advantage. It would also reduce the demands on electricity grid infrastructure.

Considering the results in combination suggests that:

- A spatial strategy focused on public transport corridors (Scenario 2) would likely be the least carbon-intensive if the quantity and type of development were held constant across all scenarios.
- However, if that spatial strategy unlocks a significantly higher quantity of industrial and logistics / warehousing development uses, it would not necessarily be the lowest emitting scenario, and could in fact become one of the higher emitting scenarios. This is because the vehicle emissions for these land uses are dominated by operational LGV and HGV movements, rather than commuting habits. These are significantly less influenced by location than by the unit's operational requirements.

Recommendations

The GHG emissions modelling has demonstrated that HDC's proposed policies are necessary to reduce building emissions under all five scenarios.

In both the Policy On and Policy Off options, Scenario 1 performs best when considering GHG emissions in isolation, with Scenario 5 following.

When considering the Standardised Assessment, assuming like-for-like development quantums across all scenarios, Scenario 2 results in the lowest transport-related GHG emissions.

GHG emissions should not be considered in isolation when deciding on a spatial strategy. As noted in the NPPF, sustainability encompasses environmental, economic and social considerations. Therefore, wider implications must be considered, including but not limited to the impacts of rural and greenfield development, flooding and drainage, impacts to landscape character and ecology, amongst a variety of other elements discussed at a high level within this report.

When considering these wider implications and policy factors, Scenarios 1 and 5 are considered to perform the best on balance of GHG emissions and wider sustainability objectives. Scenario 1 is considered to provide good potential for brownfield urban development and provides a lower GHG intensity, whilst Scenario 5 is considered to provide a balance of minimised negative impact, coupled with maximised benefit on reducing rural deprivation, increasing access to services, facilities and job opportunities.

When considering the final spatial strategy, it is essential to consider the impacts holistically. Whilst the standardised assessment demonstrates the relative carbon intensity and location-based impact of each scenario, this must be considered alongside achievable development quantums, and wider sustainability objectives.

If the spatial strategy with the lowest carbon intensity unlocks a higher quantity of development (particularly industrial / warehousing / logistics), it would not necessarily be the lowest emitting scenario, and could in fact become one of the higher emitting scenarios.

Given the uncertainty about the exact type and quantity of development that will occur in the District, HDC is advised to adopt a multi-pronged approach to minimising GHG emissions, which would include:

- Requiring developers to assess, and take steps to minimise, the embodied carbon of new developments, since this is likely to be the single largest source of emissions associated with new development
- Locating those developments in areas with higher levels of public transport accessibility
- Adopting the 20-minute neighbourhood approach to planning by ensuring that developments are located within a convenient distance of shops, schools, and other amenities, which could be achieved either through proximity to existing facilities or by providing new ones
- Incorporating measures to decarbonise industrial and logistics / warehousing development through the use of consolidation centres, sustainable 'last mile' delivery practices (e.g. use of EVs or e-cargo bikes), and enabling uptake of low emission fleets through on-site charging.
- Designing buildings to be highly energy efficient, with heating systems that can run on 100% renewable electricity, and seeking to meet this demand using on-site renewables

The following recommendations are presented here as broader strategic choices but have informed the formulation and honing of tighter policy options presented in **Document C** (sustainable design):

- As explained in accompanying **Document B**, it will be extremely challenging for Huntingdonshire to reach broader net zero targets by 2050. As HDC has an opportunity to influence the significant body of emissions typically generated by new development, it is crucial that the Council takes this opportunity to use what levers it has via land use planning policy and other realms available to mitigate this increase:

- HDC should continue to keep abreast of technological and regulatory changes and consider adopting more ambitious standards for building emissions – informed by robust evidence and viability testing – when it is practical to do so.
- Unlike operational emissions which are fundamentally controlled by building occupants, embodied carbon can be significantly determined by decisions made at the design and planning stage. This means that HDC has an ability to influence them by introducing a quantitative target.
- Of the emissions sources evaluated, operational emissions are the smallest contributor. This shows that GHG emissions assessments omit important sources of emissions when considering the impacts of new development. HDC should therefore strongly encourage assessments to take a holistic approach and consider whole life-cycle carbon, not just operational emissions.
- HDC should monitor progressions in vehicle emissions technology, particularly relating to viable alternatives to diesel HGVs and LGVs. HDC should adopt policies that minimise emissions from diesel vehicles from the industrial, warehousing and distribution sectors, as this is the biggest contributor to vehicle emissions across all tested scenarios. The promotion of on-site EV charging infrastructure would support this.
- Through the Local Plan, HDC should explore the opportunity to introduce delivery consolidation centres and use of sustainable ‘last mile’ delivery systems where possible (e.g. e-cargo bikes).

Chapter 1

Introduction

1.1 This document will assess the carbon implications of the different spatial strategy options proposed by HDC and provide a clear recommendation on the most appropriate option to minimise Green House Gas (GHG) emissions from growth.

1.2 This report is based on the expectation of needing to provide at least 13,500 new homes and at least 400,000 square metres (m^2) of new employment floorspace over the Local Plan period (not including the existing commitments when this evidence was prepared of 15,000 new homes and 317,000 m^2 of employment floorspace). This will inevitably increase carbon emissions.

1.3 These figures were taken as minimum requirements for modelling purposes only, as changes to housing numbers are anticipated through the proposed revisions to the standard method through the draft National Planning Policy Framework (2024) and economic testing had not been undertaken to provide clear quantities and use types for employment development at the time this study was undertaken.

1.4 This document will analyse the relative carbon emissions of five different spatial strategy options through a high-level analysis focused on:

- Differential impacts on transport and accessibility patterns; and
- Introducing different building performance standards covering both operational and embodied carbon (as per best practice guidance from the RIBA, LETI and other organisations).

1.5 The document assesses the above in two ways:

- Overall Assessment (total GHG emissions):

  - Considers the different spatial strategies based on based around high - level estimates of the achievable development quantum under each Scenario, and high-level descriptions of patterns for growth.
  - This first assessment was necessary to consider the Scenarios based on these best estimates at this stage of the Local Plan-making process, as each Scenario considers different locations, and different numbers of sites that could be developed. This has provided an overall analysis of GHG emissions considering all elements (location and quantum) holistically.
- Standardised assessment (GHG intensity):
  - Considers the impact of the spatial patterns in isolation, removing the variable of number of sites / achievable m^2 / residential units. This considers the amount of GHG generated for every 1,000 residential units and every 10,000 m^2 of employment floorspace.

Chapter 2

Methodology

Overview

2.1 This section describes the assessment methodology for calculating the Green House Gas (GHG) emissions implications of the spatial strategies. The assessment covers:

- Embodied carbon and operational energy use in buildings; and
- Operational energy use in transport (i.e. vehicle movements associated with the new developments).

2.2 HDC provided the consultant team with five spatial strategies to analyse. These were presented as high-level descriptions of the potential pattern for growth, as at the time of assessment HDC were not in a position to provide specific proposed site allocations. The spatial strategy descriptions are summarised in Table 2.1 and are provided in Appendix A.

Table 2.1: Spatial Strategy – Modelled Scenarios

Scenario	Description
1	Strategic expansions to existing towns
2	Public transport corridor focussed – This would include A428/A421 which has ambitions to provide a guided bus route and East West Rail and the proposal to reroute the A141 and provide a public transport corridor
3	Development concentrated around the Strategic road network
4	Two new settlements plus dispersed growth

Scenario	Description
5	Continuation of Local Plan strategy – This currently focusses on 75% growth in Spatial Planning Areas and 25% elsewhere e.g. Key Service Centres and Small Settlements.

2.3 Information provided by HDC specified the total amount of development under each of the five spatial strategies. The existing commitments were excluded from the testing as they are constant across all scenarios and will be unaffected by the choice of future development scenario. It should be noted that the amount of potential employment floorspace varies in different scenarios based on the potential of different possible site combinations that could contribute to each scenario. Development amounts are given either as number of units (# of homes) or floor area (m^2), summarised in Table 2.2 (see Appendix A for full details provided):

Table 2.2: Spatial Strategy – Total Indicative Quantity by 2046*

Scenario	Residential (units)	Employment (m2) Industrial	Employment (m2) Office / Business Park	Employment (m2) Logistics
1	13,500	190,000	73,000	145,000
2	13,500	340,000	150,000	260,000
3	13,500	225,000	102,000	205,000
4	13,500	270,000	75,000	205,000
5	13,500	227,000	73,000	193,000

** Not including existing commitments*

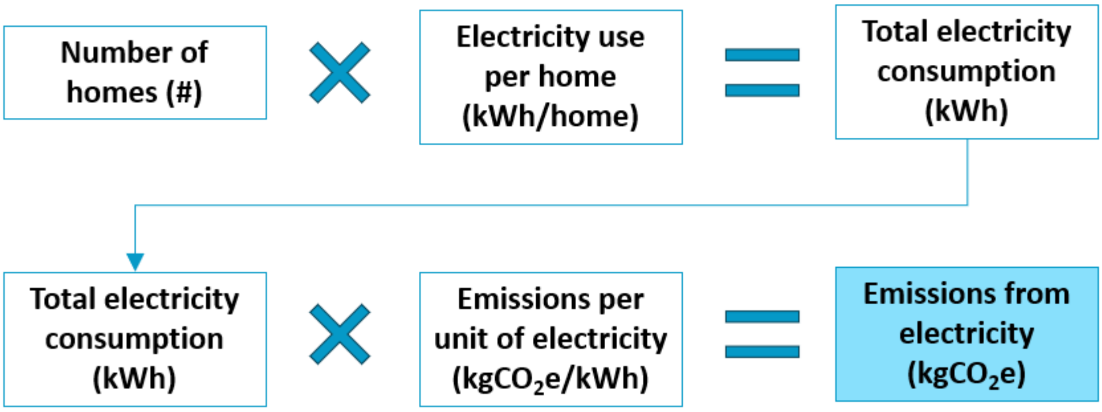
2.4 Note that the above scenarios assume different quantities of development in each spatial strategy. A standardised assessment has also been produced to provide a like-for-like comparison if all spatial strategies included 1,000 homes and 10,000 m^2 of floorspace for each employment use category.

2.5 For both buildings and transport, the overall methodological approach was as follows:

- Review information provided by HDC about the quantity of housing and employment space (industrial, office, and logistics) that is required between now and 2046.
- Use the above information to estimate the annual average build-out rate in each of the 5 spatial strategy options. As a simplifying assumption, the rate of build-out was assumed to be linear over the 22-year plan period up to 2046.
- Identify suitable benchmarks for embodied carbon, energy use in buildings, and trip generation for each type of development. Benchmarks were defined for both a ‘policy off’ scenario, and for ‘policy on’, to demonstrate the impact of select preferred policies being considered for the local plan.
- Identify relevant emission factors to convert the above information from activity data (e.g. kWh of electricity or vehicle kilometres travelled) to emissions (kgCO_2e) for each year of the local plan period.
- Sum the annual emissions by spatial scenario to find the total cumulative emissions associated with each spatial strategy option over the Local Plan period.

2.6 The diagram below presents a simplified version of the process. To illustrate the core concepts, it shows the method for calculating operational emissions from electricity use in new homes in a given year. A similar approach was taken for each source of emissions, sector and fuel type in each year of the analysis. For residential developments the key metric is number of homes (#) whereas for non-residential developments, the analysis is based on floorspace (m^2).

Figure 2.1: Simplified version of methodological approach



2.7 The calculations were then replicated using different benchmarks to represent different policy options for buildings, i.e. lower embodied carbon and more efficient design. This indicates the relative scale of impact that can be achieved through introducing HDC's preferred policies. The policy options are summarised in Table 2.3 and further details are provided in the following sections.

Table 2.3: Summary of policy options

Source of emissions	Policy Off	Policy On
Operational emissions from buildings	Meet Building Regulations	100% reduction in regulated operational emissions from buildings
Embodied carbon of buildings	No cap on embodied carbon	Major residential developments: A requirement to assess and mitigate embodied carbon is introduced, along with a quantitative limit on upfront embodied carbon (900 $kgCO_2e/m^2$), which is assumed to reduce the carbon intensity of new homes by c. 50 $kgCO_2e/m^2$ on average.
Transport	N/a – there is no quantitative policy on GHG emissions proposed for transport. Transport emissions instead will depend on the choice of spatial strategy.	Not applicable

2.8 Through comparison of a policy on and off scenario, and the five spatial scenarios the model serves as sensitivity analysis, in that it helps to identify which variables or future trends have the biggest impact on emissions, and thereby highlight risks or practical issues that HDC should be aware of.

2.9 It is important to understand that the results of the modelling do not serve as a prediction of future emissions. This analysis is solely intended to highlight the potential scale of emissions from different sources and to inform policy responses. More detailed GHG calculations will need to be undertaken at a future stage to support individual planning applications.

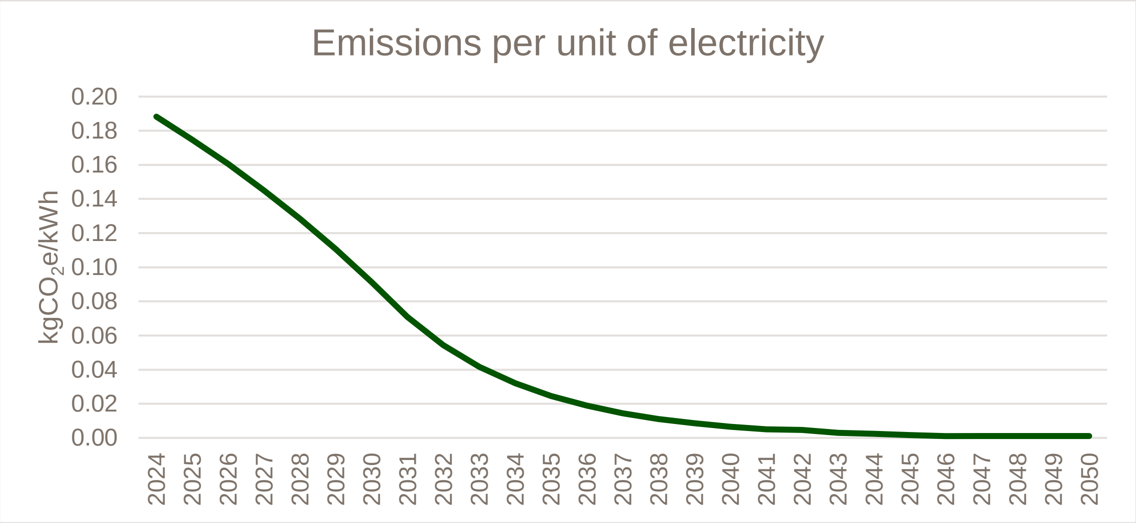
Emission factors

2.10 To convert energy use into GHG emissions, emission factors for 2024 are taken from the DESNZ GHG Conversion Factors for Company Reporting.[1]

2.11 Most emission factors are assumed to hold constant over time. The exception is for grid electricity; emissions per unit ($kgCO_2e/kWh$) are assumed to reduce due to uptake of renewable technologies instead of fossil fuels.

2.12 To estimate future emission factors for electricity, we have referred to values presented in the Treasury Green Book, Data Table 1 (accessed May 2024). These were indexed to 2024 to obtain a ‘multiplier’ which was applied to the starting year value for grid electricity emissions. This means that the proportional change over time is the same as has been assumed in the Treasury Green Book, although the starting year values are slightly different due to the use of different calculation methods.

Figure 2.2: Emissions per unit of electricity



GHG emissions from buildings

2.13 This analysis is intended to provide insight into the impacts of key variables that are of interest to HDC in producing its new development plan, including the quantity and type of development that comes forward, and what GHG emissions standards that those developments are required to meet.

Quantity and type of new development

2.14 The quantity and type of developments are based on information provided by HDC; see Table 2.2 (above). A standardised assessment of emissions for 1,000 new homes and 10,000 m^2 of floorspace for each employment uses has also been undertaken to provide an indication of the relative GHG intensity of different building types.

Policy options modelled

2.15 For the **'Policy Off'** option:

- Regarding operational emissions, new buildings constructed in the next few years are assumed to meet current (Part L 2021) Building Regulations and be heated with gas boilers. It has been assumed that the Future Homes Standard (FHS) and Future Buildings Standard (FBS) will be introduced in 2025. Those will slightly increase energy efficiency levels, and also require the use of electrically powered heating systems such as air source heat pumps (ASHPs) instead of gas boilers. The Government's consultation on the FHS and FBS indicates that there will be transitional arrangements in place, allowing the industry time to adapt. So, for the purpose of this analysis it has been assumed that buildings constructed after c. 2026 or 2027 will need to meet the FHS and FBS.
- There is currently no requirement to measure or reduce embodied carbon under Building Regulations, so the 'Policy Off' option assumes that buildings meet typical practice in regard to embodied carbon.

2.16 The **'Policy On'** option assumes that:

- All buildings will achieve a 100% reduction in regulated operational emissions. There will still be some emissions associated with unregulated energy use. The majority of unregulated emissions will be due to electricity, but in the next few years, buildings could still be connected to the gas grid in which case there could be some unregulated emissions from fossil fuel systems such as gas hobs.
- Major residential developments will be required to evaluate, and take steps to reduce, embodied carbon emissions. A quantitative limit on upfront embodied carbon will also be introduced which restricts it to 900 $kgCO_2e/m^2$. This limit is higher than current typical practice; this is intentional as the threshold is intended to be achievable with no associated cost uplift. However, it will still have a beneficial impact because it will prevent very high embodied carbon developments being built and thus reduce the *average* levels that are achieved. For the purpose of this analysis, it has been assumed that the requirement to

assess and minimise upfront embodied carbon could avoid approximately 50 $kgCO_2e/m^2$ (a saving of 3-4 tCO_2e per home) on average. This is an illustrative figure which is nonetheless considered to be realistic, based on evidence from the Low Energy Transformation Initiative (LETI), Royal Institute of British Architects (RIBA) and others; refer to Appendix B for more information.

2.17 These policies are assumed to have an immediate impact once they come into place, i.e. there is no lag between the policy being adopted and the effects being modelled.

Benchmarks used

2.18 The benchmarks for each building type and policy option are shown in the table below. ‘Policy Off’ benchmarks include total (regulated and unregulated) energy use. ‘Policy On’ benchmarks only include unregulated energy use. These have been derived from a variety of sources, including the CIBSE Energy Benchmarking Dashboard, the Non-Domestic National Energy Efficiency Database (NEED) and LETI. They also incorporate assumptions about regulated and unregulated energy use, based on the Energy Consumption in the UK (ECUK) statistics.

2.19 Further details are provided in Appendix B.

Table 2.4: Benchmarks for energy use and embodied carbon of buildings

Residential	Description	Gas ($kWh/m^2/year$)	Electricity ($kWh/m^2/year$)	Embodied carbon ($kgCO_2e/m^2$)
Policy off	Gas-heated buildings (up to 2027)	126	26	800
Policy off	Electrically-heated buildings (post-2027)	0	62	800
Policy on	Gas-heated buildings (up to 2027)	3	21	750
Policy on	Electrically-heated buildings (post-2027)	0	22	750
Industrial	**Description**	**Gas (kWh/m2/year)**	**Electricity (kWh/m2/year)**	**Embodied carbon (kgCO2e/m2)**
Policy off	Gas-heated buildings (up to 2027)	82	32	1000
Policy off	Electrically-heated buildings (post-2027)	0	55	1000
Policy on	Gas-heated buildings (up to 2027)	75	30	1000
Policy on	Electrically-heated buildings (post-2027)	0	51	1000

Offices	Description	Gas (kWh/m²/year)	Electricity (kWh/m²/year)	Embodied carbon ($kgCO_2e/m^2$)
Policy off	Gas-heated buildings (up to 2027)	97	128	1000
Policy off	Electrically-heated buildings (post-2027)	0	130	1000
Policy on	Gas-heated buildings (up to 2027)	8	88	1000
Policy on	Electrically-heated buildings (post-2027)	0	92	1000
Logistics	**Description**	**Gas (kWh/m²/year)**	**Electricity (kWh/m²/year)**	**Embodied carbon ($kgCO_2e/m^2$)**
Policy off	Gas-heated buildings (up to 2027)	103	53	1000
Policy off	Electrically-heated buildings (post-2027)	0	82	1000
Policy on	Gas-heated buildings (up to 2027)	0	43	1000
Policy on	Electrically-heated buildings (post-2027)	0	43	1000

2.20 Note that upfront embodied carbon emissions are assumed to occur as a one-off emission in the year that each building is constructed. In reality, they will occur over a period of time – potentially several years – as the constituent products go from material extraction, to manufacturing, transportation to site, and construction.

Accounting for future trends

2.21 As stated previously, this analysis has considered the following trends as part of a 'business as usual' future:

- The introduction of the FHS and FBS in 2025; and
- Decarbonisation of the UK electricity grid.

2.22 In reality, there are a large number of variables that could influence future emissions. These include, but are not limited to: Population growth, economic trends, energy prices, weather and climate variables, tighter energy efficiency standards, consumer habits (e.g. more electronic appliances), decarbonisation of industry and the wider construction supply chain, and many more.

GHG emissions from transport

Overview of the model used for transport

2.23 This section summarises the methodology used, with further detailed reporting in Appendix C.

2.24 The methodology was based on the following steps for each of the five spatial strategies:

1. Estimate housing and employment types, and rate of build out up to 2046
2. Project mode share up to 2046
3. Calculate total annual trip generation by travel mode, including Goods Vehicles for industrial uses
4. Estimate total annual vehicle km by vehicle type (car / LGV / HGV) and fuel type (petrol / diesel / hybrid / EV) up to 2046
5. Estimate total annual kWh by vehicle type (car / LGV / HGV) and fuel type (petrol / diesel / hybrid / EV) up to 2046

2.25 The assessment has been split over three assessment phases to reflect the rapidly changing nature of transportation:

- Phase 1: the first 8 years of the plan to 2029
- Phase 2: between 2029 and 2037
- Phase 3: the final 9 years between 2037 and 2046

Assumptions about housing type and tenure

2.26 Information provided by HDC specified the total potential quantum of development under each of the five spatial strategies summarised in Table 2.2: Spatial Strategy – Total Indicative Quantity by 2046* (above).

2.27 In order to derive robust estimates of trip generation and modal split, it was necessary to understand the housing growth in further detail. HDC provided high-level estimates of housing mix (see Appendix A), and these were built upon to develop set assumptions regarding proportion of housing type and tenure:

1. **Housing Type (flats and houses)**
   Based on District Average Housing Proportions (unless otherwise specified by HDC) for certain locations:

- 10%1 bedroom flats
- 25% 2 bedroom terraced/semi-detached houses and flats
- 34% 3 bedroom terraced/semi-detached and detached houses
- 31% 4+ bedroom majority detached houses

2. **Housing Tenure (affordable vs open market)**
   Based on Huntingdonshire Target Housing Tenure % (Local Plan 2036 Policy LP24a):

- 40% affordable

- 60% open market

Baseline Mode Share

2.28 As shown in Appendix A, each of the five spatial strategies included a high-level description of potential locations for growth. Specific sites were not provided, but general area descriptions were used to draw assumptions over the existing transport mode shares of the areas.

2.29 Census 2021 Method of Travel to Work data was utilised. Each potential growth area identified in each spatial strategy was examined individually, and sample Lower Super Output Areas were selected that were considered to most closely represent the descriptions provided in Appendix A.

2.30 This provided a baseline mode share assumption for each growth area based on the existing transport characteristics.

Projected Mode Share

2.31 Mode share projections were derived for 2029, 2037 and 2046 for each Spatial Strategy. The Climate Change Committee (CCC) report on 'The Sixth Carbon Budget: Surface Transport' was used which provided national estimates of future mode shift:

- 5-7% of car journeys could be shifted to walking and cycling (including e-bikes) by 2030, rising to 9-14% by 2050
- 9-12% of car trips could be shifted to buses by 2030, increasing to 17-24% by 2050
- average car occupancy to increase from 1.6 today to up to 1.7 by 2030 and up to 1.9 by 2050

2.32 These estimates were split into three categories. In line with the CCC report, the % uplifts in public transport, active travel and car passengers are assumed to come from converted car drivers:

- Standard Uplift:
  - Average proportions of CCC estimated mode shift (converted car journeys) applied to all modes.
  - Applied to Scenarios 1 and 5.
- Public Transport Focussed:
  - Upper limit of CCC estimated mode shift applied for public transport trips.
  - Average proportions of CCC estimated mode shift for other modes.
  - Applied to Scenario 2.
- Road Network Focussed:
  - Lower limit of CCC estimated mode shift applied for public transport trips.
  - Applied to Scenarios 3 and 4.

Table 2.5: Projected Mode Share Factors (% of baseline car drivers converting)

Modes of transport	2029	2037	2046
Standard Uplift	Standard Uplift	Standard Uplift	Standard Uplift
Car Passenger	4%	8%	12%
Public Transport	11%	16%	21%
Active Travel	6%	9%	13%
Other*	1%	2%	3%
Public Transport Focussed	Public Transport Focussed	Public Transport Focussed	Public Transport Focussed
Car Passenger	4%	8%	12%
Public Transport	12%	18%	24%
Active Travel	6%	9%	13%
Other*	1%	2%	3%
Road Network Focussed	Road Network Focussed	Road Network Focussed	Road Network Focussed
Car Passenger	4%	8%	12%
Public Transport	9%	13%	17%
Active Travel	5%	7%	9%
Other*	1%	2%	3%

** High level estimation of 1% uplift per assessed year to account for on take up of unknown novel micromobility technology.*

2.33 The factors outlined above were applied to the derived baseline mode shares to project the estimated future mode shares for each growth area and Spatial Strategy scenario.

2.34 Further detail is provided in Appendix C.

Annual Trip Generation

2.35 Annual Trip Generation estimations were derived for each scenario using the TRICS Trip Generation Database.

2.36 This is a nationally recognised system to establish potential levels of trip generation for various development scenarios using a series of database filtering processes.

2.37 Comparable site surveys were filtered to derive ‘Total Person’ Daily Trip Rates for the variety of housing types, tenures and employment types. The estimated ‘Total Person’ daily trip rates were applied to the development growth quantum for each scenario, and expanded to annual figures using a factor of 292.5 to account for lower weekend and holiday trips.

2.38 The annual ‘Total Person’ Trip Rates were applied to the projected mode shares to derive total annual trip estimates by mode, for each Scenario.

Total Annual Vehicle km by vehicle type

2.39 National DfT data[2] on ‘Average trip length by main mode’ was used to convert Total Annual Vehicle Trips to Total Annual Vehicle km. The latest national average trip length for car or van drivers is 13.006km (8.1 miles) which was used as a flat conversion factor against total vehicle trips for cars, Light Goods Vehicles and Heavy Goods Vehicles (HGVs).

2.40 Despite the government announcement to delay the 2030 target for no new internal combustion engine vehicles to 2035, it is widely accepted that the use of electric vehicles will become more widespread and will play a greater role in the vehicle mix when calculating tail pipe emissions from vehicles. The

Total Annual Vehicle km was therefore further broken down by fuel type, and future projections for the assessed years were derived.

2.41 DVLA Data3 provides data for licensed vehicles in Huntingdonshire by body and fuel type, and this was used as the baseline fuel type split. Future projections were calculated based on the National Grid 'Future Energy Scenarios' document (July 2017) 'Slow Progression' Scenario of growth in Pure Electric Vehicles (PEVs) and Plug-In Hybrid EVs (PHEVs).

2.42 The 'Slow Progression' scenario was chosen as this was considered most reflective of the current economic climate, defined as:

2.43 *"Low economic growth and affordability compete with the desire to become greener and decrease carbon emissions. With limited money available, the focus is on cost efficient longer-term environmental policies. Effective policy intervention leads to a mixture of renewable and low carbon technologies and high levels of distributed generation."*

Figure 2.3: The Growth of EVs

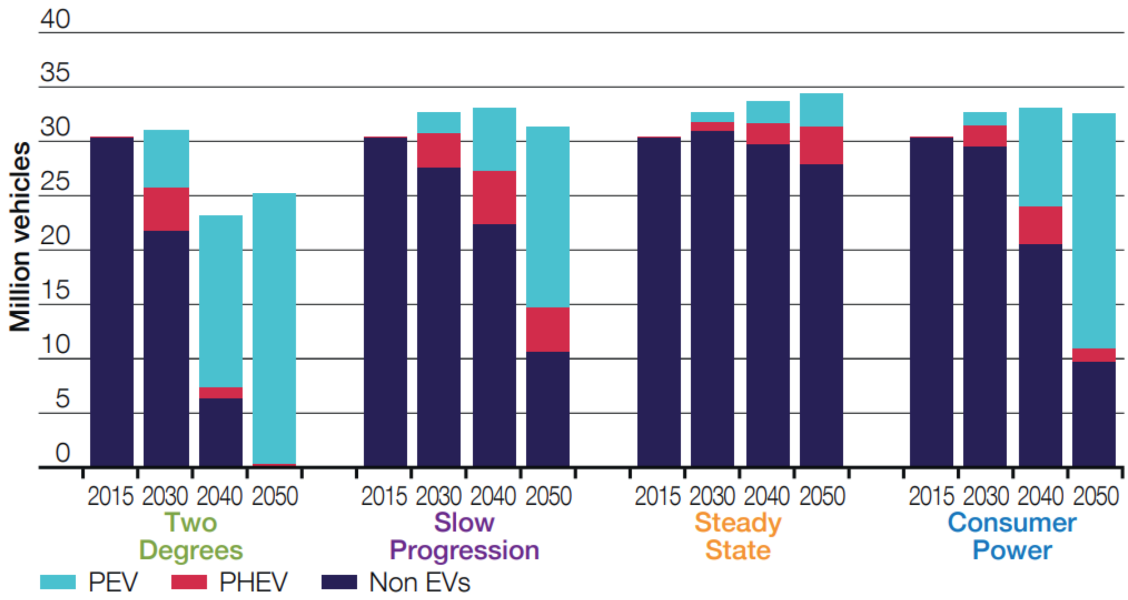


Image Source: Figure 3.13 of National Grid, Future Energy Scenarios (July 2017)

2.44 Baseline data for LGV and HGVs in Huntingdonshire shows a negligible proportion of PEV and PHEV vehicles. The future scenario derived by the National Grid was therefore used to inform future car splits, whilst LGV and HGV proportions were rationalised against the baseline data.

2.45 Further detail on Fuel Type projections and the derived Total Annual Vehicle km is included in Appendix C.

Total Annual kWh by Vehicle Type

2.46 Conversion factors are published by the UK Government (Department for Energy Security & Net Zero)[4] to calculate the energy use, in kilowatt hours (kWh), based on vehicle kilometres.

2.47 Conversion factors are published by vehicle fuel type and body type. The Total Annual Vehicle km calculated through the above methodology have been applied to these factors to calculate Total Annual kWh for each Spatial Strategy Scenario. This is summarised in Table 2.6.

Table 2.6: Total Annual Vehicle kWh by Fuel Type and Land Use – All Body Types

Scenario	Land Use	Quantum	Unit	Petrol 2029	Petrol 2037	Petrol 2049	Diesel 2029	Diesel 2037	Diesel 2049	Hybrid 2029	Hybrid 2037	Hybrid 2049	Hybrid 2029	Hybrid 2037	Hybrid 2049	Total 2029	Total 2037	Total 2049
1	**Total Residential**	13,500	unit	17,329,501	32,533,953	27,292,222	10,748,233	20,178,453	16,927,387	1,864,485	6,278,385	9,464,716	749,135	3,313,330	12,807,242	30,691,354	62,304,122	66,491,568
1	**Industrial**	190,000	m2	3,020,400	5,745,849	5,007,680	7,277,504	17,443,777	25,144,430	312,668	1,052,866	1,587,203	146,001	677,438	2,982,355	10,756,573	24,919,929	34,721,668
1	**Office/ business park**	73,000	m2	1,654,187	3,105,528	2,605,178	1,025,972	1,926,134	1,615,803	177,974	599,303	903,454	71,509	316,274	1,222,515	2,929,642	5,947,238	6,346,951
1	**Logistics**	145,000	m2	217,615	414,758	365,727	1,308,188	3,299,467	5,298,282	22,458	75,625	114,005	10,645	49,757	227,699	1,558,906	3,839,606	6,005,712
1	**Total Employment**	408,000	m2	4,892,202	9,266,134	7,978,585	9,611,664	22,669,378	32,058,516	513,101	1,727,793	2,604,662	228,154	1,043,468	4,432,568	15,245,121	34,706,774	47,074,331
1	**Total (all land uses)**	-	-	**22,221,703**	**41,800,087**	**35,270,808**	**20,359,897**	**42,847,831**	**48,985,903**	**2,377,586**	**8,006,179**	**12,069,378**	**977,289**	**4,356,798**	**17,239,810**	**45,936,475**	**97,010,895**	**113,565,899**
2	**Total Residential**	13,500	unit	16,435,155	30,290,440	24,665,155	10,193,535	18,786,965	15,298,008	1,768,262	5,845,434	8,553,671	710,473	3,084,846	11,574,455	29,107,425	58,007,684	60,091,289
2	**Industrial**	340,000	m2	5,678,256	10,607,183	8,985,736	13,192,428	31,416,840	45,010,569	588,919	1,946,820	2,848,798	273,080	1,245,370	5,348,400	19,732,683	45,216,213	62,193,503
2	**Office/ business park**	150,000	m2	3,482,799	6,418,895	5,226,832	2,160,128	3,981,175	3,241,825	374,715	1,238,715	1,812,622	150,557	653,715	2,452,761	6,168,200	12,292,499	12,734,039
2	**Logistics**	260,000	m2	425,121	795,198	680,434	2,367,371	5,948,223	9,515,655	44,026	145,540	212,970	20,597	94,463	419,853	2,857,115	6,983,423	10,828,912
2	**Total Employment**	750,000	m2	9,586,177	17,821,275	14,893,002	17,719,927	41,346,238	57,768,049	1,007,661	3,331,075	4,874,389	444,234	1,993,548	8,221,015	28,757,999	64,492,135	85,756,455
2	**Total (all land uses)**	-	-	**26,021,331**	**48,111,715**	**39,558,156**	**27,913,462**	**60,133,202**	**73,066,057**	**2,775,923**	**9,176,508**	**13,428,060**	**1,154,708**	**5,078,393**	**19,795,470**	**57,865,424**	**122,499,819**	**145,847,744**
3	**Total Residential**	13,500	unit	19,028,062	37,054,936	33,419,797	11,801,728	22,982,491	20,727,878	2,047,234	7,150,842	11,589,708	822,562	3,773,757	15,682,689	33,699,585	70,962,026	81,420,071
3	**Industrial**	225,000	m2	4,145,286	8,152,309	7,553,047	8,970,694	21,493,180	30,782,866	431,430	1,506,954	2,442,391	197,471	939,514	4,293,303	13,744,881	32,091,956	45,071,607
3	**Office/ business park**	102,000	m2	2,623,740	5,109,428	4,608,187	1,627,316	3,169,008	2,858,124	282,289	986,015	1,598,081	113,421	520,356	2,162,454	4,646,766	9,784,807	11,226,845
3	**Logistics**	205,000	m2	361,784	712,438	665,664	1,883,075	4,742,947	7,582,842	37,574	131,244	212,713	17,389	83,183	391,652	2,299,822	5,669,811	8,852,870
3	**Total Employment**	532,000	m2	7,130,810	13,974,175	12,826,897	12,481,084	29,405,135	41,223,832	751,293	2,624,212	4,253,184	328,282	1,543,053	6,847,409	20,691,468	47,546,574	65,151,322
3	**Total (all land uses)**	-	-	**26,158,872**	**51,029,111**	**46,246,694**	**24,282,812**	**52,387,626**	**61,951,709**	**2,798,526**	**9,775,054**	**15,842,892**	**1,150,843**	**5,316,810**	**22,530,098**	**54,391,054**	**118,508,600**	**146,571,393**
4	**Total Residential**	13,500	unit	20,107,197	39,156,426	35,315,128	12,471,037	24,285,893	21,903,414	2,163,338	7,556,387	12,246,993	869,211	3,987,777	16,572,098	35,610,784	74,986,482	86,037,633
4	**Industrial**	270,000	m2	5,013,988	9,859,973	9,133,286	10,789,421	25,839,699	36,982,625	521,981	1,823,243	2,955,016	238,679	1,135,279	5,184,638	16,564,069	38,658,194	54,255,564
4	**Office/ business park**	75,000	m2	2,029,268	3,951,763	3,564,090	1,258,608	2,450,992	2,210,547	218,329	762,609	1,235,997	87,723	402,456	1,672,497	3,593,928	7,567,821	8,683,130
4	**Logistics**	205,000	m2	362,537	713,905	666,987	1,883,542	4,743,857	7,583,662	37,655	131,527	213,172	17,422	83,333	392,273	2,301,156	5,672,621	8,856,094
4	**Total Employment**	550,000	m2	7,405,793	14,525,641	13,364,362	13,931,570	33,034,548	46,776,834	777,966	2,717,379	4,404,184	343,824	1,621,068	7,249,408	22,459,153	51,898,636	71,794,788
4	**Total (all land uses)**	-	-	**27,512,990**	**53,682,067**	**48,679,490**	**26,402,608**	**57,320,441**	**68,680,248**	**2,941,304**	**10,273,766**	**16,651,177**	**1,213,035**	**5,608,846**	**23,821,507**	**58,069,937**	**126,885,119**	**157,832,422**
5	**Total Residential**	13,500	unit	18,346,658	34,443,538	28,894,143	11,379,102	21,362,830	17,920,943	1,973,921	6,646,896	10,020,249	793,105	3,507,807	13,558,965	32,492,788	65,961,072	70,394,301
5	**Industrial**	227,000	m2	3,886,892	7,387,267	6,421,168	8,867,316	21,164,786	30,312,828	403,500	1,358,727	2,048,292	186,463	862,572	3,768,811	13,344,172	30,773,351	42,551,099
5	**Office/ business park**	73,000	m2	1,717,776	3,224,907	2,705,324	1,065,412	2,000,176	1,677,917	184,816	622,341	938,184	74,258	328,432	1,269,510	3,042,261	6,175,857	6,590,935
5	**Logistics**	193,000	m2	306,879	584,398	513,925	1,751,927	4,411,763	7,069,023	31,746	106,900	161,152	14,913	69,521	315,806	2,105,466	5,172,582	8,059,906
5	**Total Employment**	493,000	m2	5,911,547	11,196,572	9,640,417	11,684,656	27,576,724	39,059,767	620,062	2,087,968	3,147,628	275,634	1,260,525	5,354,126	18,491,899	42,121,789	57,201,939
5	**Total (all land uses)**	-	-	**24,258,206**	**45,640,110**	**38,534,561**	**23,063,758**	**48,939,555**	**56,980,710**	**2,593,983**	**8,734,864**	**13,167,877**	**1,068,740**	**4,768,331**	**18,913,092**	**50,984,686**	**108,082,860**	**127,596,240**

Limitations of this approach

2.48 The assessment of transport-related emissions does not serve as a prediction of future emissions but rather a comparative analysis of each of the assessed scenarios to highlight the potential scale of emissions from different sources and to inform policy responses.

2.49 The assessment has been based on a linear build-out rate over the Local Plan period; the actual rate of build-out is highly uncertain and may vary significantly year-on-year.

2.50 For buildings emissions, actual energy use in buildings depends on a wide variety of factors, and this model only considers the following variables:

- Quantity and type of development
- GHG emissions standards, which impact energy demands and heating system/fuel type
- Electricity grid decarbonisation

2.51 Future changes in population and economic growth, energy prices, consumer habits, and structure of households have not been assessed. For example, higher energy costs may lead to lower energy demand whereas an increase in the use of consumer electronics could increase energy demand. Impacts of climate change itself have not been assessed and this could influence heating demand in buildings, for example.

2.52 Different buildings, even of the same size and type, may have significantly different embodied carbon emissions, and so the actual figures could be higher or lower.

2.53 Assumptions around employment transport impacts are based on standard assumptions around general industrial, office, and warehousing uses.

However, impacts of these uses will be highly subject to the end tenants, specific business structures, and unit size and layouts. For example, a large-scale distribution centre for a global retailer is likely to generate higher HGV movements than the equivalent m^2 of smaller-scale units occupied by more local logistics operators. Conversely, global retailers have greater potential to invest in lower-emission fleets or make use of technologies to reduce vehicle mileage such as logistics planning software.

2.54 Whilst the assessment has included projections for uptake in lower-carbon vehicles including Hybrid and EVs, there may be a rapid expansion of future technologies that are unknown at this stage (e.g. Hydrogen).

2.55 The assessment methodology has been developed based on the best available assumptions at this stage in the process;further, more detailed emissions modelling should be undertaken at the application stage.

Standardised Assessment

2.56 The assessment described within this chapter so far is based around high - level estimates of the achievable development quantum under each Scenario, and high-level descriptions of patterns of growth.

2.57 This has allowed for the modelling to be as true to the future scenarios as possible, based on what is known at this stage of the Local Plan-making process.

2.58 It was necessary to consider the Scenarios based on these quantums and growth patterns in the initial modelling assessment, as each Scenario considers different locations, and different numbers of sites that may be developed. This has provided an **overall** analysis of carbon emissions considering all elements (location and quantum) holistically.

2.59 However, to isolate the impacts of location (i.e. the spatial strategy itself), a further standardised assessment has been carried out. This has rationalised the findings so far, to standardised findings for:

- Every 1,000 residential units
- Every 10,000 m^2 of employment floorspace

2.60 This additional assessment has removed the variable of number of sites / achievable m^2 / residential units, providing a focussed assessment of the impacts of **location type only.**

2.61 The standardised figures for vehicle kWh are summarised in Table 2.7 overleaf.

2.62 These have fed into a standardised Greenhouse Gas assessment, to calculate the carbon intensity of each scenario (rather than the overall carbon impacts), described in the following chapter.

Table 2.7: Total Annual Vehicle kWh by Fuel Type and Land Use – All Body Types (Standardised – by 1,000 units / 10,000 m^2)

Scenario	Land Use	Quantum	Unit	Petrol 2029	Petrol 2037	Petrol 2049	Diesel 2029	Diesel 2037	Diesel 2049	Hybrid 2029	Hybrid 2037	Hybrid 2049	EV 2029	EV 2037	EV 2049	Total 2029	Total 2037	Total 2049
1	**Total Residential**	1,000	unit	1,283,667	2,409,922	2,021,646	796,165	1,494,700	1,253,881	138,110	465,066	701,090	55,491	245,432	948,685	2,273,434	4,615,120	4,925,301
1	**Industrial**	10,000	m2	158,968	302,413	263,562	383,027	918,094	1,323,391	16,456	55,414	83,537	7,684	35,655	156,966	566,135	1,311,575	1,827,456
1	**Office/ business park**	10,000	m2	226,601	425,415	356,874	140,544	263,854	221,343	24,380	82,096	123,761	9,796	43,325	167,468	401,321	814,690	869,445
1	**Logistics**	10,000	m2	15,008	28,604	25,223	90,220	227,549	365,399	1,549	5,215	7,862	734	3,431	15,703	107,511	264,800	414,187
1	**Total Employment**	10,000	m2	119,907	227,111	195,554	235,580	555,622	785,748	12,576	42,348	63,840	5,592	25,575	108,641	373,655	850,656	1,153,783
2	**Total Residential**	1,000	unit	1,217,419	2,243,736	1,827,049	755,077	1,391,627	1,133,186	130,982	432,995	633,605	52,628	228,507	857,367	2,156,106	4,296,865	4,451,207
2	**Industrial**	10,000	m2	167,008	311,976	264,286	388,013	924,025	1,323,840	17,321	57,259	83,788	8,032	36,629	157,306	580,373	1,329,889	1,829,221
2	**Office/ business park**	10,000	m2	232,187	427,926	348,455	144,009	265,412	216,122	24,981	82,581	120,841	10,037	43,581	163,517	411,213	819,500	848,936
2	**Logistics**	10,000	m2	16,351	30,585	26,171	91,053	228,778	365,987	1,693	5,598	8,191	792	3,633	16,148	109,889	268,593	416,497
2	**Total Employment**	10,000	m2	127,816	237,617	198,573	236,266	551,283	770,241	13,435	44,414	64,992	5,923	26,581	109,614	383,440	859,895	1,143,419
3	**Total Residential**	1,000	unit	1,409,486	2,744,810	2,475,540	874,202	1,702,407	1,535,398	151,647	529,692	858,497	60,930	279,538	1,161,681	2,496,266	5,256,446	6,031,116
3	**Industrial**	10,000	m2	184,235	362,325	335,691	398,697	955,252	1,368,127	19,175	66,976	108,551	8,776	41,756	190,813	610,884	1,426,309	2,003,183
3	**Office/ business park**	10,000	m2	257,229	500,924	451,783	159,541	310,687	280,208	27,675	96,668	156,675	11,120	51,015	212,005	455,565	959,295	1,100,671
3	**Logistics**	10,000	m2	17,648	34,753	32,471	91,857	231,363	369,895	1,833	6,402	10,376	848	4,058	19,105	112,186	276,576	431,847
3	**Total Employment**	10,000	m2	134,038	262,672	241,107	234,607	552,728	774,884	14,122	49,327	79,947	6,171	29,005	128,711	388,937	893,733	1,224,649
4	**Total Residential**	1,000	unit	1,489,422	2,900,476	2,615,935	923,781	1,798,955	1,622,475	160,247	559,732	907,185	64,386	295,391	1,227,563	2,637,836	5,554,554	6,373,158
4	**Industrial**	10,000	m2	185,703	365,184	338,270	399,608	957,026	1,369,727	19,333	67,528	109,445	8,840	42,047	192,024	613,484	1,431,785	2,009,465
4	**Office/ business park**	10,000	m2	270,569	526,902	475,212	167,814	326,799	294,740	29,111	101,681	164,800	11,696	53,661	223,000	479,190	1,009,043	1,157,751
4	**Logistics**	10,000	m2	17,685	34,825	32,536	91,880	231,408	369,935	1,837	6,416	10,399	850	4,065	19,135	112,252	276,713	432,005
4	**Total Employment**	10,000	m2	134,651	264,103	242,988	253,301	600,628	850,488	14,145	49,407	80,076	6,251	29,474	131,807	408,348	943,612	1,305,360
5	**Total Residential**	1,000	unit	1,359,012	2,551,373	2,140,307	842,896	1,582,432	1,327,477	146,216	492,363	742,241	58,749	259,838	1,004,368	2,406,873	4,886,005	5,214,393
5	**Industrial**	10,000	m2	171,229	325,430	282,871	390,631	932,369	1,335,367	17,775	59,856	90,233	8,214	37,999	166,027	587,849	1,355,654	1,874,498
5	**Office/ business park**	10,000	m2	235,312	441,768	370,592	145,947	273,997	229,852	25,317	85,252	128,518	10,172	44,991	173,905	416,748	846,008	902,868
5	**Logistics**	10,000	m2	15,900	30,280	26,628	90,773	228,589	366,271	1,645	5,539	8,350	773	3,602	16,363	109,092	268,009	417,612
5	**Total Employment**	10,000	m2	119,910	227,111	195,546	237,011	559,366	792,287	12,577	42,352	63,846	5,591	25,568	108,603	375,089	854,397	1,160,283

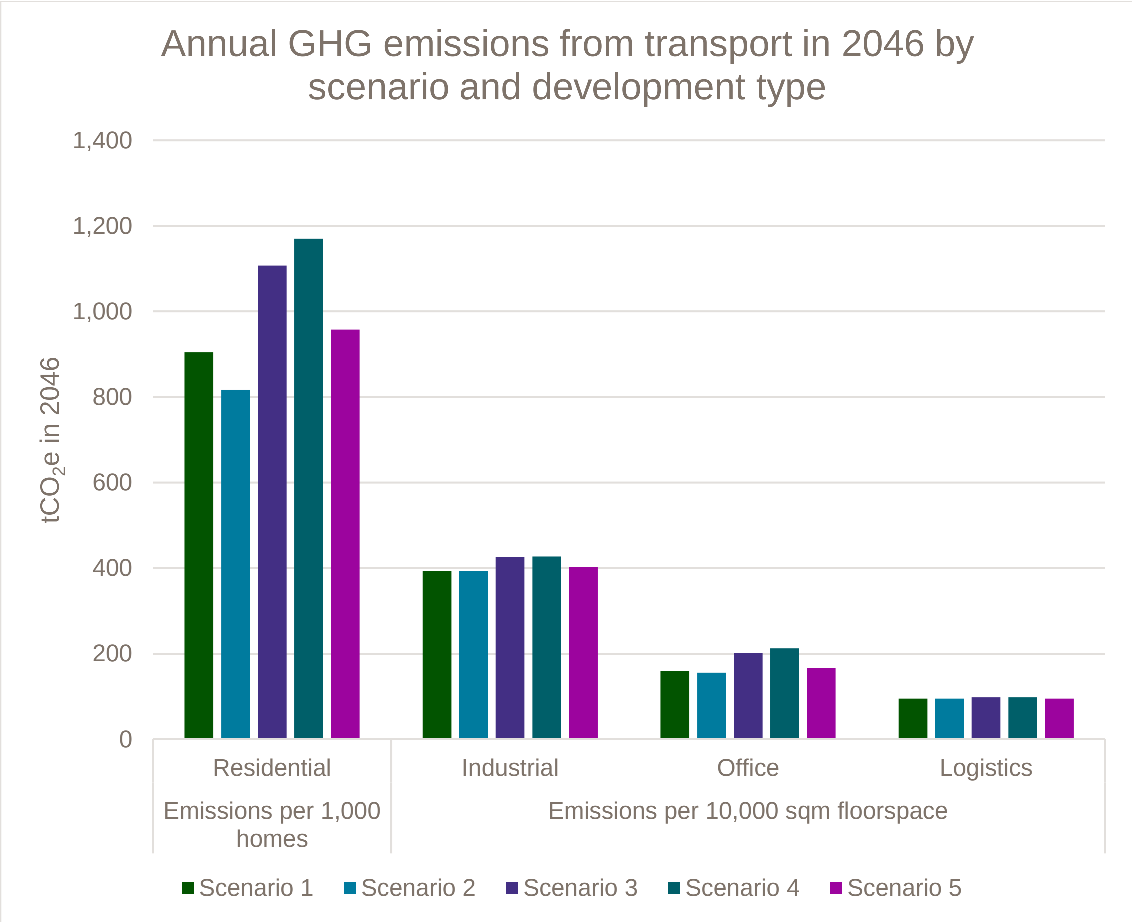
Chapter 3

Results & Discussion

Headline results

3.1 The Standardised Assessment indicates that if the quantity and type of development are held constant across all scenarios (resulting in emissions from buildings being the same in all scenarios), **Scenario 2 is likely to be the least carbon-intensive** because it provides the best public transport accessibility, followed by Scenario 1. The graph below shows the relative GHG emissions from transport for different types of development in each spatial strategy.

Figure 3.1: Annual GHG emissions from transport in 2046 by scenario and development type



Note: This chart should not be used for drawing comparisons between GHG emissions for residential and employment uses. Results are presented per 1,000 homes, and per 10,000 m^2 of employment floorspace. This does not directly correlate.

3.2 In reality, different spatial strategies are likely to result in different quantities and types of development being brought forward. The Overall Assessment, which varies the quantity and type of development across different scenarios, gives a more holistic understanding of the scale of total emissions. It suggests that Scenario 1 would have the lowest emissions overall, followed by Scenario 5.

Figure 3.2: Cumulative GHG Emissions by 2046 - Policy On

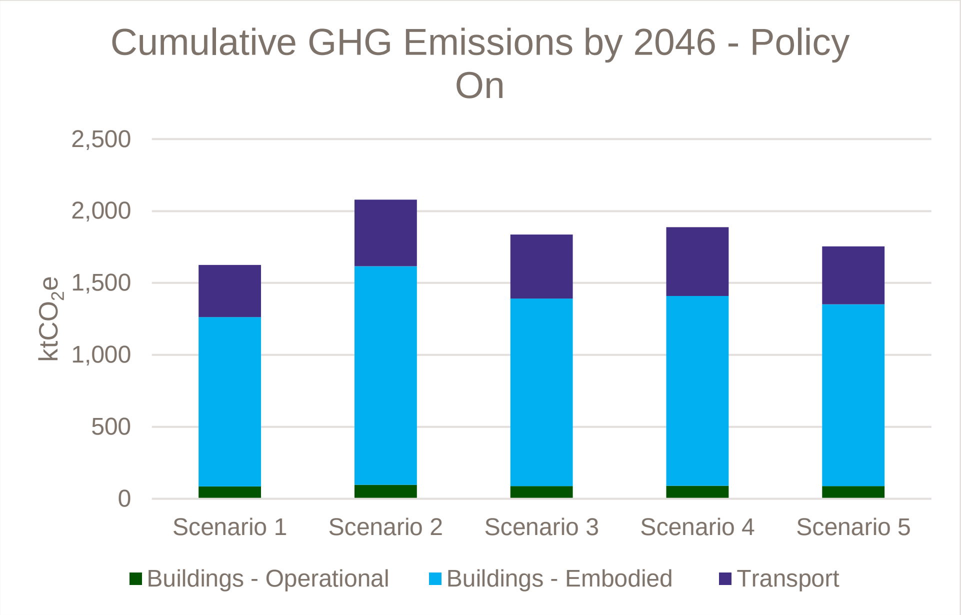


Table 3.1: Total Emissions

Source	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Buildings – Operational ($ktCO_2e$)	86	97	89	91	89
Buildings - Embodied ($ktCO_2e$)	1,178	1,520	1,302	1,320	1,263
Transport ($ktCO_2e$)	361	463	445	478	404
Total Emissions ($ktCO_2e$)	1,624	2,079	1,836	1,889	1,755

3.3 The results of the Overall Assessment indicate that the cumulative emissions from new development over the Local Plan period are expected to be in the region of 1,600-2,100 $ktCO_2e$. To put these numbers into context, Local Authority GHG emissions statistics from DESNZ indicate that annual emissions in Huntingdonshire are around 1,800-1,900 $ktCO_2e$ (see Document B for more information). In other words, the scale of emissions from new development over the next two decades is roughly equivalent to one year's worth of GHG emissions for the District as a whole. Although these are small in relative terms, as explained in Document B, it will be extremely challenging for the District to reach net zero by 2050. Any increase in emissions will make the task harder than it already is. Because HDC has an opportunity to influence emissions from new development, it is crucial that the Council takes this opportunity to use what levers it has available to mitigate this increase.

3.4 There are several other important take-home points from this analysis.

3.5 When looking at the emissions from buildings and transport together (see graph above), emissions are dominated by **embodied carbon**, which accounts for roughly 70-73% of emissions across the five scenarios. This means that a policy that limits embodied carbon would have a significant impact on the cumulative emissions from new development, and is therefore strongly recommended.

3.6 Transport is the next most significant contributor, representing around 21-24% of the total. Even though this is smaller than the emissions from embodied carbon, it is still 3-4 times higher than operational emissions from energy use in buildings. This is important because typically the emissions from buildings and transport are usually assessed separately as part of the planning and building control process, and the impact of transport is therefore often overlooked. Selecting a spatial strategy that reduces reliance on car travel will have a beneficial impact on reducing these emissions.

3.7 Of the sources evaluated, **operational emissions from energy use in buildings** is the smallest proportion of the total. This shows that GHG emissions assessments omit important sources of emissions when considering the impacts of new developments. HDC should therefore encourage assessments to take a holistic approach and assess whole life-cycle carbon, not just operational emissions.

3.8 It is also worth remembering that these results are subject to considerable uncertainty, as explained in Section 2.48. In particular:

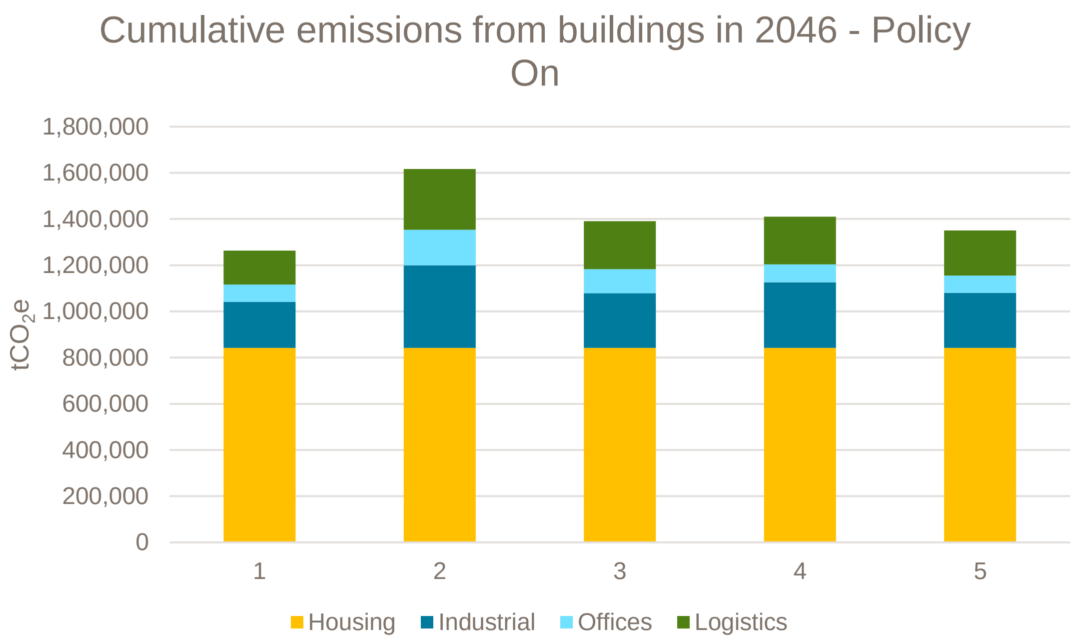
- The emissions from energy use in buildings and transport could be much higher if the national electricity grid does not decarbonise in line with the Government's aspirations and/or if the shift to electric vehicles and heating systems is delayed. This would mean that cumulative emissions would be much higher, and it is one of the key sensitivities of the model. HDC can play its role in mitigating against this possibility by working to achieve a step-change in renewable energy deployment. All Local Authorities will need to do their part to ensure that the energy system is capable of meeting the demands of a net zero future.
- Emissions from transport are dominated by diesel use in HGVs. HGVs are assumed to continue to use fossil fuels over the course of the Local Plan period. If a zero-emission alternative becomes commercially available in that timeframe, this would reduce GHG emissions by a considerable amount.

3.9 A more detailed discussion of the results is provided in the following sections.

Emissions from buildings

3.10 In the Overall Assessment, emissions from buildings vary across the five spatial strategy options due to differences in the amount and type of non-residential development included under each scenario. The amount of housing developed is assumed to be the same in each scenario, and this is the main source of emissions in all cases.

Figure 3.3: Cumulative emissions from buildings in 2046 - Policy On

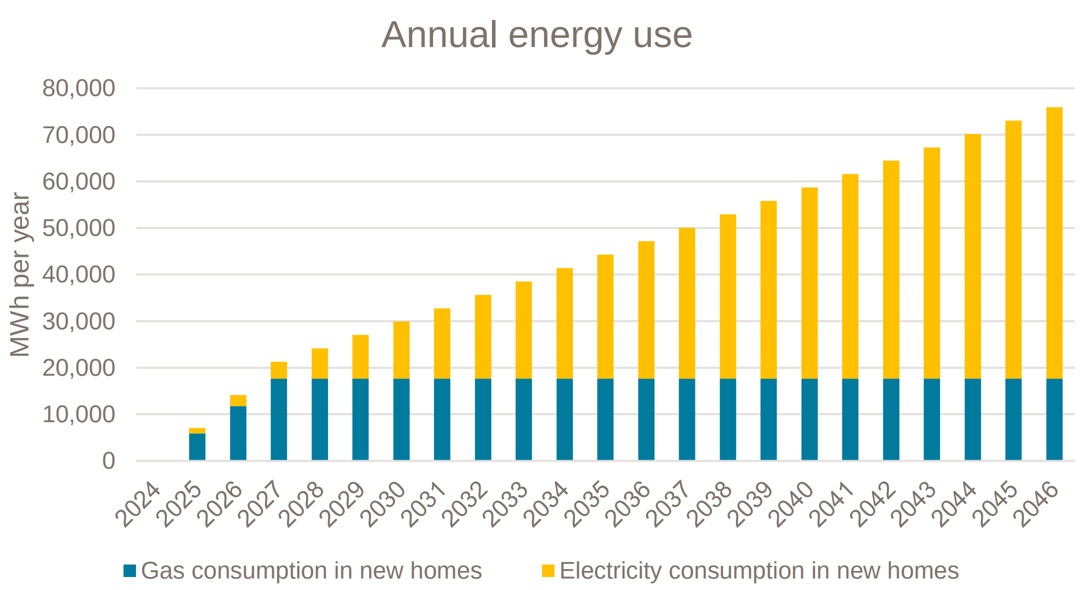


3.11 Embodied carbon emissions are significantly higher than operational emissions in buildings (Figure 3.3). When these emissions occur outside of the District boundary, they will not appear on Huntingdonshire's 'balance sheet' of area-wide emissions as reported by DESNZ. In some cases, they will occur overseas and therefore would not be counted within the UK's territorial GHG inventory at all. However, when considering global climate change it is irrelevant where the emissions occur – it is still important to take steps to mitigate them where possible.

3.12 Operational emissions from buildings do not just depend on the energy efficiency standards that are adopted. They also strongly dependent on the type of fuel that is used for heating. Electricity can, in principle, be generated by renewable technologies instead of fossil fuels. By contrast, due to the inherent properties of natural gas, it will always emit a certain amount of CO_2 during combustion. This means that, over time, operational emissions from buildings will come to be dominated by any remaining fossil fuel heating systems. This is illustrated by considering the series of charts below.

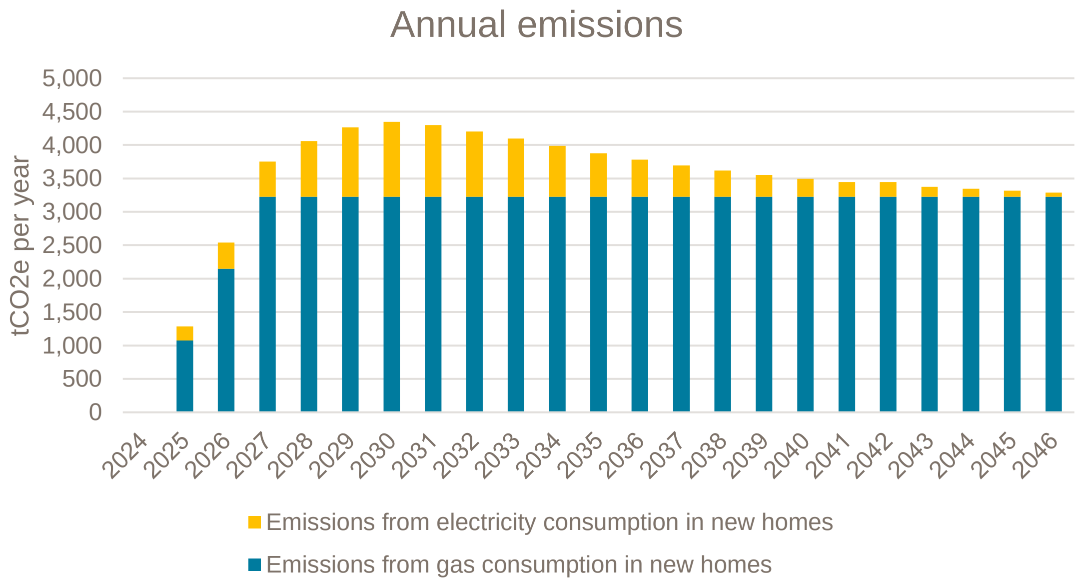
3.13 First, Figure 3.4 shows the additional amount of gas and electricity used in new developments each year. Energy use goes up over time as new buildings are constructed. In the first few years, new buildings use gas boilers. However, after the introduction of the FHS, all subsequent buildings are assumed to switch to heat pumps. Unless occupants replace their gas boilers, those systems will continue to operate; this is why gas consumption flatlines in the graph below while electricity use increases.

Figure 3.4: Annual energy use



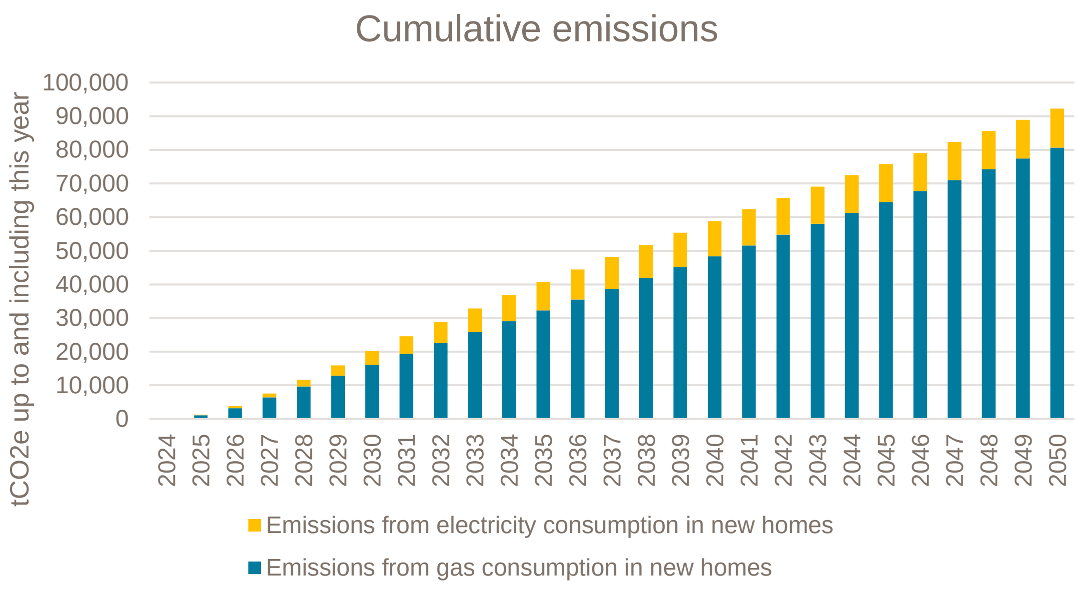
3.14 Next, consider Figure 3.5, which shows the GHG emissions associated with this amount of gas and electricity use. Emissions from gas increase, then hold constant, for the reason described in the previous paragraph. However, even though electricity use continues to rise, the emissions from electricity start to fall over time, as the national grid decarbonises. As time goes on, the additional emissions from electricity each year start to decrease and become negligible in the 2040s. Note that this analysis was produced prior to the summer 2024 election; the new Government has proposed an earlier date for a decarbonised national grid, which would mean that emissions from electricity reduce more quickly.

Figure 3.5: Annual emissions



3.15 Figure 3.6 adds up these annual results to calculate the *cumulative* operational emissions up to and including a given year. This shows that, over the course of the Local Plan period, gas consumption could become the main source of emissions from new buildings even if gas heating systems are only installed for a few more years prior to the introduction of the FHS and FBS.

Figure 3.6: Cumulative emissions



3.16 Although this is a high-level calculation based on benchmarks, it illustrates some important points:

- There is a carbon penalty associated with continuing to use gas heating systems, even if they are only installed in the next few years. To avoid this, HDC should seek to phase out the use of fossil fuel heating systems as quickly as possible.
- If the grid does not decarbonise in line with the Government's expectations, emissions from buildings would be higher than indicated in this report. To mitigate this possibility, it is important for HDC to (a) set ambitious energy efficiency standards for buildings, because demand reduction can help to reduce emissions even if the carbon intensity of electricity does not decrease, and (b) proactively seek to deliver the additional renewables and infrastructure needed to meet demands.

Standardised Assessment

3.17 This section describes the emissions from buildings if the quantity, type and design of new developments is held constant. Information is provided separately for residential and non-residential buildings; a comparison is provided from paragraph 3.26 onwards.

Residential buildings

3.18 Emissions per dwelling will depend on the size, typology (detached, semi-detached, terrace, flats, etc.), and occupant habits, among many other factors.

3.19 On average, this model assumes that a Future Homes Standard-compliant dwelling (the 'Policy Off' option) would use roughly 4,000-5,000 kWh of electricity per year (based on a benchmark of 62 kWh/m^2). The annual emissions would then be approximately 0.9 tCO_2e per dwelling (<0.01 tCO_2e/m^2), based on the current carbon intensity of the electricity grid as of 2024, but this would decrease in future years as the grid decarbonises. The cumulative emissions of that dwelling over the lifespan of the Local Plan (up to 2046) would depend on when it is constructed and how much electricity is supplied with renewables, either through the grid or on-site.

3.20 In the 'Policy On' option, assuming that all of the regulated electricity demand is either mitigated through energy efficiency measures or supplied via on-site renewables, the dwelling would still require around 1,700 kWh of electricity per year for unregulated uses (22 kWh/m^2). This represents a c. 64% reduction in electricity use, which would have a major beneficial impact on occupants' energy bills. That dwelling would emit c. 0.3 tCO_2e per year if operating in 2024, and as explained previously, this would decrease over time.

3.21 The upfront embodied carbon of an average home, based on the LETI/RIBA 'Policy Off' benchmarks set out in Table 2.4, would be c. 61 tCO_2e per dwelling (800 $kgCO_2e/m^2$). This is an order of magnitude higher than the GHG emissions from operational energy use in buildings and significantly higher than the associated emissions from transport. The 'Policy On' analysis has assumed that a saving of 3-4 tCO_2e per dwelling (50 $kgCO_2e/m^2$) could be achieved, although further improvements would be possible with the introduction of a stricter limit on embodied carbon.

Non-residential buildings

3.22 Compared with residential buildings, non-residential buildings exhibit much more variation in their size, construction and usage patterns. Consider, for example, a small storage unit or village hall compared with a high-rise office building, data centre or factory. The following figures are intended to represent averages within a wide range and should be interpreted as such.

3.23 In the 'Policy Off' option, the benchmarks presented in Table 2.4 assume that an electrically heated industrial building would use around 55 kWh/m^2 of electricity per year, an office would use 130 kWh/m^2 and a logistics centre or warehouse would use around 82 kWh/m^2.

3.24 The proportion of total energy use that is regulated varies between sectors as well as building-to-building. Therefore, the policy to reduce regulated emissions to net zero will have a different impact on different types of buildings. If the 'Policy On' option is adopted, the remaining unregulated electricity demands for industrial buildings would be 51 kWh/m^2 for industrial buildings, 92 kWh/m^2 for offices and 43 kWh/m^2 for logistics centres or warehouses. So, on average, the policy could reduce annual energy use from an industrial building by up to c. 8%, for an office it could be up to c. 29% and for a logistics centre it could be up to c. 48%.

3.25 *Note: because non-residential buildings vary widely in their size, it is not possible to convert this to an average per building as was done for new dwellings.*

Summary of Standardised Assessment results

3.26 Based on the information in the preceding sections, the estimated emissions per 1,000 homes and 10,000 m^2 of employment space are set out below. This information can be scaled up or down if the anticipated quantity of development changes. The results will not necessarily match those shown in the Overall Assessment because that analysis looks in more detail at changes occurring over time. However, it will provide a reasonable order of magnitude estimate.

Table 3.2: Summary of Standardised Assessment results

Category	Description	tCO_2e	Metric
Residential	Upfront embodied carbon	60,800	per 1,000 homes
Residential	Annual operational emissions (based on 2024 electricity grid carbon intensity)	883	per 1,000 homes
Residential	Cumulative operational emissions over the Local Plan period	1,766	per 1,000 homes
Residential	**Total (upfront embodied carbon + cumulative operational emissions over the Local Plan period)**	**62,566**	**per 1,000 homes**
Industrial	Upfront embodied carbon	10,000	per 10,000 m^2
Industrial	Annual operational emissions (based on 2024 electricity grid carbon intensity)	552	per 10,000 m^2
Industrial	Cumulative operational emissions over the Local Plan period	1,105	per 10,000 m^2
Industrial	**Total (upfront embodied carbon + cumulative operational emissions over the Local Plan period)**	**11,105**	**per 10,000 m^2**
Offices	Upfront embodied carbon	10,000	per 10,000 m^2
Offices	Annual operational emissions (based on 2024 electricity grid carbon intensity)	1300	per 10,000 m^2
Offices	Cumulative operational emissions over the Local Plan period	2,600	per 10,000 m^2
Offices	**Total (upfront embodied carbon + cumulative operational emissions over the Local Plan period)**	**12,600**	**per 10,000 m^2**
Logistics	Upfront embodied carbon	10,000	per 10,000 m^2
Logistics	Annual operational emissions (based on 2024 electricity grid carbon intensity)	822	per 10,000 m^2

Category	Description	tCO_2e	Metric
Logistics	Cumulative operational emissions over the Local Plan period	1,644	per 10,000 m^2
Logistics	**Total (upfront embodied carbon + cumulative operational emissions over the Local Plan period)**	**11,644**	**per 10,000 m^2**

Emissions from transport

3.27 In the Overall Assessment, transport emissions are comprised of emissions from petrol, diesel, hybrid and EV vehicles. Figure 3.7 shows emissions across the scenarios in 2046.

Figure 3.7: Total Emissions by Vehicle Category in 2046

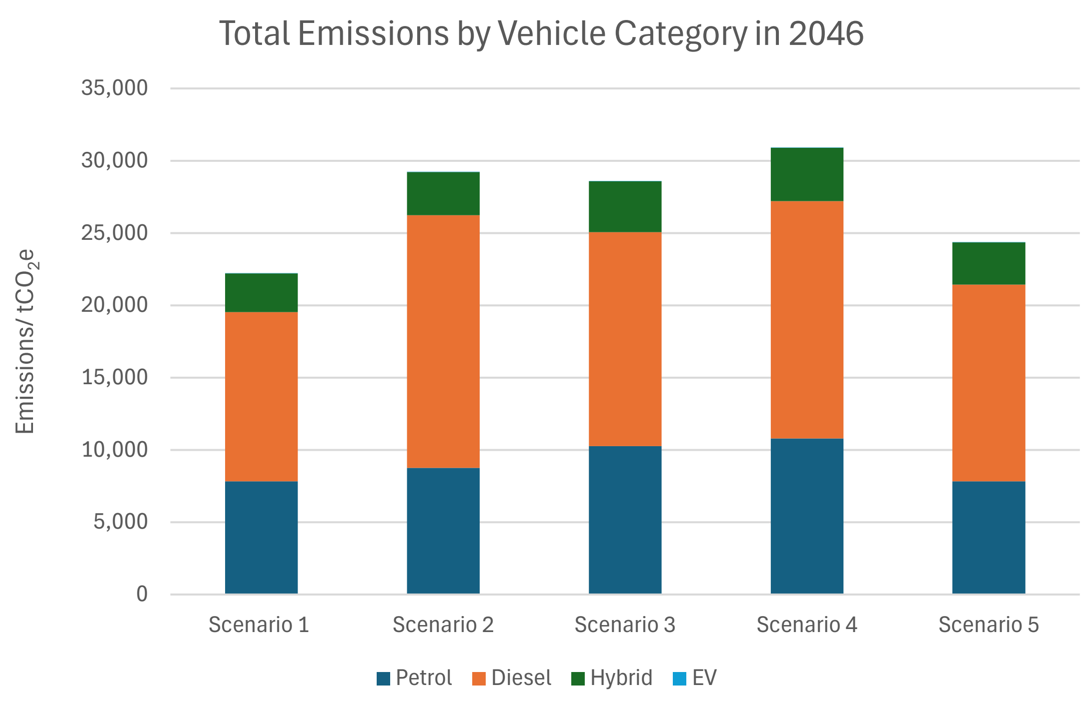


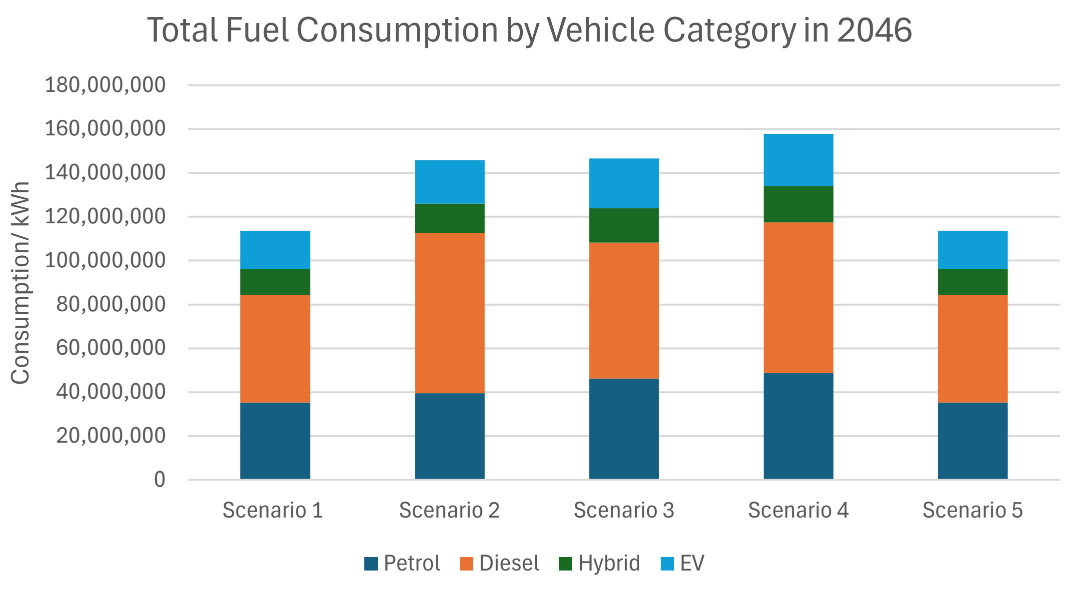
Table 3.3: Percentage of emissions comprised each vehicle type in 2046

Vehicle Type	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Petrol	35%	30%	36%	35%	32%
Diesel	53%	60%	52%	53%	56%
Hybrid	12%	10%	12%	12%	12%
EV	<1%	<1%	<1%	<1%	<1%

3.28 In 2046, the majority of emissions come from diesel vehicles, then petrol vehicles. Hybrid vehicles account for only a small portion of emissions, while emissions from EVs are miniscule. EV emissions are very small and therefore difficult to see on the graph. The overall trend is consistent across the scenarios.

3.29 Emissions from EVs are very small in 2046 due to decarbonisation of the national grid (low carbon production of national energy), not because of low consumption. Figure 3.8 shows that EV fuel consumption is high in 2046, but this does not translate to high emissions. Numerical data on fuel consumption (kWh) is provided in Appendix C.

Figure 3.8: Total Fuel Consumption by Vehicle Category in 2046



3.30 Although this is a high-level calculation with limitations, it illustrates a key point that the majority of vehicle emissions will come from diesel vehicles under all scenarios, originating from HGV and LGV movements associated with the employment land uses.

3.31 There will be a carbon penalty associated with the use of diesel vehicles to serve employment use, particularly warehousing and industrial land uses. HDC's ability to reduce transport related emissions is capped by the ability to reduce these diesel emissions from LGV and HGVs.

3.32 To address this, HDC will need to put in place policies to control and reduce these emissions through the Local Plan, for example the requirement to introduce delivery consolidation centres and use of sustainable 'last mile' delivery systems where possible (e.g. e-cargo bikes).

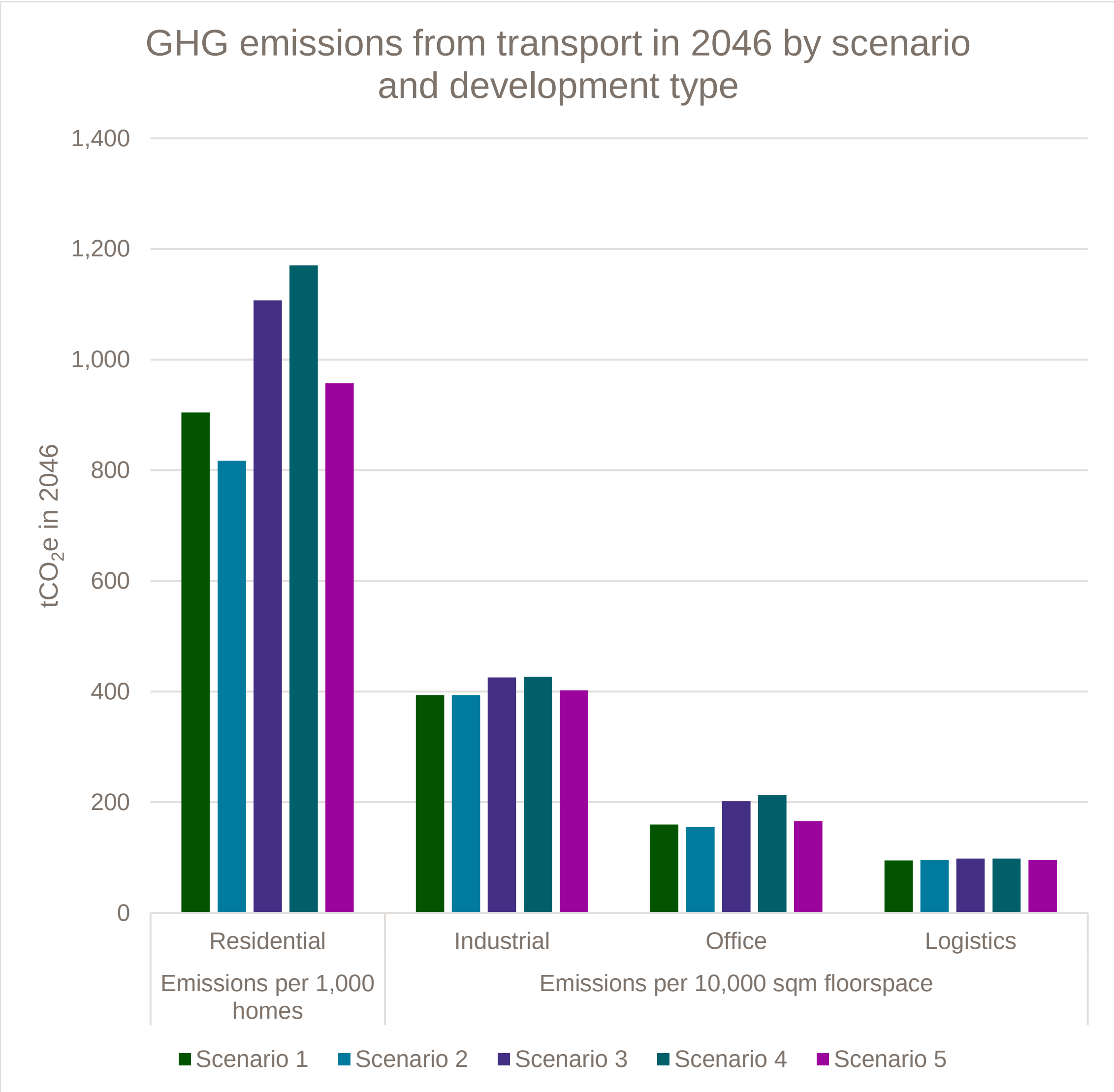
Standardised Assessment

3.33 The key finding of the Overall Assessment is that diesel vehicles have the greatest impact on transport-related emissions, originating from the warehousing and logistics land uses. The Spatial Scenarios that achieve a higher quantum of warehousing and logistics floorspace provide the highest overall transport-related GHG emissions.

3.34 However, as noted previously the floorspace estimates used in the assessment are based on the best estimates of achievable development quantum and growth patterns based on what is known at this stage of the Local Plan-making process.

3.35 The standardised vehicle kWh presented in Table 2.7 previously have been converted to GHG emissions, and this provides a standardised assessment of transport-related GHG emissions considering **location type only**, shown in Figure 3.9.

Figure 3.9: GHG emissions from transport in 2046 by scenario and development type



3.36 *Note: This chart should not be used for drawing comparisons between GHG emissions for residential and employment uses. Results are presented per 1,000 homes, and per 10,000 m² of employment floorspace. This does not directly correlate.*

3.37 The findings of the standardised assessment for transport are:

- Scenario 2 (Public transport corridor focussed) provides the lowest GHG emissions per 1,000 residential units, and the lowest per 10,000 m^2 of employment space.
- There is significantly more variation in the residential GHG emissions than the employment space. This is because residential vehicle demand is predominantly influenced by residents' daily travel habits. These are influenced by individual site connectivity and therefore mode choice; with more accessible sites encouraging a higher non-car more share.
- Office floor space behaves similarly to residential in how it is influenced by location, and demonstrates more variation between the scenarios generating the highest and lowest GHG emissions (Scenarios 4 and 2 respectively)
- Conversely, the warehousing and industrial land uses experience less variation across the scenarios when considered on a standardised basis. This is because the emissions generated by vehicles are dominated by operational LGV and HGV movements, rather than commuting habits. These are significantly less influenced by location than by the unit's operational requirements.
- Scenario 4 generates the highest level of GHG emissions per 1,000 homes / per 10,000 m^2 of employment space. This scenario considers dispersed growth and two new settlements.
  - It is important to note that when modelling future mode share for this scenario, proxy settlements were used within Huntingdonshire that were considered to have similar accessibility, and host similar numbers of facilities to what may be achievable in the new settlements.
  - The outputs for this Scenario are therefore considered robust based on the current policy landscape. With the right policy framework within the Local Plan allocations, there is potential for this Scenario to perform more favourably. The new settlements would require highly ambitious, low car policies and be supported by a wide range of facilities following the 20-minute neighbourhood principles. However, even with these policies in place, this scenario would still include a high level of dispersed rural growth which would lead to higher vehicle mode shares.

- Applying these same low-car policies to lower emission5 Scenarios (e.g. Scenario 1 and 2) would lead to maximum impact.

Impacts of HDC’s proposed policies

3.38 As explained in the methodology chapter (see above), two policy scenarios have been explored as part of this study.

3.39 The headline results presented above show the ‘Policy On’ option as this reflects HDC’s preferred GHG emissions standards for new developments. For comparison, the graph and table below also show the cumulative emissions by 2046 for the ‘Policy Off’ option, based on the Overall Assessment. This represents the potential scale of emissions if HDC does *not* introduce any additional local policies. By considering this counterfactual, it is possible to estimate the potential impact of HDC’s proposed policies.

Figure 3.10: Cumulative GHG Emissions by 2046 - Policy On vs Policy Off

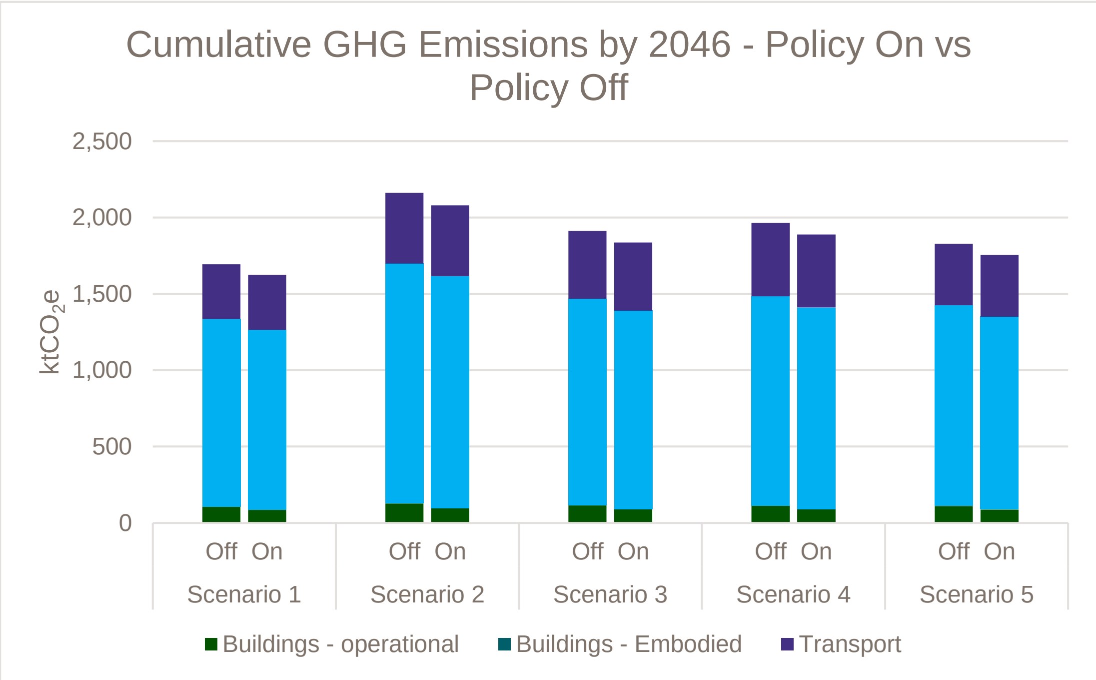


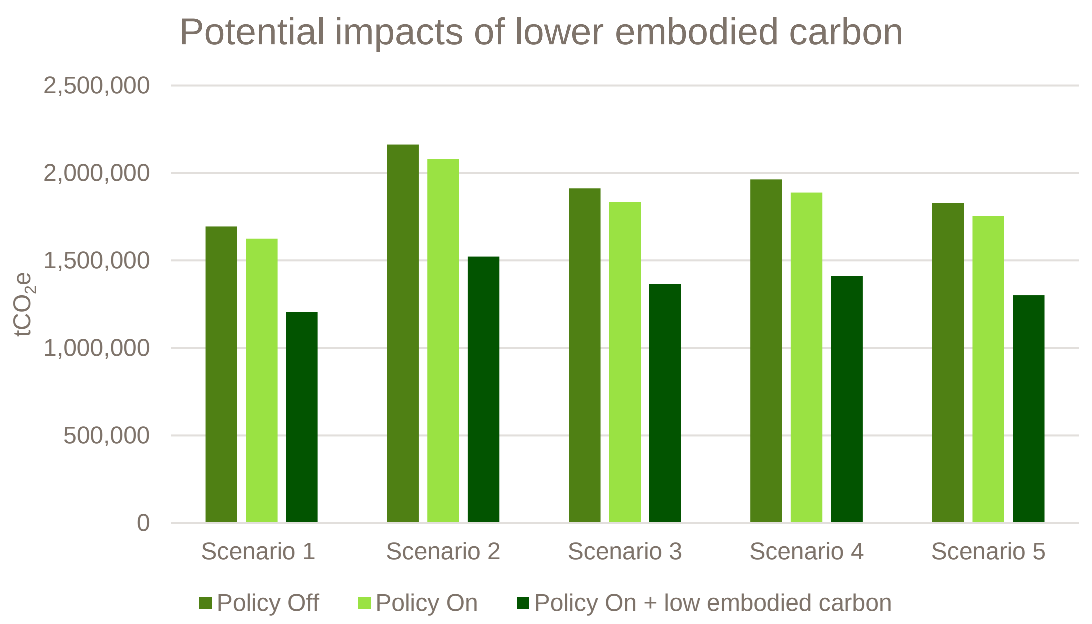
Table 3.4: 'Policy On' and 'Policy Off' GHG Emissions, ktCO2e

Source	Scenario 1 - Strategic Expansion to existing towns Policy Off	Scenario 1 - Strategic Expansion to existing towns Policy On	Scenario 2 - Public transport corridor Policy Off	Scenario 2 - Public transport corridor Policy On	Scenario 3 - Development around strategic road network Policy Off	Scenario 3 - Development around strategic road network Policy On	Scenario 4 – two new settlements plus dispersed growth Policy Off	Scenario 4 – two new settlements plus dispersed growth Policy On	Scenario 5- Continuation of local plan strategy Policy Off	Scenario 5- Continuation of local plan strategy Policy On
Buildings – Operational	106	86	128	97	114	89	114	91	111	89
Buildings - Embodied	1,229	1,178	1,571	1,520	1,353	1,302	1,371	1,320	1,314	1,263
Transport	361	361	463	463	445	445	478	478	404	404
Total Emissions	1,695	1,624	2,162	2,079	1,912	1,836	1,964	1,889	1,829	1,755
Rank (1 = best, 5 = worst)	1	1	5	5	3	3	4	4	2	2

3.40 For each scenario, **the 'Policy On' option would reduce total GHG emissions by around 70-80 ktCO₂e over the Local Plan period**, equivalent to a roughly 4% reduction compared to the 'Policy Off' option. This figure masks significant differences in the proportional reduction that can be achieved across each category of emissions, as described below.

3.41 Embodied carbon emissions are reduced by 3-4% overall in the Policy On scenario. Bearing in mind that the proposed policy target is intentionally easy to achieve and only applies to residential developments, the reduction in embodied carbon would be greater if targets were adopted for all types of development. For example, the graph below shows how emissions could be mitigated even further by adopting the LETI 2030 design target for all building types, which would reduce embodied carbon by around 40%.

Figure 3.11: Potential impacts of lower embodied carbon



3.42 Regulated operational emissions from buildings are reduced by 100% in the Policy On scenario. This is inherent in the policy definition which requires a 100% reduction in this category. However, there will still be some unregulated operational emissions that are unaffected by the policy. This means that total operational emissions will only reduce by around 18-25% across scenarios. The variation is due to the quantity and type of developments included in each spatial strategy.

3.43 Readers should note that there are important benefits of setting stricter standards for energy use in buildings aside from GHG reductions. In future, if and when the electricity grid decarbonises, there might be no difference in annual emissions from a home built to the FHS versus one that is more energy efficient, but the latter will have much lower bills. In this analysis, the home that achieves a 100% reduction in regulated emissions might use only 1/3rd the amount of electricity each year as a home built to the FHS. Energy demands are important because these have a major impact on the amount of new infrastructure and renewable technologies that will be required to serve future developments.

3.44 Going forward, it is recommended that HDC continue to keep abreast of technological and regulatory changes, and consider adopting more ambitious standards for buildings – informed by robust evidence and viability testing – when it is practical to do so.

3.45 Transport emissions do not change in the Policy On or Off options, because no quantitative GHG reduction policies for transport have been set. Instead, it is the selection of a spatial strategy that is expected to impact accessibility and car dependency, which influence GHG emissions. However, as stated previously, the Standardised Assessment demonstrates that Scenario 2, which concentrates development in areas with higher public transport accessibility, would be the least GHG-intensive spatial strategy option if the amount and type of development was held constant.

Wider Policy Considerations

3.46 Whilst it is recognised that the GHG emissions of the five scenarios are an important variable in any recommendation, it is not the only variable to be considered. This section considers, on a qualitative basis, wider variables that should be considered when selecting the spatial strategy.

3.47 The NPPF states that *"all plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects".*

3.48 The five spatial strategy scenarios do not just impact carbon. They also impact other aspects of sustainability in Huntingdonshire. These are explored below when considering the likely impacts of the two main poles of development strategies faced by local authorities – dispersed, rural growth and denser, brownfield, urban development.

Dispersed and Rural Growth

3.49 More dispersed growth patterns (e.g. those included as part of Scenario 4) are likely to result in greater environmental impacts not only to air quality, but also water quality and biodiversity.

3.50 This is because dispersed growth is most likely to result in rural development and therefore the development of greenfield land. This can have a significant impact particularly when relating to large-scale new settlements (as is the case for one potential settlements in Scenario 4). Rural development may mean the loss of green space and likely present habitats and species, as well as potential loss or impacts on designated, protected areas. Development may, therefore, produce negative impacts on natural assets and biodiversity via destruction or disturbance.

3.51 In addition, rural and greenfield development could increase flood risk by increasing impermeable surfaces and run-off, as well as potentially result in loss of good quality agricultural land. Dispersed growth's typical development pattern extending into rural areas could also lead to significant negative impacts on landscape character.

3.52 Whilst the modelling within this report has considered transport-related emissions, there are wider impacts from travel habits to be aware of when considering the different growth scenarios. Scenario 4 (which includes two new developments alongside dispersed growth) results in the highest transport-related GHG emissions (see **Figure 3.9**) due to increased reliance on private vehicles. This is also the case for Scenario 3 which concentrates development around the strategic road network. This in turn has a negative impact on air quality, contributions to climate change, and reducing opportunities for and the use of active travel which has subsequent negative impacts on people's health and wellbeing (this in turn increases strain on local NHS services and increased absenteeism).

3.53 Notwithstanding, increased growth in rural areas could have positive impacts for housing provision, community cohesion and health and wellbeing and access to services and facilities by addressing rural deprivation. Appropriately designed schemes could support the viability of local centres, aid in meeting the needs of some rural residents locally and support the assimilation of growth more readily without substantial impacts on existing community networks.

3.54 Overall, however, spatial strategies that imply rural dispersed growth patterns (most notably in Scenario 4) would likely result in unsustainable growth options for Huntingdonshire, alongside considerations of GHG emissions.

Urban Edge and Brownfield Growth

3.55 Scenarios 1 and 5 present strategies that prioritise development in existing urban areas such as existing towns and Spatial Planning Areas. They would likely be the most sustainable options overall due to the of proximity existing, established amenities and employment centres within urban areas, as well as the potential for re-use of brownfield land.

3.56 Brownfield and urban edge development minimises the negative impact of rural / greenfield development and its associated disturbance and destruction of biodiversity, and landscape and visual impacts. It also does not exacerbate flood risk as significantly as rural development may, as urban edge and brownfield development may involve the development of land already made impermeable.

3.57 It should also involve development patterns that do not increase reliance on private vehicles, as this has several implications and consequential costs from reduced health and wellbeing. More urban development increases active travel opportunities. As evidenced by the WHOs Health Economic Assessment Tool (HEAT) for walking and cycling[6], such increased uptake of these travel modes leads to many health co-benefits amongst the populace through reduced absenteeism, reduced pressure on health services, fewer road-related deaths (through reduced vehicle km), and reduced morbidity through improved air quality and increased physical activity.

3.58 Greater access to public transport and active travel infrastructure also means that people will have greater access to key services, facilities and education and employment opportunities, including those who do not own cars, are young, elderly and/or disabled.

3.59 Conversely, a key drawback to concentrating development in urban areas is that historic environment assets and their settings may be at risk of harm from nearby development.

3.60 While Scenario 1 concentrates development in more urban areas, it is likely that in terms of sustainable growth, Scenario 5 will be the most sustainable option when considered holistically. This is because it also focuses some growth elsewhere in the District, including in Key Service Areas and Small Settlements. This will result in supporting growth and sustainable development in other areas of the District, which would for example, aid in reducing rural deprivation, provide more access to services, facilities and job opportunities and support and improve the wellbeing of more rural communities.

Conclusions and Recommendations

3.61 The GHG emissions modelling has demonstrated that HDC's 'Policy On' scenario is necessary to reduce building emissions under all five scenarios.

3.62 This document has assessed the GHG emissions of the spatial strategies in two ways:

- Overall Assessment (total GHG emissions):
  - Considered the different spatial strategies based on based around high level estimates of the achievable development quantum under each Scenario, and high level descriptions of patterns for growth.
  - It was necessary to consider the Scenarios based on these best estimates at this stage of the Local Plan-making process, as each Scenario considers different locations, and different numbers of sites that could be developed.
  - This provided an overall analysis of GHG emissions considering all elements (location and quantum) holistically.
  - Under this assessment, Scenario 1 performs best when considering **total** GHG emissions in isolation, with Scenario 5 following.
- Standardised assessment (GHG intensity):
  - Considered the impact of the spatial patterns in isolation, removing the variable of number of sites / achievable m^2 / residential units. This considers the amount of GHG generated for every 1,000 residential units and every 10,000 m^2 of employment floorspace.
  - Under this assessment Scenario 2 performs best when considering the **GHG intensity**, with Scenario 1 following.

3.63 As discussed, though, within Sections 3.46 to 3.60, GHG emissions should not be considered in isolation when deciding on a spatial strategy. When considering wider implications and policy factors on broader sustainability, Scenarios 1 and 5 continue to perform the best. Scenario 1 is considered to provide good potential for urban edge and some brownfield development and provides a lower GHG intensity, whilst Scenario 5 is considered to provide a balance of minimised negative impacts on sustainability, coupled with maximised benefits across the region in terms of reducing rural deprivation, increasing access to services, facilities and job opportunities.

3.64 When considering the final spatial strategy, it is essential to consider the impacts holistically. Whilst the standardised assessment demonstrates the relative carbon intensity and location-based impact of each scenario, this must be considered alongside achievable development quantums, and wider sustainability objectives.

3.65 If the spatial strategy with the lowest carbon intensity unlocks a higher quantity of development (particularly industrial / warehousing / logistics), it would not necessarily be the lowest emitting scenario, and could in fact become one of the higher emitting scenarios.

3.66 Given the uncertainty about the exact type and quantity of development that will occur in the District, HDC is advised to adopt a multi-pronged approach to minimising GHG emissions, which would include:

- Requiring developers to assess, and take steps to minimise, the embodied carbon of new developments, since this is likely to be the single largest source of emissions associated with new development
- Locating those developments in areas with higher levels of public transport accessibility
- Adopting the 20-minute neighbourhood approach to planning by ensuring that developments are located within a convenient distance of shops, schools, and other amenities, which could be achieved either through proximity to existing facilities or by providing new ones
- Incorporating measures to decarbonise industrial and logistics / warehousing development through the use of consolidation centres, sustainable ‘last mile’ delivery practices (e.g. use of EVs or e-cargo bikes), and enabling uptake of low emission fleets through on-site charging.

- Designing buildings to be highly energy efficient, with heating systems that can run on 100% renewable electricity, and seeking to meet this demand using on-site renewables

3.67 The following recommendations made below to further help reduce GHG emissions. These are presented here as broader strategic choices but have informed the formulation and honing of tighter policy options presented in **Document C** (sustainable design):

- As explained in accompanying **Document B**, it will be extremely challenging for Huntingdonshire to reach broader net zero targets by 2050. As HDC has an opportunity to influence the significant body of emissions typically generated by new development, it is crucial that the Council takes this opportunity to use what levers it has via land use planning policy and other realms available to mitigate this increase:
  - HDC should continue to keep abreast of technological and regulatory changes and consider adopting more ambitious standards for building emissions – informed by robust evidence and viability testing – when it is practical to do so.
  - Unlike operational emissions which are fundamentally controlled by building occupants, embodied carbon can be significantly determined by decisions made at the design and planning stage. This means that HDC has an ability to influence them by introducing a quantitative target.
  - Of the emissions sources evaluated, operational emissions are the smallest contributor. This shows that GHG emissions assessments omit important sources of emissions when considering the impacts of new developments. HDC should therefore strongly encourage assessments to take a holistic approach and consider whole life-cycle carbon, not just operational emissions.
  - HDC should monitor progressions in vehicle emissions technology, particularly relating to viable alternatives to diesel HGVs and LGVs. HDC should adopt policies that minimise emissions from diesel vehicles from the industrial, warehousing and distribution sectors, as this is the biggest contributor to vehicle emissions across all tested

scenarios. The promotion of on-site EV charging infrastructure would support this.

- Through the Local Plan, HDC should explore the opportunity to introduce delivery consolidation centres and use of sustainable ‘last mile’ delivery systems where possible (e.g. e-cargo bikes).

Appendix A

Spatial Strategy options

A.1 Five potential strategy options have been identified to be tested in the climate change and IWMS evidence base:

1. Strategic expansions to existing towns

2. Public transport corridor focussed – This would include A428/A421 which has ambitions to provide a guided bus route and East West Rail and the proposal to reroute the A141 and provide a public transport corridor

3. Development concentrated around the Strategic road network

4. Two new settlements plus dispersed growth

5. Continuation of Local Plan strategy – This currently focusses on 75% growth in Spatial Planning Areas and 25% elsewhere e.g. Key Service Centres and Small Settlements.

A.2 Using the standard method plus a 20% uplift to take into account any fluctuations within the calculation means that the potential housing target of the next Local Plan over 25 years is 28,500 new homes (1,140 homes a year). Note that this is subject to change following the new Government's proposed standard method calculation.

A.3 The following tables provide the full information on potential growth patterns and housing mix. It is important to note these were derived as estimates based on the current stage of Local Plan-making and are subject to change.

Table A.1: Scenario 1: Strategic expansions to existing towns

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
Huntingdon - greenfield land around the north of the town in close proximity to the A141 with potential to be served by expanded existing bus services and part would be potentially close to a new railway station at Alconbury Weald if this is ever achieved. These would all form large scale mixed use sites with secondary school provision and employment uses included.	6,500	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	150,000	25,000	130,000
Godmanchester - greenfield land to the south east of the town with direct access to the A1198 and potentially an access to the A1307. A primary school would be required on site but secondary education would be in Huntingdon which is connected by cycle paths for most of the route. This would be residential led with community facilities with limited employment provision.	1,000	Single large site with strong emphasis on market and affordable family homes. Around 50% likely to be 3-5 bedroom detached; 40% 2-4 bedroom semis and short terraces; 10% flats.	5,000	5,000	5,000
St Neots - St Neots has limited options for where it can grow within Huntingdonshire's boundary - to the east is the only substantive option. Continued development anticipated on greenfield land to the east of St Neots in close proximity to the A428 (about to be upgraded and redesignated as the A421) and the B1428. The proposed East West Rail would pass immediately by the land but with station accesses at Cambourne and Tempsford rather than in the immediate locality.	3,220	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	15,000	40,000	5,000
St Ives - primarily on greenfield land to the north east adjoining existing and proposed employment and retail services; approximately 1.5 miles from the Guided Bus park and ride. A primary school would be provided on site but secondary education would be off-site. Smaller greenfield development (up to 300 homes) to the north west close to the A1123 and in close proximity to the Guided Bus services.	2,150	Land to the north east would be a single small scale urban extension with emphasis on family homes of all types and tenures; expectation would be around 45% as 3-5 bedroom detached; 45% 2-4 bedroom semis and short terraces; 10% flats. North western development would likely be heavily dominated by larger detached homes (50%) with up to up to 45% 2-3 bedroom semis and short terrraces. 5% flats - all likely to be 1 or 2 bedrooms.	5,000	3,000	0

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
Ramsey - scattered wholly residential greenfield sites around the edges of the existing town. Separate employment site to the west of the the town.	630	A series of small/medium scale sites with 40% 3-4 bedroom detached homes, 50% 2-3 bedroom semis and terraced homes and 10% 1-2 bedroom flats at a maximum of 3 storeys.	15,000	0	5,000

Table A.2: Scenario 2: Public transport corridor focussed

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
A141 corridor around the north of Huntingdon with extended guided busway services around St Ives - a combination of half greenfield and half previously developed sites around the north east of Huntingdon and heading north up the A141 corridor. Sites would all have direct access to the A141 and the outcomes of any improvement works completed by the Cambridgeshire and Peterborough Combiined Authority (CPCA) regarding increased capacity for the A141, improved active travel linkages in the vicinity into both Huntingdon and St Ives. The Guided Bus services would be expected to be extended to serve the new development areas although are likely to be on road at this point. As large scale sites primary and secondary schools, community facilities and employment uses would be integral.	8,450	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	110,000	60,000	50,000
A428/A421 south and east of St Neots with potential enhanced public transport corridor to Cambridge and may include East West Rail from the late 2030s - Continued development anticipated on greenfield land to the east of St Neots in close proximity to the A428 (about to be upgraded and redesignated as the A421) and the B1428. The proposed East West Rail would pass immediately by the land but with station accesses at Cambourne and Tempsford rather than in the immediate locality. Primary schools would be included along with community facilities but more limited employment land than around Huntingdon.	3,320	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	15,000	40,000	5,000

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
St Ives to Ramsey enhanced bus provision connecting into the guided busway services to Cambridge and Huntingdon - a series of small/ medium sites in and between St Ives, Somersham, Warboys and Ramsey to support and enhance existing limited bus connections.	1,080	Small/ medium sites are likely to have a range of densities between 25-35 dw/ha. The housing mix would typically be 5% 1 bedroom flats, 25% 2 bedroom (terraced/semi-detached houses and flats),35% 3 bedroom (terraced/ semi-detached and detached houses) and 35% 4 bedroom+ (a few semi-detached but majority are detached houses).	15,000	0	5,000
Huntingdon to Peterborough existing rail corridor and enhanced bus routes - growth would primarily be focused on villages close to the A1 with current bus services approximately hourly. Development land would primarily be greenfield and could include small/ medium sites in villages such as Alconbury, Stilton and Yaxley with the largest proportion likely to be around Sawtry as this has a secondary school and leisure centre. Employment uses would be concentrated in free-standing sites with direct accesses to the A1.	650	Small/ medium sites are likely to have a range of densities between 25-35 dw/ha. The housing mix would typically be 5% 1 bed flats, 25% 2 bedroom (terraced/semi-detached houses and flats),35% 3 bedroom (terraced/ semi-detached and detached houses) and 35% 4 bedroom+ (a few semi-detached but majority are detached houses).	200,000	50,000	200,000

Table A.3: Scenario 3: Development concentrated around the strategic road network

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
A428 (A421) corridor - expanded development anticipated on greenfield land to the east of St Neots in close proximity to the A428 (about to be upgraded and redesignated as the A421) and the B1428. The proposed East West Rail would pass immediately by the land but with station accesses at Cambourne and Tempsford rather than in the immediate locality. Primary and secondary education would be provided on site along with local scale community facilities and limited employment land.	4,100	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	15,000	42,000	0

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
A14/ A1307 corridor - greenfield development to the south east of Godmanchester but separate from the existing town as a new village with a secondary school, primary schools and local community facilities. Some employment provision would be integral focused on offices and manufacturing with limited logistics to support this.	4,400	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	10,000	10,000	5,000
A1 corridor - development is again likely to be focused on greenfield land with the possibility of one new settlement accessed off the A1 plus several small/ medium sites in villages such as Sawtry and Alconbury which both have direct A1 access .Any new settlement would be expected to include primary and secondary school provision along with community facilities and some employment land. The majority of employment land would be concentrated in 1 or 2 locations with direct access to the A1.	5,000	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	200,000	50,000	200,000

Table A.4: Scenario 4: Dispersed growth plus two new settlements

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
Two new settlements - this would best be assessed assuming that each would be expected to include 4,500 homes and that one would be on previously developed land in the Huntingdon/ St Ives area and the other would be greenfield land in the A1/ A14 corridor. Each would be expected to include a secondary school, 2-3 primary schools, local shopping facilities and community facilities.	9,000	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	50,000	25,000	5,000

Pattern of growth	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
Dispersed growth in villages throughout the district -a series of predominantly small sites across many of the villages scattered throughout the district. Development in the towns would be limited to very small quantities on the few previously developed parcels of land within their existing built frameworks. The majority of employment land would be concentrated in 1 or 2 locations with direct access to the A1 although small extensions to established employment areas would be supported across the district.	4,500	Small/ medium sites are likely to have a range of densities between 25-35 dw/ha. The housing mix would typically be 5% 1 bedroom flats, 25% 2 bedroom (terraced/semi-detached houses and flats),35% 3 bedroom (terraced/ semi-detached and detached houses) and 35% 4 bedroom+ (a few semi-detached but majority are detached houses). At most 300 homes might be on previously developed sites in towns at 50 dw/ha.	220,000	50,000	200,000

Table A.5: Scenario 5: Continuation of Local Plan strategy

Pattern of growth	Area	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
75% of 13,500 is 10,125. This has been proportioned according to size of each SPA - there are few remaining previously developed sites in any of the towns now so it should be assumed that the majority of growth will be on greenfield sites around the outskirts. For Huntingdon this would primarily be to the north near the A141 or to the south east of Godmanchester, for St Neots to the east near the A428, for St Ives a mixture of the east (1,750 homes) and west (250 homes) whilst for Ramsey the sites would be spread around the edges of Ramsey and Bury. Employment uses will primarily be integral with larger mixed use evelopments.	Huntingdon SPA	3,375	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	70,000	10,000	110,000

Pattern of growth	Area	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
75% of 13,500 is 10,125. This has been proportioned according to size of each SPA - there are few remaining previously developed sites in any of the towns now so it should be assumed that the majority of growth will be on greenfield sites around the outskirts. For Huntingdon this would primarily be to the north near the A141 or to the south east of Godmanchester, for St Neots to the east near the A428, for St Ives a mixture of the east (1,750 homes) and west (250 homes) whilst for Ramsey the sites would be spread around the edges of Ramsey and Bury. Employment uses will primarily be integral with larger mixed use evelopments.	St Neots SPA	3,375	All on large scale urban extension sites with full range of housing types and tenures. District average proportions for property sizes are: 10% 1 bedroom (flats), 25% 2 bedroom (terraced/semi-detached houses and flats), 34% 3 bedroom (terraced/ semi-detached and detached houses) and 31% 4 bedroom+ (a few semi-detached but majority are detached houses).	15,000	40,000	5,000

Pattern of growth	Area	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
75% of 13,500 is 10,125. This has been proportioned according to size of each SPA - there are few remaining previously developed sites in any of the towns now so it should be assumed that the majority of growth will be on greenfield sites around the outskirts. For Huntingdon this would primarily be to the north near the A141 or to the south east of Godmanchester, for St Neots to the east near the A428, for St Ives a mixture of the east (1,750 homes) and west (250 homes) whilst for Ramsey the sites would be spread around the edges of Ramsey and Bury. Employment uses will primarily be integral with larger mixed use evelopments.	St Ives SPA	2,000	Land to the north east would be a single small scale urban extension with emphasis on family homes of all types and tenures; expectation would be around 45% as 3-5 bedroom detached; 45% 2-4 bedroom semis and short terraces; 10% flats. North western development would likely be heavily dominated by larger detached homes (50%) with up to up to 45% 2-3 bedroom semis and short terrraces. 5% flats - all likely to be 1 or 2 bedrooms.	5,000	3,000	0

Pattern of growth	Area	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
75% of 13,500 is 10,125. This has been proportioned according to size of each SPA - there are few remaining previously developed sites in any of the towns now so it should be assumed that the majority of growth will be on greenfield sites around the outskirts. For Huntingdon this would primarily be to the north near the A141 or to the south east of Godmanchester, for St Neots to the east near the A428, for St Ives a mixture of the east (1,750 homes) and west (250 homes) whilst for Ramsey the sites would be spread around the edges of Ramsey and Bury. Employment uses will primarily be integral with larger mixed use evelopments.	Ramsey SPA	1,375	A series of small/medium scale sites with 40% 3-4 bedroom detached homes, 50% 2-3 bedroom semis and terraced homes and 10% 1-2 bedroom flats at a maximum of 3 storeys.	15,000	0	5,000
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Buckden	270	35 dw/ha - 10% 1 bedroom flats, 60% 2-3 bedroom semis and terraced houses, 30% 3-4 bedroom detached houses. Less 4 bedroom properties in Buckden than elsewhere.	0	0	0
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Fenstanton	324	35dph - 10% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 30% 3-4 bedroom detached houses.	50,000	7,000	43,000

Pattern of growth	Area	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Kimbolton	135	35dph - 5% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 35% 3-4 bedroom detached houses.	12,000	3,000	0
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Sawtry	486	35dph - 10% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 30% 3-4 bedroom detached houses.	25,000	5,000	20,000
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Somersham	324	35dph - 10% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 30% 3-4 bedroom detached houses.	0	0	0
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Warboys	378	35dph - 10% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 30% 3-4 bedroom detached houses.	0	0	0

Pattern of growth	Area	Residential - Number of homes	Residential - Mix of homes	Employment (sqm) - Industrial	Employment (sqm) - Office/ business park	Employment (sqm) - Logistics
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Yaxley	783	35dph - 10% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 30% 3-4 bedroom detached houses.	20,000	5,000	10,000
25% of 13,500 is 3,375. This has been proportioned according to size of each settlement - none have any substantial areas of previously developed land so all sites should be assumed to be greenfield land adjoining the existing settlements.	Small Settlements	675	25dph - 5% 1 bedroom flats, 60% 2-3 bedroom semi-detached and short terraced houses, 35% 3-4 bedroom detached houses.	15,000	0	0

Appendix B

Derivation of benchmarks for buildings

B.1 The benchmarks used in this analysis are shown in Table B.1. 'Policy Off' benchmarks include total (regulated and unregulated) energy use. 'Policy On' benchmarks only include unregulated energy use.

Table B.1: Benchmarks for energy use and embodied carbon of buildings

Residential	Description	Gas (kWh/m²/year)	Electricity (kWh/m²/year)	Embodied carbon (kgCO2e/m²)
Policy off	Gas-heated buildings (up to 2027)	126	26	800
Policy off	Electrically-heated buildings (post-2027)	0	62	800
Policy on	Gas-heated buildings (up to 2027)	3	21	750
Policy on	Electrically-heated buildings (post-2027)	0	22	750
Industrial	Description	Gas (kWh/m2/year)	Electricity (kWh/m2/year)	Embodied carbon (kgCO2e/m2)
Policy off	Gas-heated buildings (up to 2027)	82	32	1000
Policy off	Electrically-heated buildings (post-2027)	0	55	1000
Policy on	Gas-heated buildings (up to 2027)	75	30	1000
Policy on	Electrically-heated buildings (post-2027)	0	51	1000

Offices	Description	Gas (kWh/m2/year)	Electricity (kWh/m2/year)	Embodied carbon (kgCO2e/m2)
Policy off	Gas-heated buildings (up to 2027)	97	128	1000
Policy off	Electrically-heated buildings (post-2027)	0	130	1000
Policy on	Gas-heated buildings (up to 2027)	8	88	1000
Policy on	Electrically-heated buildings (post-2027)	0	92	1000
Logistics	Description	Gas (kWh/m2/year)	Electricity (kWh/m2/year)	Embodied carbon (kgCO2e/m2)
Policy off	Gas-heated buildings (up to 2027)	103	53	1000
Policy off	Electrically-heated buildings (post-2027)	0	82	1000
Policy on	Gas-heated buildings (up to 2027)	0	43	1000
Policy on	Electrically-heated buildings (post-2027)	0	43	1000

B.2 The following sections describe the approach to deriving benchmarks for operational energy use and embodied carbon associated with buildings.

B.3 Note that GHG emissions from buildings vary widely depending on the type of building, quality of construction, location, occupant habits, energy prices, and many other factors. Therefore, the approach described below is not intended to predict energy use, but provides a reasonable ‘order of magnitude’ estimate of the emissions from different sources, in order to test out different scenarios as part of the analysis of spatial strategy options.

Residential buildings

Policy Off benchmarks

B.4 Operational energy use in buildings constructed to current Building regulations has been estimated based on the CIBSE Energy Benchmarking Dashboard ‘good practice’ values for semi-detached homes. This was used as a proxy for a typical new residential property, recognising that the mixture of sizes and dwelling types will vary across different developments.

B.5 The FHS will introduce slightly better energy efficiency standards in new buildings, and require the use of heat pumps in most cases.[7] Therefore, to estimate operational energy use in FHS-compliant buildings, the values for gas consumption were adjusted to account for the difference between typical efficiency of gas boilers (assumed to be 85%) and the typical coefficient of performance (COP) of heat pumps (assumed to be 3.0).

B.6 These are simplifying assumptions which reflect the lack of detailed design information about the proposed developments. The results were sense-checked against the Government’s FHS Consultation. After correcting for differences in emission factors for electricity, which vary year-on-year, the values used in this study were found to fall within the range presented in the FHS Consultation.

B.7 Upfront embodied carbon for residential buildings has been based on the LETI Embodied Carbon Primer, Business as Usual scenario which assumes typical practice achieves around 800 $kgCO_2e/m^2$. The FHS and FBS Consultation assumes that a typical house has a floor area of around $76m^2$ and this value has been used to derive an estimate of embodied carbon for new residential buildings (c. 61 tCO_2e/dwelling).

B.8 Note that these embodied carbon benchmarks, while endorsed by CIBSE and the RIBA, are higher than those that have been produced as part of the UK Net Zero Carbon Buildings Standard (NZCBS).[8] The NZCBS was released in September 2024 and it therefore draws on a more up-to-date evidence base.

Among 204 projects submitted as evidence, the average upfront embodied carbon intensity for new housing was 574 $kgCO_2e/m^2$.[9]

B.9 If that were the case, it would mean that the embodied carbon results (and, by extension, the total GHG emissions) presented in Chapter 3 are significant overestimates. However, the key findings and recommendations of this part of the analysis would remain the same:

B.10 Embodied carbon would still be the highest contributor towards total emissions, higher than operational emissions from buildings and transport; therefore

B.11 Policy measures aimed at reducing embodied carbon emissions should be pursued because they offer significant potential to mitigate the total GHG impacts of the new developments.

Policy On benchmarks

B.12 To derive the 'Policy On' benchmarks, the 'Policy Off' benchmarks were adjusted to reflect the proportion of energy use that is regulated or unregulated, based on assumptions about how energy tends to be used in dwellings.

B.13 Aside from fixed lighting, most of the electricity used in homes is unregulated.[10] The precise amount varies, but the proportion is typically in the region of 80-85%. As lighting becomes more efficient, that proportion will increase. Conversely, the majority of gas consumption is for regulated uses, aside from gas used in cooking. Therefore, in this analysis, unregulated electricity use in dwellings in the 'Policy On' option is equivalent to the unregulated electricity use in gas-heated dwellings, plus a small amount of extra which represents electricity used for cooking, assuming that a 40% efficient gas hob is replaced with an 80% efficient electric hob.

B.14 For embodied carbon, the ‘Policy On’ option would require developers to assess and reduce embodied carbon, and also cap upfront embodied carbon in major residential developments at 900 $kgCO_2e/m^2$.

B.15 The potential GHG emissions reductions associated that this could achieve has been based on a review of evidence from LETI (produced in collaboration with the RIBA, CIBSE and Institute of Structural Engineers) and the NZCBS. LETI’s position, as set out in the paper ‘Embodied Carbon Target Alignment’, is that current typical practice for residential buildings is between 675-850 $kgCO_2e/m^2$ and that good practice is between 400-500 $kgCO_2e/m^2$. Calculating the difference between these two ranges suggests that moving from ‘typical practice’ to ‘good practice’ as defined by LETI would reduce the upfront embodied carbon of new residential developments by 175-400 $kgCO_2e/m^2$. Given that this is a wide range, and that the evidence base on embodied carbon is more limited than the evidence base on operational emissions, this report has intentionally taken a conservative approach when estimating the potential embodied carbon savings that could be achieved. The chosen value (a reduction of 50 $kgCO_2e/m^2$) is illustrative, and it represents a c. 6% reduction against the LETI’s assumptions for typical practice, or a c. 9% reduction against the average values set out in the NZCBS technical report. This scale of reduction is considered realistic based on current design practices and available technologies.

Non-residential buildings

Policy Off benchmarks

B.16 Operational energy use in buildings constructed to current Building regulations has been estimated based on the CIBSE Energy Benchmarking Dashboard ‘good practice’ values for offices and logistics/warehouses. For industrial buildings, benchmarks have been derived from the Non-Domestic National Energy Efficiency Database (ND-NEED) statistics for factories.

B.17 The FBS will require the use of heat pumps in most cases. Therefore, to estimate operational energy use in FBS-compliant buildings, the values for gas consumption were adjusted to account for the difference between typical efficiency of gas boilers (assumed to be 85%) and the typical coefficient of performance (COP) of heat pumps (assumed to be 3.0).

B.18 Upfront embodied carbon for all non-residential buildings has been based on the LETI Embodied Carbon Primer, Business as Usual scenario which assumes typical practice achieves around 1000 $kgCO_2e/m^2$. As in the case of residential benchmarks (see parag. B.8) these may be overestimates; the same caveats apply but the key findings remain the same.

Policy On benchmarks

B.19 The Energy Consumption in the UK (ECUK) statistics report energy use by fuel type and end use in different sectors. This was used to calculate the proportion of heat and electricity required for ‘regulated’ and ‘unregulated’ uses.

- Space heating, water heating and lighting were assumed to be regulated. note that this is a simplifying assumption as some lighting may not be fixed.
- Cooking/catering, computing, and ‘other’ categories were assumed to be unregulated.

B.20 To derive the ‘Policy On’ benchmarks, the ‘Policy Off’ benchmarks were adjusted to reflect the proportion of energy use that is regulated or unregulated, based on the analysis of ND-NEED. So for example, if total (regulated and unregulated) electricity consumption in a building was 10,000 kWh per year, and 20% of that was unregulated, then the ‘Policy On’ benchmark would be 2,000 kWh of electricity per year as this only includes the unregulated energy use. The remaining 80% (8,000 kWh per year) would have to be reduced and offset to net zero under HDC’s proposed policy.

Appendix C

Derivation of Transport Emissions

Overview of the model used for transport

C.1 The methodology followed the following steps for each of the five spatial strategies:

1. Estimate housing and employment types, and rate of build out up to 2046

2. Project mode share up to 2046

3. Calculate total annual trip generation by travel mode, including Goods Vehicles for industrial uses

4. Estimate total annual vehicle km by vehicle type (car / LGV / HGV) and fuel type (petrol / diesel / hybrid / EV) up to 2046

5. Estimate total annual kWh by vehicle type (car / LGV / HGV) and fuel type (petrol / diesel / hybrid / EV) up to 2046

C.2 The assessment has been split over three assessment phases to reflect the rapidly changing nature of transportation:

- Phase 1: the first 8 years of the plan to 2029
- Phase 2: between 2029 and 2037
- Phase 3: the final 9 years between 2037 and 2046

Assumptions about housing type and tenure

C.3 Information provided by HDC specified the total quantum of development under each of the five spatial strategies summarised in Table 2.2: Spatial Strategy – Total Indicative Quantity by 2046* (above).

C.4 In order to derive robust estimates of trip generation and modal split, it was necessary to understand the housing growth in further detail. HDC provided high-level estimates of housing mix (see Appendix A), and these were built upon to develop set assumptions over proportion of housing type and tenure:

1. **Housing Type (flats and houses)**
   Based on District Average Housing Proportions (unless otherwise specified by HDC) for certain locations:
   - 10%1 bedroom flats
   - 25% 2 bedroom terraced/semi-detached houses and flats
   - 34% 3 bedroom terraced/semi-detached and detached houses
   - 31% 4+ bedroom majority detached houses
2. **Housing Tenure (affordable vs open market)**
   Based on Huntingdonshire Target Housing Tenure % (Local Plan 2036 Policy LP24a):
   - 40% affordable
   - 60% open market

Baseline Mode Share

C.5 As shown in Appendix A, each of the five spatial strategies included a high-level description of potential locations for growth. Specific sites were not provided, but general area descriptions were used to draw assumptions over the existing transport mode shares of the areas.

C.6 Census 2021 Method of Travel to Work data was utilised. Each potential growth area identified in each spatial strategy was examined individually, and sample Lower Super Output Areas were selected that were considered to most closely represent the descriptions provided in Appendix A.

C.7 This provided a baseline mode share assumption for each growth area based on the existing transport characteristics.

Projected Mode Share

C.8 Mode share projections were derived for 2029, 2037 and 2046 for each Spatial Strategy. The Climate Change Committee (CCC) report on 'The Sixth Carbon Budget: Surface Transport' (Chapter 2(a)) was used which provided national estimates of future mode shift:

- 5-7% of car journeys could be shifted to walking and cycling (including e-bikes) by 2030, rising to 9-14% by 2050
- 9-12% of car trips could be shifted to buses by 2030, increasing to 17-24% by 2050
- average car occupancy to increase from 1.6 today to up to 1.7 by 2030 and up to 1.9 by 2050

C.9 These estimates were split into three categories. In line with the CCC report, the % uplifts in public transport, active travel and car passengers are assumed to come from converted car drivers:

- Standard Uplift:
  - Average proportions of CCC estimated mode shift (converted car journeys) applied to all modes.
  - Applied to Scenarios 1 and 5.
- Public Transport Focussed:

- Upper limit of CCC estimated mode shift applied for public transport trips.
- Average proportions of CCC estimated mode shift for other modes.
- Applied to Scenario 2.

- Road Network Focussed:
  - Lower limit of CCC estimated mode shift applied for public transport trips.
  - Applied to Scenarios 3 and 4.

Table C.1 Projected Mode Share Factors (% of baseline car drivers converting)

Modes of transport	2029	2037	2046
Standard Uplift	Standard Uplift	Standard Uplift	Standard Uplift
Car Passenger	4%	8%	12%
Public Transport	11%	16%	21%
Active Travel	6%	9%	13%
Other*	1%	2%	3%
Public Transport Focussed	Public Transport Focussed	Public Transport Focussed	Public Transport Focussed
Car Passenger	4%	8%	12%
Public Transport	12%	18%	24%
Active Travel	6%	9%	13%
Other*	1%	2%	3%
Road Network Focussed	Road Network Focussed	Road Network Focussed	Road Network Focussed
Car Passenger	4%	8%	12%

Public Transport	9%	13%	17%
Active Travel	5%	7%	9%
Other*	1%	2%	3%

** High level estimation of 1% uplift per assessed year to account for on take up of unknown novel micromobility technology.*

C.10 The factors outlined above were applied to the derived baseline mode shares to project the estimated future mode shares for each growth area and Spatial Strategy scenario.

C.11 These are outlined in the tables overleaf.

Table C.2 Projected Mode Share – Scenario 1 (Strategic expansions to existing towns)

Scenario 1 Growth Areas	Baseline (Census 2021) Mode Share Driving	Baseline (Census 2021) Mode Share Passenger	Baseline (Census 2021) Mode Share PT	Baseline (Census 2021) Mode Share Active Travel	Baseline (Census 2021) Mode Share Other	2029 Mode Share Driving	2029 Mode Share Passenger	2029 Mode Share PT	2029 Mode Share Active Travel	2029 Mode Share Other	2037 Mode Share Driving	2037 Mode Share Passenger	2037 Mode Share PT	2037 Mode Share Active Travel	2037 Mode Share Other	2046 Mode Share Driving	2046 Mode Share Passenger	2046 Mode Share PT	2046 Mode Share Active Travel	2046 Mode Share Other
Huntingdon	72%	6%	4%	17%	2%	56%	9%	12%	21%	2%	47%	12%	15%	23%	3%	36%	15%	19%	26%	4%
Godmanchester	77%	4%	8%	11%	1%	60%	7%	16%	16%	2%	50%	10%	20%	18%	3%	39%	13%	24%	21%	3%
St Neots	71%	5%	10%	13%	1%	55%	7%	18%	17%	2%	46%	10%	22%	20%	3%	36%	13%	25%	22%	3%
St Ives	71%	4%	7%	17%	1%	56%	7%	14%	21%	2%	46%	10%	18%	23%	3%	36%	13%	22%	26%	3%
Ramsey	85%	5%	1%	8%	1%	66%	8%	11%	13%	2%	55%	12%	15%	16%	3%	43%	15%	19%	19%	4%

Table C.3 Projected Mode Share – Scenario 2 (Public transport corridor focussed)

Scenario 2 Growth Areas	Baseline (Census 2021) Mode Share Driving	Baseline (Census 2021) Mode Share Passenger	Baseline (Census 2021) Mode Share PT	Baseline (Census 2021) Mode Share Active Travel	Baseline (Census 2021) Mode Share Other	2029 Mode Share Driving	2029 Mode Share Passenger	2029 Mode Share PT	2029 Mode Share Active Travel	2029 Mode Share Other	2037 Mode Share Driving	2037 Mode Share Passenger	2037 Mode Share PT	2037 Mode Share Active Travel	2037 Mode Share Other	2046 Mode Share Driving	2046 Mode Share Passenger	2046 Mode Share PT	2046 Mode Share Active Travel	2046 Mode Share Other
A141 corridor around the north of Huntingdon	67%	5%	3%	23%	2%	52%	8%	11%	27%	2%	42%	10%	15%	29%	3%	32%	13%	19%	32%	4%

A428/A421 south and east of St Neots	73%	2%	11%	12%	1%	56%	5%	20%	17%	2%	46%	8%	24%	19%	3%	35%	11%	29%	22%	3%
St Ives to Ramsey	81%	5%	3%	9%	1%	62%	8%	13%	14%	2%	51%	12%	18%	17%	3%	39%	15%	23%	20%	4%
Huntingdon to Peterborough	84%	5%	4%	7%	1%	64%	8%	14%	12%	2%	52%	12%	19%	15%	3%	40%	15%	24%	18%	3%

Table C.4 Projected Mode Share – Scenario 3 (Development concentrated around the strategic road network)

Scenario 3 Growth Areas	Baseline (Census 2021) Mode Share Driving	Baseline (Census 2021) Mode Share Passenger	Baseline (Census 2021) Mode Share PT	Baseline (Census 2021) Mode Share Active Travel	Baseline (Census 2021) Mode Share Other	2029 Mode Share Driving	2029 Mode Share Passenger	2029 Mode Share PT	2029 Mode Share Active Travel	2029 Mode Share Other	2037 Mode Share Driving	2037 Mode Share Passenger	2037 Mode Share PT	2037 Mode Share Active Travel	2037 Mode Share Other	2046 Mode Share Driving	2046 Mode Share Passenger	2046 Mode Share PT	2046 Mode Share Active Travel	2046 Mode Share Other
A428 (A421) corridor	73%	2%	11%	12%	1%	59%	5%	18%	16%	2%	51%	8%	21%	18%	3%	43%	11%	23%	19%	3%
A14/ A1307 corridor	77%	4%	8%	11%	1%	62%	7%	14%	15%	2%	53%	10%	18%	17%	3%	45%	13%	21%	18%	3%
A1 corridor	83%	5%	3%	9%	1%	67%	8%	10%	13%	2%	58%	12%	14%	14%	2%	48%	15%	17%	16%	3%

Table C.5 Projected Mode Share – Scenario 4 (Two new settlements plus dispersed growth)

Scenario 4 Growth Areas	Baseline (Census 2021) Mode Share Driving	Baseline (Census 2021) Mode Share Passenger	Baseline (Census 2021) Mode Share PT	Baseline (Census 2021) Mode Share Active Travel	Baseline (Census 2021) Mode Share Other	2029 Mode Share Driving	2029 Mode Share Passenger	2029 Mode Share PT	2029 Mode Share Active Travel	2029 Mode Share Other	2037 Mode Share Driving	2037 Mode Share Passenger	2037 Mode Share PT	2037 Mode Share Active Travel	2037 Mode Share Other	2046 Mode Share Driving	2046 Mode Share Passenger	2046 Mode Share PT	2046 Mode Share Active Travel	2046 Mode Share Other
Two new settlements	81%	6%	2%	10%	1%	66%	9%	9%	14%	2%	57%	12%	12%	16%	3%	47%	16%	16%	17%	4%
Dispersed growth in villages throughout the district	83%	6%	3%	7%	1%	67%	9%	11%	11%	2%	58%	12%	14%	13%	3%	48%	16%	17%	15%	4%

Table C.6 Projected Mode Share – Scenario 5 (Continuation of Local Plan strategy)

Scenario 5 Growth Areas	Baseline (Census 2021) Mode Share Driving	Baseline (Census 2021) Mode Share Passenger	Baseline (Census 2021) Mode Share PT	Baseline (Census 2021) Mode Share Active Travel	Baseline (Census 2021) Mode Share Other	2029 Mode Share Driving	2029 Mode Share Passenger	2029 Mode Share PT	2029 Mode Share Active Travel	2029 Mode Share Other	2037 Mode Share Driving	2037 Mode Share Passenger	2037 Mode Share PT	2037 Mode Share Active Travel	2037 Mode Share Other	2046 Mode Share Driving	2046 Mode Share Passenger	2046 Mode Share PT	2046 Mode Share Active Travel	2046 Mode Share Other
Huntingdon SPA	73%	6%	5%	15%	1%	57%	9%	13%	20%	2%	47%	12%	16%	22%	3%	37%	15%	20%	25%	4%
St Neots SPA	71%	5%	10%	13%	1%	55%	7%	18%	17%	2%	46%	10%	22%	20%	3%	36%	13%	25%	22%	3%
St Ives SPA	75%	5%	5%	14%	1%	58%	8%	13%	19%	2%	48%	11%	17%	21%	2%	38%	15%	21%	24%	3%
Ramsey SPA	85%	4%	2%	8%	1%	66%	8%	11%	13%	2%	55%	11%	15%	15%	3%	43%	15%	20%	19%	4%
Buckden	81%	4%	3%	12%	1%	63%	7%	11%	17%	1%	52%	11%	16%	19%	2%	41%	14%	20%	23%	3%
Fenstanton	82%	5%	3%	9%	1%	64%	8%	12%	14%	2%	53%	12%	16%	16%	3%	41%	15%	21%	19%	4%
Kimbolton	78%	3%	2%	15%	2%	61%	6%	10%	20%	3%	51%	10%	14%	22%	4%	40%	13%	18%	25%	4%
Sawtry	85%	4%	3%	8%	1%	66%	7%	12%	13%	2%	55%	11%	16%	16%	3%	43%	14%	20%	19%	4%
Somersham	83%	6%	2%	9%	1%	64%	10%	11%	13%	2%	54%	13%	15%	16%	2%	42%	17%	19%	19%	3%
Warboys	83%	6%	3%	6%	1%	65%	10%	12%	11%	2%	54%	13%	16%	14%	3%	42%	16%	21%	17%	4%
Yaxley	82%	6%	3%	8%	1%	64%	9%	12%	13%	2%	53%	13%	16%	15%	3%	41%	16%	20%	19%	4%
Small Settlements	84%	4%	3%	7%	1%	65%	8%	13%	12%	2%	54%	11%	17%	15%	3%	43%	15%	21%	18%	4%

Annual Trip Generation

C.12 Annual Trip Generation estimations were derived for each scenario using the TRICS Trip Generation Database.

C.13 This is a nationally recognised system to establish potential levels of trip generation for various development scenarios using a series of database filtering processes.

C.14 Comparable site surveys were filtered to derive 'Total Person' Daily Trip Rates for the variety of housing types, tenures and employment types, shown below.

Table C.7 Total Person Daily Trip Rates (two-way)

Land Use Type (TRICS categories)	Daily Trips (Arrivals + Departures)	Unit
Houses Privately Owned	7.4	Per dwelling
Flats Privately Owned	5.6	Per dwelling
Affordable Houses	8.3	Per dwelling
Affordable Flats	3.9	Per dwelling
Industrial Estate	8.6*	Per 100m^2
Office	12.9	Per 100m^2
Warehousing	0.8**	Per 100m^2

** Plus 1.6 Light Goods Vehicle (LGV), and 0.6 Other Goods Vehicle (OGV) trips per day per 100*m^2

*** Plus 0.1 LGV, and 0.3 OGV trips per day per 100*m^2

C.15 The estimated 'Total Person' daily trip rates were applied to the development growth quantum for each scenario, and growthed up to annual figures using a factor of 292.5 to account for lower weekend and holiday trips.

C.16 The annual 'Total Person' Trip Rates were applied to the projected mode shares to derive total annual trip estimates by mode, for each Scenario.

Total Annual Vehicle km by vehicle type

C.17 National DfT data **11** on was used to convert Total Annual Vehicle Trips to Total Annual Vehicle km. The latest national average trip length for car or van drivers is 13.006km (8.1 miles) which was used as a flat conversion factor against total vehicle trips for cars, LGVs and OGVs.

C.18 Despite the recent government announcement to scrap the 2035 target for no new internal combustion engine vehicles, it is widely accepted that the use of electric vehicles will become more widespread and will play a greater role in the vehicle mix when calculating tail pipe emissions from vehicles. The Total Annual Vehicle km was therefore further broken down by fuel type, and future projections for the assessed years were derived.

C.19 DVLA Data**12** provides data for licensed vehicles in Huntingdonshire by body and fuel type, and this was used as the baseline fuel type split. Future projections were calculated based on the National Grid 'Future Energy Scenarios' document (July 2017) 'Slow Progression' Scenario of growth in Pure Electric Vehicles (PEVs) and Plug-In Hybrid EVs (PHEVs).

Figure C.1 The Growth of EVs

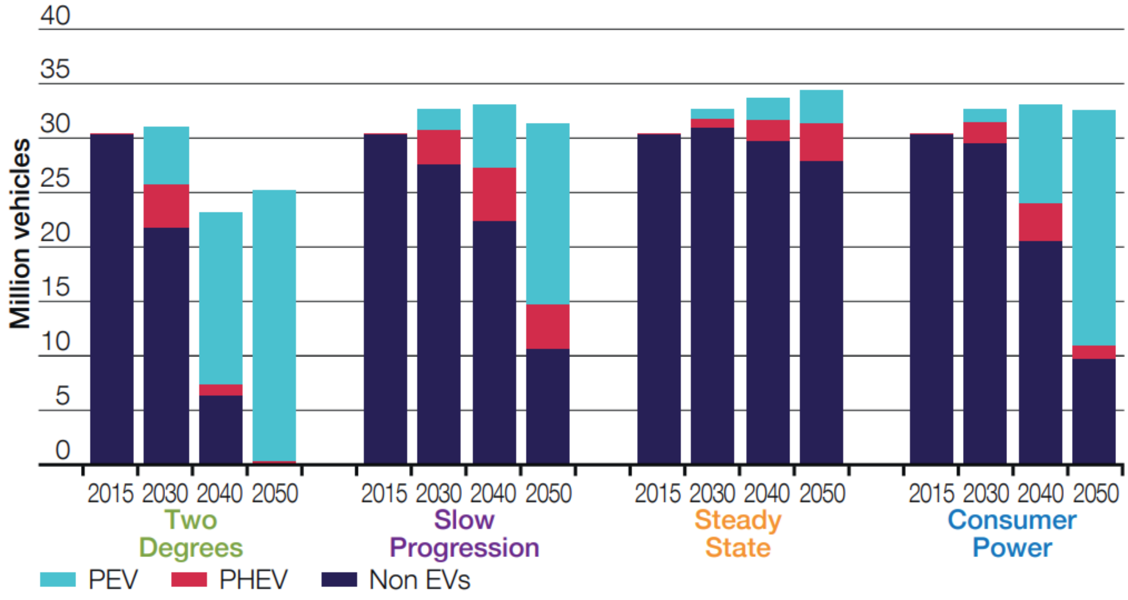


Image Source: Figure 3.13 of National Grid, Future Energy Scenarios (July 2017)

C.20 Baseline data for LGV and HGVs in Huntingdonshire shows a negligible proportion of PEV and PHEV vehicles. The future scenario derived by the National Grid was therefore used to inform future car splits, whilst LGV and HGV proportions were rationalised against the baseline data.

C.21 Fuel Type projections are summarised in Table C.8.

Table C.8 Projected Fuel Type Proportions

Body Type	Fuel Type	Baseline	2029	2037	2046
Cars	Petrol	56%	52%	45%	29%
Cars	Diesel	36%	34%	29%	19%

Cars	Hybrid	4%	8%	12%	14%
Cars	EV	4%	6%	13%	39%
LGVs	Petrol	4%	4%	4%	4%
LGVs	Diesel	94%	93%	91%	78%
LGVs	Hybrid	0%	0%	0%	1%
LGVs	EV	1%	2%	5%	18%
HGVs	Petrol	0.6%	0.6%	0.6%	0.6%
HGVs	Diesel	99%	99%	99%	98%
HGVs	Hybrid	0.0%	0.0%	0.0%	0.0%
HGVs	EV	0.0%	0.1%	0.2%	1.1%

C.22 Total Annual Vehicle km for all vehicle body types are summarised in **Table C.9** below.

Table C.9 Total Annual Vehicle km by Fuel Type – All Body Types

Scenario	Petrol 2029	Petrol 2037	Petrol 2049	Diesel 2029	Diesel 2037	Diesel 2049	Hybrid 2029	Hybrid 2037	Hybrid 2049	EV 2029	EV 2037	EV 2049	Total 2029	Total 2037	Total 2049
1	31,584,767	59,375,131	49,998,739	24,179,315	47,908,875	46,756,652	4,858,761	16,361,178	24,664,605	3,975,250	17,664,972	69,193,408	396,521,652	364,936,885	702,083,407
2	36,951,466	68,250,841	55,929,107	30,557,612	61,050,411	61,886,235	5,672,790	18,752,827	27,441,166	4,674,948	20,454,700	78,443,911	470,066,014	433,114,548	834,929,721
3	37,178,637	72,484,926	65,577,885	28,576,124	58,374,113	59,882,975	5,718,982	19,975,997	32,376,042	4,679,813	21,558,256	90,565,163	496,948,912	459,770,275	884,234,261
4	39,095,568	76,233,898	68,997,689	30,597,292	62,785,117	65,098,024	6,010,757	20,995,148	34,027,827	4,927,720	22,712,591	95,549,664	527,031,296	487,935,728	938,733,126
5	34,472,613	64,812,455	54,598,141	26,820,846	53,395,315	52,747,914	5,300,983	17,850,297	26,909,464	4,342,900	19,307,542	75,724,152	436,282,622	401,810,008	773,280,174

Total Annual kWh by Vehicle Type

C.23 Conversion factors are published by the UK Government (Department for Energy Security & Net Zero)[13] to calculate the energy use, in kilowatt hours (kWh), based on vehicle kilometres.

C.24 Conversion factors are published by vehicle fuel type and body type. The Total Annual Vehicle km calculated through the above methodology have been applied to these factors to calculate Total Annual kWh for each Spatial Strategy Scenario. This is summarised in Table C.10.

Table C.10 Total Annual Vehicle kWh by Fuel Type and Land Use – All Body Types

Scenario	Land Use	Quantum	Unit	Petrol 2029	Petrol 2037	Petrol 2049	Diesel 2029	Diesel 2037	Diesel 2049	Hybrid 2029	Hybrid 2037	Hybrid 2049	EV 2029	EV 2037	EV 2049	Total 2029	Total 2037	Total 2049
1	**Total Residential**	13,500	unit	17,329,501	32,533,953	27,292,222	10,748,233	20,178,453	16,927,387	1,864,485	6,278,385	9,464,716	749,135	3,313,330	12,807,242	30,691,354	62,304,122	66,491,568
1	**Industrial**	190,000	m2	3,020,400	5,745,849	5,007,680	7,277,504	17,443,777	25,144,430	312,668	1,052,866	1,587,203	146,001	677,438	2,982,355	10,756,573	24,919,929	34,721,668
1	**Office/ business park**	73,000	m2	1,654,187	3,105,528	2,605,178	1,025,972	1,926,134	1,615,803	177,974	599,303	903,454	71,509	316,274	1,222,515	2,929,642	5,947,238	6,346,951
1	**Logistics**	145,000	m2	217,615	414,758	365,727	1,308,188	3,299,467	5,298,282	22,458	75,625	114,005	10,645	49,757	227,699	1,558,906	3,839,606	6,005,712
1	**Total Employment**	408,000	m2	4,892,202	9,266,134	7,978,585	9,611,664	22,669,378	32,058,516	513,101	1,727,793	2,604,662	228,154	1,043,468	4,432,568	15,245,121	34,706,774	47,074,331
1	**Total (all land uses)**	-	-	**22,221,703**	**41,800,087**	**35,270,808**	**20,359,897**	**42,847,831**	**48,985,903**	**2,377,586**	**8,006,179**	**12,069,378**	**977,289**	**4,356,798**	**17,239,810**	**45,936,475**	**97,010,895**	**113,565,899**
2	**Total Residential**	13,500	unit	16,435,155	30,290,440	24,665,155	10,193,535	18,786,965	15,298,008	1,768,262	5,845,434	8,553,671	710,473	3,084,846	11,574,455	29,107,425	58,007,684	60,091,289
2	**Industrial**	340,000	m2	5,678,256	10,607,183	8,985,736	13,192,428	31,416,840	45,010,569	588,919	1,946,820	2,848,798	273,080	1,245,370	5,348,400	19,732,683	45,216,213	62,193,503
2	**Office/ business park**	150,000	m2	3,482,799	6,418,895	5,226,832	2,160,128	3,981,175	3,241,825	374,715	1,238,715	1,812,622	150,557	653,715	2,452,761	6,168,200	12,292,499	12,734,039
2	**Logistics**	260,000	m2	425,121	795,198	680,434	2,367,371	5,948,223	9,515,655	44,026	145,540	212,970	20,597	94,463	419,853	2,857,115	6,983,423	10,828,912
2	**Total Employment**	750,000	m2	9,586,177	17,821,275	14,893,002	17,719,927	41,346,238	57,768,049	1,007,661	3,331,075	4,874,389	444,234	1,993,548	8,221,015	28,757,999	64,492,135	85,756,455
2	**Total (all land uses)**	-	-	**26,021,331**	**48,111,715**	**39,558,156**	**27,913,462**	**60,133,202**	**73,066,057**	**2,775,923**	**9,176,508**	**13,428,060**	**1,154,708**	**5,078,393**	**19,795,470**	**57,865,424**	**122,499,819**	**145,847,744**
3	**Total Residential**	13,500	unit	19,028,062	37,054,936	33,419,797	11,801,728	22,982,491	20,727,878	2,047,234	7,150,842	11,589,708	822,562	3,773,757	15,682,689	33,699,585	70,962,026	81,420,071
3	**Industrial**	225,000	m2	4,145,286	8,152,309	7,553,047	8,970,694	21,493,180	30,782,866	431,430	1,506,954	2,442,391	197,471	939,514	4,293,303	13,744,881	32,091,956	45,071,607
3	**Office/ business park**	102,000	m2	2,623,740	5,109,428	4,608,187	1,627,316	3,169,008	2,858,124	282,289	986,015	1,598,081	113,421	520,356	2,162,454	4,646,766	9,784,807	11,226,845
3	**Logistics**	205,000	m2	361,784	712,438	665,664	1,883,075	4,742,947	7,582,842	37,574	131,244	212,713	17,389	83,183	391,652	2,299,822	5,669,811	8,852,870
3	**Total Employment**	532,000	m2	7,130,810	13,974,175	12,826,897	12,481,084	29,405,135	41,223,832	751,293	2,624,212	4,253,184	328,282	1,543,053	6,847,409	20,691,468	47,546,574	65,151,322
3	**Total (all land uses)**	-	-	**26,158,872**	**51,029,111**	**46,246,694**	**24,282,812**	**52,387,626**	**61,951,709**	**2,798,526**	**9,775,054**	**15,842,892**	**1,150,843**	**5,316,810**	**22,530,098**	**54,391,054**	**118,508,600**	**146,571,393**

4	**Total Residential**	13,500	unit	20,107,197	39,156,426	35,315,128	12,471,037	24,285,893	21,903,414	2,163,338	7,556,387	12,246,993	869,211	3,987,777	16,572,098	35,610,784	74,986,482	86,037,633
4	**Industrial**	270,000	m2	5,013,988	9,859,973	9,133,286	10,789,421	25,839,699	36,982,625	521,981	1,823,243	2,955,016	238,679	1,135,279	5,184,638	16,564,069	38,658,194	54,255,564
4	**Office/ business park**	75,000	m2	2,029,268	3,951,763	3,564,090	1,258,608	2,450,992	2,210,547	218,329	762,609	1,235,997	87,723	402,456	1,672,497	3,593,928	7,567,821	8,683,130
4	**Logistics**	205,000	m2	362,537	713,905	666,987	1,883,542	4,743,857	7,583,662	37,655	131,527	213,172	17,422	83,333	392,273	2,301,156	5,672,621	8,856,094
4	**Total Employment**	550,000	m2	7,405,793	14,525,641	13,364,362	13,931,570	33,034,548	46,776,834	777,966	2,717,379	4,404,184	343,824	1,621,068	7,249,408	22,459,153	51,898,636	71,794,788
4	**Total (all land uses)**	**-**	**-**	**27,512,990**	**53,682,067**	**48,679,490**	**26,402,608**	**57,320,441**	**68,680,248**	**2,941,304**	**10,273,766**	**16,651,177**	**1,213,035**	**5,608,846**	**23,821,507**	**58,069,937**	**126,885,119**	**157,832,422**
5	**Total Residential**	13,500	unit	18,346,658	34,443,538	28,894,143	11,379,102	21,362,830	17,920,943	1,973,921	6,646,896	10,020,249	793,105	3,507,807	13,558,965	32,492,788	65,961,072	70,394,301
5	**Industrial**	227,000	m2	3,886,892	7,387,267	6,421,168	8,867,316	21,164,786	30,312,828	403,500	1,358,727	2,048,292	186,463	862,572	3,768,811	13,344,172	30,773,351	42,551,099
5	**Office/ business park**	73,000	m2	1,717,776	3,224,907	2,705,324	1,065,412	2,000,176	1,677,917	184,816	622,341	938,184	74,258	328,432	1,269,510	3,042,261	6,175,857	6,590,935
5	**Logistics**	193,000	m2	306,879	584,398	513,925	1,751,927	4,411,763	7,069,023	31,746	106,900	161,152	14,913	69,521	315,806	2,105,466	5,172,582	8,059,906
5	**Total Employment**	493,000	m2	5,911,547	11,196,572	9,640,417	11,684,656	27,576,724	39,059,767	620,062	2,087,968	3,147,628	275,634	1,260,525	5,354,126	18,491,899	42,121,789	57,201,939
5	**Total (all land uses)**	**-**	**-**	**24,258,206**	**45,640,110**	**38,534,561**	**23,063,758**	**48,939,555**	**56,980,710**	**2,593,983**	**8,734,864**	**13,167,877**	**1,068,740**	**4,768,331**	**18,913,092**	**50,984,686**	**108,082,860**	**127,596,240**

References

1 https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

2 DfT Table NTS0303d: Average trip length by main mode (miles): England, 2002 onwards

3 DVLA Table VEH0105: Licensed vehicles at the end of the year by body type and upper and lower tier local authority, including diesel cars and vans: Great Britain and United Kingdom

4 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023

5 At a base level, not considering achievable development quantum, employment mix and future policies.

6 World Health Organisation (undated) Health Economic Assessment Tool (HEAT) for walking and cycling. Available at: https://www.who.int/tools/heat-for-walking-and-cycling

7 https://www.gov.uk/government/consultations/the-future-homes-and-buildings-standards-2023-consultation/the-future-homes-and-buildings-standards-2023-consultation#performance-requirements-for-new-buildings

8 See Table EC-1 https://www.nzcbuildings.co.uk/_files/ugd/6ea7ba_558d6df150b448f084c5a98b94f88727.pdf

9https://www.nzcbuildings.co.uk/_files/ugd/6ea7ba_46d5fa2dc4e444e1bd85aa8e2f7f99ab.pdf

10 ECUK, Table U2: https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2023

---

11 DfT Table NTS0303d: Average trip length by main mode (miles): England, 2002 onwards. Available at: https://assets.publishing.service.gov.uk/media/66ce0f118e33f28aae7e1f75/nts0303.ods

12 DVLA Table VEH0105: Licensed vehicles at the end of the year by body type and upper and lower tier local authority, including diesel cars and vans: Great Britain and United Kingdom. Available at: https://www.gov.uk/government/statistical-data-sets/vehicle-licensing-statistics-data-tables#all-vehicles

13 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023