Planning Guidance on low carbon energy and sustainable design

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Cover Photo: Blue Print Development, Meadows, Nottingham

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Executive summary

The Nottinghamshire councils have identified the preparation of planning guidance for developers on low carbon development as a key piece of work that will help the relevant councils to achieve their stated objectives of reducing carbon emissions. Most Nottinghamshire councils (including Broxtowe, Gedling, Mansfield, Newark & Sherwood and Nottingham City) have declared individual climate emergencies and some of these have set ambitious targets to be carbon neutral varying between 2027 and 2030. If these targets are to be met there needs to be a step change in terms of delivering zero carbon buildings in the next few years with the longer term aim of ensuring all new builds are zero carbon by 2030.

A zero-energy building is a building with zero net energy consumption, meaning the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on the site, or by renewable energy sources elsewhere. A glossary of terms is included at the back of this document.

The domestic sector is the largest user of energy in the area and a major contributor to CO_2 emissions. Although. carbon dioxide emissions have fallen especially in Nottingham City there is still much to do.

LPAs have included policies in their local plans (or emerging local plans) which require new development to address climate change mitigation and adaptation. Policies such as concentrating development within and adjoining the main urban areas reducing the need to travel and encouraging more sustainable transport modes have a major role to play in terms of reducing emissions from transport. However, there is a lack of standards in the various local plan policies relating to energy performance and CO_2 emissions of new homes and buildings.

This document has been prepared in consultation with all Nottinghamshire Planning Authorities. Part 1 of this guidance seeks to include an energy performance target in a model policy. If approved by the relevant Council this can then be a material consideration in planning decisions. It is intended that the Part 1 guidance also signal a clear direction for future policy being to achieve zero energy buildings by 2030.

Part 2 of this guidance sets out practical measures which can be used to help implement the various existing policies identified in local plans across the area and to help assist developers in making planning applications. Examples of good practice are also included from within the area and beyond.

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Purpose of the planning guidance

1.1 There is an urgent need for consistent policy guidance to achieve low carbon development across Nottinghamshire to inform decisions on future planning applications.

1.2 Working in partnership with the Midlands Energy Hub[1] and the D2N2 Local Enterprise Partnership, Nottinghamshire councils have identified the preparation of planning guidance for developers on low carbon development as a key piece of work that will help the relevant councils to achieve their stated objectives of reducing carbon emissions. Most Nottinghamshire councils (including Broxtowe, Gedling, Mansfield, Newark & Sherwood and Nottingham City) have declared individual climate emergencies and some of these have set ambitious targets to be carbon neutral varying between 2027 and 2030.

1.3 This planning guidance covers Nottingham City and Nottinghamshire County where local planning authorities have different local plans adopted or in the process of being adopted or in preparation. It is not possible to prepare a single Nottinghamshire-wide supplementary planning document (SPD) to support policy implementation of each of the councils' adopted local plans. Instead, this guidance document provides a foundation for individual local planning authorities to take this forward as they see fit. All councils have local plan policies that are relevant to the low carbon and sustainable design agenda as outlined elsewhere in the document (**Appendix 1**). This document is intended to provide a more consistent approach to provide advice to local planning authorities and developers to help deliver low carbon development. If approved by the Councils this document can be a material consideration in planning decisions. It includes a **glossary** attached at the back of this document.

1.4 The planning guidance is intended to provide:

- A model policy on climate change setting energy performance standards for both homes and other buildings to inform decision-making and future local plan preparation;
- An overview of Local Planning Policies relating to the delivery of low carbon development;
- Practical guidance on the forms of sustainable design and construction;

[1] The Midlands Energy Hub is a BEIS funded initiative, managed by Nottingham City Council, as part of the Clean Growth Strategy. Its mission is to support the capacity of LEPs and Local Authorities to deliver local low carbon energy projects, reduce carbon emissions, tackle fuel poverty and create new green jobs.

- Guidance to help inform planning applications;
- Sign-posting to best practice examples and guidance; and
- A checklist guide for developers to assist in the submission of planning applications (**Appendix 2**).

Introduction

Impact of global warming

2.1 Climate change is measured over long timescales as opposed to the weather, which is what happens day to day. There is strong evidence that the earth's temperature is getting warmer with most of this change happening recently. The key factor is an increase in Green House Gas (GHG) emissions that have a warming effect where it is estimated that GHG emissions have increased by a third in the last 100 years resulting in a rise in the earth's temperature by one degree centigrade. With this, has come more unpredictable weather patterns causing flooding, high winds and drought[2]: all with financial, social and environmental costs. This reality underpins the need for new development to play its role in being part of the solution towards reducing GHG emissions particularly Carbon Dioxide (CO_2) emissions and designing in resilience to climate change.

2.2 The Inter-governmental Panel on Climate Change (IPCC) issued its Fifth Assessment[3] and estimated[4] that 50% of the increase in GHG emissions has occurred in the 40 years between 1970 and 2010. During the period, 2000 to 2010 annual emissions of GHGs also increased. The report estimates that due to human activities, a rise of around 1.5 C is likely to occur between 2030 and 2052, if current trends continues. The report concludes that this would result in even more extreme weather events including extreme hot spells and heavy rainfall. Rises in sea level are also predicted to continue beyond the year 2100 under the various scenarios. Recent extreme weather events since the report was written enforce these findings.

2.3 To put this in perspective, the UKCP (UK Climate Projections) predicts[5] that summer days could increase between 3.7- 6.8° C by 2070, including the frequency in which this occurs. Climate change has already increased the chance of seeing a summer as hot as 2018 to between 12-25%. With future warming, hot summers by mid-century could become even more common, near to 50%. Average winter precipitation is likely to increase by around a third

[2] https://ukclimateprojections.metoffice.gov.uk/
[3] https://www.ipcc.ch/assessment-report/ar5/
[4] Based on an assessment of a warming of 1.5 C and for comparison between global warming of 1.5 C and 2 C above pre-industrial levels.
[5] UK Climate Projections: Headline Findings September 2019 - www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf

(27%). Whilst summer rain is predicted to be less, it will be heavier when it does rain. Overall, extreme rainfall events that typically occur every 2 years, will increase by around 25% in frequency. Flood risk is an issue across Nottinghamshire and overheating is also a significant issue affecting Nottinghamshire peoples' health and well being. The climatejust tool[6] provides evidence on the vulnerability of local areas to both heat and flooding and it is recommended that Nottinghamshire Councils make use of this evidence in drawing up their local plans and supplementary planning guidance to address the low carbon agenda.

2.4 The UK Government has set a target for the UK to be carbon neutral by 2050. Councils have agreed to be carbon neutral before this target as follows:-

	Date	Statement	In-house carbon neutral target	Area-wide carbon neutral target
Ashfield	**26/09/19**	**Commitment made**	**No target**	**No target**
Bassetlaw	**27/06/19**	**Commitment made**	**No target**	**No target**
Broxtowe	**17/07/19**	**Emergency declared**	**2027**	**2027**
Gedling	**20/1/2019**	**Emergency declared**	**2030**	**2030**
Mansfield	**05/03/19**	**Emergency declared**	**2040**	**2040**
Newark	**16/07/19**	**Emergency declared**	**No target**	**No target**
Nottingham City	**21/01/19**	**Commitment made**	**2028**	**2028**
Nottinghamshire	**16/05/19**	**Commitment made**	**No target**	**No target**
Rushcliffe	**07/03/19**	**Emergency declared**	**2030[7]**	**No target**

Table 1: Nottinghamshire Councils Climate Change Emergency commitments and zero carbon targets

What are zero carbon buildings and Zero Energy Buildings?

2.5 A zero-carbon building is a building designed to achieve zero or negative carbon. This is achieved by maximising energy efficiency and using renewable

[6] https://www.climatejust.org.uk/

[7] To be considered

energy in place of fossil fuels. A zero net energy building means the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on the site, or by renewable energy sources elsewhere. These buildings consequently contribute less overall greenhouse gas to the atmosphere than similar buildings. They do at times consume non-renewable energy and produce greenhouse gases, but at other times reduce energy consumption and greenhouse gas production elsewhere by the same amount.

2.6 The ability to achieve zero carbon in buildings depends on design, materials, fabric, location, orientation and surrounding buildings. Most zero net energy buildings get half or more of their energy from the grid, and return the same amount at other times. Buildings that produce a surplus of energy over the year may be called "energy-plus buildings" and buildings that consume slightly more energy than they produce are called "near-zero energy buildings" or "ultra-low energy houses".

2.7 Traditional buildings consume 40% of the total fossil fuel energy in the European Union and are significant contributors of greenhouse gases. The zero net energy consumption principle is viewed as a means to reduce carbon emissions and reduce dependence on fossil fuels. To meet local and national targets for zero carbon the building sector will need much stronger new build standards for energy efficiency and low-carbon heat and for these to be in place as soon as possible and Councils in Nottinghamshire have an important role in implementing these changes.

Assessment Frameworks and standards

2.8 The model policy set out elsewhere in this guidance uses standards for energy performance for new homes based on an improvement on the current Part L of the Building Regulations (equivalent to Level 4 of the Code for Sustainable Homes). For non-residential buildings it uses BREEAM standards. More information is set out on these standards below and in **Appendix 3**.

2.9 There are various assessment frameworks for measuring the performance of new buildings both during the design phase and after completion. These include, for example, The Code for Sustainable Homes, Home Quality Mark and BREEAM standards. These generally assess building performance against a number of sustainability criteria. For example, the Code for Sustainable Homes and BREEAM standards have similar methods of assessment against a number of criteria relating to categories including for example, energy and carbon dioxide emissions, water conservation, waste and

pollution against which the performance of the building is measured. Credits earned against each category can be weighted and totalled to provide an overall score based on a star rating system. Both of these systems have an independent assessor and certification process. More details on standards are set out in **Appendix 3**.

2.10 Energiesprong[8] (energy leap) is a set of zero carbon standards for the refurbishment of homes and for new build. The concept is that the standards can be achieved from funding saved in future lower energy bills and the budget for future maintenance and repairs. The work comes with a long warranty guaranteed by the developer. Originating from the Netherlands where it has been used to improve the energy efficiency of thousands of Dutch homes. It is estimated that it can cut household energy bills by 50%. The Dutch approach aims to refurbish the whole house and bring it to future standards needed to deliver zero carbon. Measures include prefabricated super insulation, solar panels and community heating schemes.

Case Study: Energiesprong retrofit pilot Sneinton, Nottingham City Homes

Nottingham City Homes were the first Registered Social Landlord to pilot the first net zero retrofit in the UK under the energiessprong (energy leap) initiative. Completed in early 2018 ten social rent homes in Sneinton (seven terraced three-storey houses and three bungalows) were retrofitted with super prefabricated insulation, solar panels and connected to a community heating system. This project is now being rolled out to many more homes across the city.

Performance targets include:

- Internal temperature in living areas 21 C
- Installation within 15 days
- Overheating no more than 11 days per year in excess of 26 C
- Hot water 140 litres per day
- Energy 1,500 kw per year
- High indoor air quality

[8] http://www.energiesprong.uk

Photo Energiesprong retrofit homes pilot Sneinton

Building for a Healthier Life

2.11 The Building for a Healthier Life[9] Assessment is a tool for assessing the design qualities of homes and housing schemes. It includes guidance that is highly relevant to the low carbon agenda and is widely used by developers and local authorities. The assessment is based on questions or criteria from which an overall score can be calculated. The criteria include:

- Connections;
- Facilities and services;
- Meeting Local Housing Requirements;
- Character;
- Working with the site in its context;
- Creating well defined streets and spaces;
- Easy to find your way around;
- Streets for all;
- Car parking;
- Public and private spaces; and
- External storage and amenity.

Impact of corona 19

2.12 At the time of writing, the scale of the impact of the COVID 19 crisis on the economy and housebuilding is not yet known. It is difficult to predict how the crisis will affect the building industry, impact on land values and ultimately on the viability of housing schemes. It is important to acknowledge that economic viability of housing schemes will be a factor to be considered in implementing the low carbon planning policies. It is recommended that Councils take account of costs associated with achieving low carbon buildings in their plan wide

[9] https://www.udg.org.uk/publications/othermanuals/building-healthy-life

viability guidance when taking this guidance forward. The energy performance standards set out in the model policy to follow are considered to be feasible and if taken into account in the plan wide viability assessment work during the preparation of local plans can be factored into land costs.

Case example: Modular Homes - ILKE homes Chase Farm, Gedling Borough Council

The company manufactures modular homes that can be delivered far more quickly than traditionally built homes, which the company claims to be twice as energy-efficient as the average UK home.

Source: ILKE website
https://ilkehomes.co.uk/

Photo Modular Homes Gedling Colliery/Chase Farm

Key Facts

3.1 An area profile is included at **Appendix 4**. Key facts and statistics include:

- The populations of Nottingham City and Nottinghamshire are 333,000 and 823,000 people respectively
- There are a number of large urban areas with the rural areas having a settlement pattern of market towns and villages
- Most of the population lives in the Greater Nottingham area
- The area has five[10] power stations (or power plants) along the River Trent reflecting its historical importance in generating electricity for the national grid and part of the so called "Megawatt Valley", however, the two remaining coal powered power stations (Ratcliffe-on-Soar and West Burton A) are due to close or be replaced by 2025. The remaining three are gas fired and remain in operation (Cottam, Stayhtorpe C and West Burton B).
- There are seven Air Quality Management Areas all in the Greater Nottingham area including one covering the whole of Nottingham City
- Emissions of CO_2 have fallen in recent years although this is largely due to a reduction in the use of fossil fuels to generate electricity but further reductions are needed to meet the zero carbon targets locally
- The area has a number of nationally important transport routes including the M1 Motorway and A1 running north south through the area, other A Roads, Midland Main Line and East Coast Mainline railways and the East Midlands Airport is located just outside the area
- Broadband ICT connectivity in Nottingham and Nottinghamshire is generally good.
- Transport is the largest source of CO_2 emissions with 96% of this attributable to road vehicles
- There is a relatively limited number of electric vehicle charging points especially in the more rural areas;
- Nottingham City has a higher mortality rate due to air pollution particulates than the average for the East Midlands as a whole
- The domestic sector accounts for the most energy use
- The area is expected to accommodate significant levels of new development growth
- Very few new homes were built between 2008 and 2019 to the highest standard of the Energy Performance Certificate rated as A (1.4%). A very high percentage met the national target rated C and above (96%). A small percentage of new homes did not meet the national target (3%).

[10] Includes the 400 mw power plant at Cottam which uses combined cycle gas turbine technology (CCGT)

- There are significant areas at a high risk of flooding
- There is a significant and strategic network of green and blue infrastructure available within the area including the strategic river corridors and canals with potential for better connectivity and biodiversity gain

Policy context

National legislation, Planning Policy and Practice Guidance

4.1 Section 19 of the Planning and Compulsory Purchase Act 2004 requires LPAs to include Local Plan policies, which are designed to secure the development and the use of land that, contribute to the mitigation of, and adaptation to, climate change[11].

4.2 The Planning and Energy Act 2008 allows local planning authorities (LPAs) to set energy efficientcy standards in their development plans policies that exceed the energy efficiency standards set out in the building regulations. Such policies must not be inconsistent with relevant national policies for England. A Ministerial Statement (March 2015) clarified its expectation that local planning authorities should not set energy efficiency standards for new homes higher than the energy requirements of Level 4 of the Code for Sustainable Homes (equivalent to a 19% improvement on the Part L 2013 standard). The Climate Change Act 2008 commits the UK to ensuring that the Kyoto greenhouse gas emissions are 80% lower than the 1990 baseline by 2050. The 2018 amendments to the Energy Performance of Buildings Directive (EU/2018/844) provides a specific built environment focus for the Climate Change Act and states that by the 31st December 2020 all new buildings should be nearly zero-energy buildings.

4.3 The NPPF 2019 (paragraph 149) sets out national requirements for planning and climate change. LPAs are required to adopt proactive strategies to adapt to and mitigate against the impacts of climate change in line with objectives and provisions of the Climate Change Act (2008).

4.4 In line with this, the NPPF 2019 (paragraph 150) states that:
'*New development should be planned for in ways that: a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and b) can help to reduce greenhouse gas emissions, such as through its location,*

[11] http://www.legislation.gov.uk/ukpga/2004/5/section/19

orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards'.

4.5 Government Planning Practice Guidance[12] advises how suitable mitigation and adaptation measures can be implemented in the planning process in order to address the impacts of climate change. This focuses on win-win solutions, for example:

- by maximising summer cooling through natural ventilation in buildings and avoiding solar gain;
- through district heating networks that include tri-generation (combined cooling, heat and power); or
- through the provision of multi-functional green infrastructure, which can reduce urban heat islands, manage flooding and help species adapt to climate change – as well as contributing to a pleasant environment which encourages people to walk and cycle.

4.6 The government has recently consulted on Future Homes Standards with the aim of bringing these new standards into force in 2025. The proposals amount to a near zero carbon Future Homes Standard based on producing 75-80% less CO_2 emissions than one built to current requirements. The intention is to future proof new homes for low carbon heating systems and meet higher standards of energy efficiency.

4.7 At the end of February 2020, government consultation ended on the Future Homes Standard. The consultation also included proposals for changes to Part L of the Building Regulations outlining options for the interim uplifting of Part L in 2020. The Consultation also sought responses to the question of whether government should amend the Planning and Energy Act 2008 in order to remove the power, which allows local planning authorities to set and apply policies in their local plans for energy efficiency standards for new homes that exceed the requirements of the Building Regulations.

4.8 The government has stated that it would not wish to see local planning authorities depart from these new standards. The timetable for implementation of the Future Homes Standards is a considerable time off and there is as yet no definite date for the publication of any uplifts to Part L of the Building Regulations. The updates to Part L may also be used to implement the EU Directive on Energy Performance and Building Design (EPBD) subject to the EU withdrawal agreement.

[12] https://www.gov.uk/guidance/climate-change

4.9 As set out above Section 19 of the Planning and Compulsory Purchase Act, Section 182 of the Planning Act 2008 and the NPPF Part 14 provide the national policy context for local planning authorities to include policies, which reduce carbon emissions. More specifically local planning authorities can:

- set energy performance standards for new housing or conversions higher than the Building Regulations up to the equivalent of Level 4 of the Code for Sustainable Homes; and
- for non-housing development can set energy performance standards above the Building Regulations

4.10 The D2N2 Local Enterprise Partnership has produced an Energy Strategy – Energy Strategy 2019 – 2030[13] which includes actions to include the energy efficiency of homes and rolling out low carbon heating amongst others.

Local Plans in Nottinghamshire

4.11 Based on the requirements in National planning legislation and policy guidance, the LPAs have included policies in their local plans (or emerging local plans) which require new development to address climate change mitigation and adaptation (see **Appendix 1** for a list of relevant plans and policies). These policies include for example Policy P5 of the Mansfield Local Plan, which, sets out a commitment to improving sustainability, and environmental performance of all new development – with policies seeking to influence design and layout. Policy 1 Climate Change of the Greater Nottingham Aligned Core Strategies sets out policy on sustainable design, adaptation and seeks to reduce carbon emissions. However, the various policies do not include any standards on energy performance of buildings, which is the subject of the model policy below.

4.12 Taken as a whole the various policies in local plans across the area focus on a number of ways to address climate change through the delivery of sustainable development, including:

- concentrating development within and around existing urban areas
- contributing to the sustainable transport network (e.g. buses, cycle networks)
- designing in green networks for people and wildlife (green infrastructure) to support healthy lifestyles and improve resilience for nature
- designing better connected developments
- tree planting
- encouraging micro-generation and larger-scale energy generation

[13] https://d2n2lep.org/wp-content/uploads/2020/07/D2N2_Energy_Strategy-1.pdf

- encouraging the uptake of electric car charging points
- sustainable design

4.13 These measures also have other benefits such as improving health and wellbeing, reducing fuel poverty, improving air quality and encouraging inward investment as shown in the diagram below. These measures can be taken forward through the practical advice set out in Part 2 of this guidance.

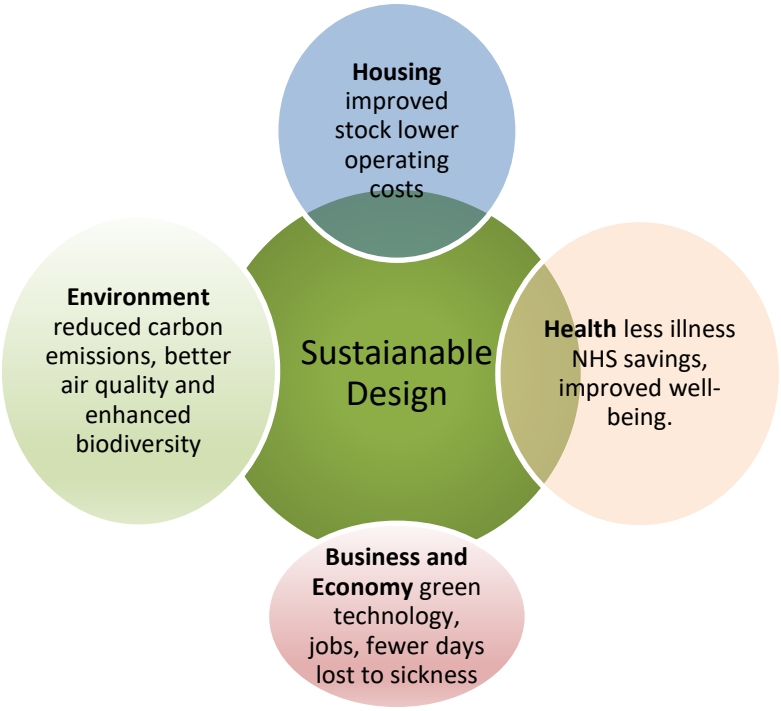


Figure 1: Benefits of Sustainable Design

UK Green Building Council energy performance standard

4.14 A recent publication by the UK Green Building Council (UKGBC) [14] sets out a baseline or minimum standard on energy performance for all local planning authorities to provide a consistent baseline across the country. The recommended standard is considered to be relatively modest but is considered by UKGBC to be legally sound, practical and achievable in terms of viability. The recommended standard for energy performance in housing development is as follows:

> 'A 19% reduction on the Dwelling Emission Rate (DER) against the Target Emission Rate (TER) based on the 2013 Edition of the 2010 Building

[14] The Policy Play Book: Driving Sustainability in New Homes, UKGBC https://www.ukgbc.org/

Regulations (Part L) whilst meeting the TER solely from energy efficiency measures as defined within the SAP calculation model'.

4.15 The UKGBC report also recommends that Councils commit to all new builds becoming zero carbon by 2030 in order to show the future direction of travel.

4.16 This planning guidance document includes this energy performance standard set out above, in its Model Policy below as an interim measure.

4.17 For non-residential development, the Model Policy includes standards based on the BREEAM standards and includes a standard for the conservation of water based on the optional standard set out in the Building Regulations.

4.18 As stated above, local plans do not currently include standards on energy performance and it is intended that the standards set out in model policy show the future direction of policy travel for low carbon homes and buildings across the Area. This policy if approved by the relevant Council can be a material consideration in planning decisions and/or included in new emerging local plans in future.

Part 1: Model Policy: Climate Change

1. All development proposals will be expected to mitigate against and adapt to climate change, to comply with national and contribute to local targets on reducing carbon emissions and energy use unless it can be demonstrated that compliance with the policy is not viable or feasible.

Sustainable Design and Adaptation

2. Development, including refurbishment where it requires planning permission, will be expected to take account of the following:

a) how it makes effective use of sustainably sourced resources and materials, minimises waste, and water use. For residential development, planned water use should meet the optional National Housing Standard of no than 110 litres per person per day;

b) how it is located~~,~~ laid out, sited and designed to withstand the long and short term impacts of climate change, particularly the effect of rising temperatures, sustained periods of high temperatures and periods of intense rain and storms. This includes the designing in of on-site, and where necessary off-site, green and blue infrastructure and sustainable drainage systems;

c) how it is located laid out, sited and designed to promote the use of sustainable modes of transport and minimises car usage, connecting people to where they want and need to go through attractive, efficient and convenient walking, cycling and public transport networks;

d) that the building form and its construction allows for adaptation to future changes in climate;

e) that the building form and its construction permits further reduction in the building's carbon footprint, where feasible and viable; and

f) that in addressing the above measures, the development's design and layout also strives to maximise health and well-being and enjoyment of its residents and net gains in biodiversity, where possible.

Reducing Carbon Dioxide Emissions

3. Until the Government's Future Homes Standards are implemented, residential development should meet a minimum 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations where technically feasible and viable.

Where technically feasible and viable non-residential developments of 1,000 sq. m or more will be required to achieve “Very Good” in the BREEAM Standards.

4 Development should demonstrate how carbon dioxide emissions have been minimised in accordance with the following energy hierarchy:

a) Using less energy through whole development layout energy efficient building design and construction, including thermal insulation, avoiding internal overheating by providing passive cooling and ventilation;

b) Utilising energy efficient supplies – including connecting to available heat and power networks;

c) Maximising use of renewable and low carbon energy generation systems in order to balance with the predicted energy use for the development, such that zero carbon is as closely achieved as possible; and

d) ensure the performance of the dwelling following completion (energy use, carbon emissions, indoor air quality, and overheating risk) matches the calculated design performance of dwellings

Decentralised Energy Generation

5. The extension of existing or development of new decentralised renewable and low-carbon energy schemes appropriate for the plan area will be promoted and encouraged, including biomass power generation, combined heat and power, and micro generation systems. This is provided there is no significant adverse impact (alone or in combination) on the natural and historic environment and amenity of nearby residential and non-residential uses. In line with the energy hierarchy, adjacent new developments will be expected to utilise such energy wherever it is feasible and viable to do so.

Justification

Tackling Climate Change

I. The Councils will look to mitigate against and adapt to climate change and its effects through a variety of means including the policy outlined above. Tackling climate change is major challenge. It is a global problem requiring local action. Major changes in attitude and practices are required if we are to make changes to the earth’s climate and reverse the effects of global warming. National objectives to address climate change will not be achieved without substantial efforts to reduce energy consumption and increase energy produced from naturally occurring, renewable sources.

Sustainable Design and Adaptation

II. Simple measures, such as the design, siting and orientation of development, appropriate sourcing of materials (for instance, where there is a choice, using materials with a lower 'carbon footprint'), and minimising waste, both during construction and in use, can improve the sustainability of development at little or no cost. Sustainability Statements can be an effective way of demonstrating how development contributes to both mitigating the causes of climate change and adapting to its effects, and their use will be encouraged.

III. It is critical that new builds are "future proofed" to ensure that they are adaptable to future changes in climate including through,for example being capable of connection to renewable and low carbon energy generation, more efficient in the consumption of water and more resilient to flood risk.

IV. The government has stated that local planning authorities can include policies in plans which include a target for water consumption based on the optional National Housing Standard of no more than 110 litres per person per day.

Reducing Carbon Dioxide: Residential development

V. The relevant provisions in the Planning and Energy Act remain in force and as a minimum there is an option for the Councils to adopt the approach of a 19% reduction in carbon dioxide emissions over and above that required by the 2013 Building Regulations as set out in the Ministerial Statement in March 2015. This is considered an achievable target and necessary to enable the Councils to make progress towards achieving their carbon reduction targets locally.

VI. The policy will be implemented through the development control process. A sustainability statement setting out the sustainability credentials of the development will be required including information on energy use and carbon reductions. A checklist for developers is attached as **Appendix 2**.

Non-Residential Development

VII. The Building Research Establishment's Environmental Assessment Method is known as BREEAM Standards and is the most widely recognised method of assessing the environmental quality of building design. BREEAM Standards are a nationally recognised standard and involves a process of certification and more details are set out in **Appendix 3**.

Energy efficiency and adaptation

VIII. The ‘energy hierarchy’ is a recognised approach to reducing the CO2 emissions from new development. Firstly, long term reductions are normally most effectively made through ensuring the building itself is as energy efficient as possible, and by ensuring that the building’s systems use energy as efficiently as possible, thus reducing its energy demands over its lifetime. Secondly, once the building’s energy demands have been minimised, the focus should be on supplying energy efficiently (encouraging the use of local networks such as combined heat and power). Thirdly, sourcing the building’s remaining energy requirements from renewable carbon sources can contribute to further CO2 savings, whilst also contributing to national and local targets for renewable and low-carbon generation

IX. Further guidance for developers on reducing emissions is set out in the Sustainable design and construction principles set out in Part 2 of this document below.

Decentralised Energy Generation

X. Supporting renewable and low-carbon decentralised energy schemes is an important component of meeting carbon reduction targets, and in the short term at least, they are capable of delivering greater carbon savings than achievable through the development of new low carbon buildings.

Sustainable Transport and Connectivity

XI. The sustainability of new development needs to be fully considered as part of its overall design, this includes planning for layouts that minimise the use of the private car and prioritise safe and attractive routes that benefits pedestrians and cyclists. This means designing in routes that are well connected to public spaces (both existing and planned) such as schools, shops, open space, green corridors, employment areas and other community facilities. New walking and cycling routes should also connect to existing routes and bus stops. These should also be accessible to those with disabilities. The layout of routes should be designed to promote convenient and healthy routes around the development site and also connect with and provide extensions to existing adjacent green corridors (i.e. green infrastructure). Layouts which lengthen journey times to community facilities, through unnecessary dead ends and awkward journeys should be discouraged.

XII. Many of the most liveable cities in the world are also those that score well for walkability. In addition to reducing the need to travel and thus reducing

vehicle emissions, connected neighbourhoods improve health and wellbeing and community cohesion through increased walking and positive sociable interaction.

Green and Blue Infrastructure

XIII. The NPPF (2019) makes clear that the integration of green (and blue) infrastructure (GI) is important for mitigating and adapting to climate change and minimising and mitigating air quality (paragraphs 150 and 181). The designing in of GI within developments is fundamental ingredient for avoiding and minimising flood risk, regulating heat, and reducing impacts from air pollution, complementing sustainable transport routes, and improving overall health and wellbeing of residents / employees.

XIV. Green infrastructure is defined as a network of natural and managed multi-functional green space, urban and rural, which is capable of delivering a wide range of environmental and quality of life benefits for local communities. This can comprise of, but is not limited to: urban parks, green corridors, nature reserves, natural and semi-natural habitats, cycle and walking provision, landscaping and landscape features. GI provides essential ecosystem services, such as, providing clean air and water, contributing to health and wellbeing, enhancing biodiversity and managing and minimising flood risk.

XV. The water environment, natural and manufactured, is also part of green infrastructure and can include reservoirs, rivers, sustainable drainage systems, etc.

XVI. Green infrastructure can be integrated within developments on varying scales such as the building level (e.g. green roofs and living walls) to whole development layouts that incorporate landscaping, recreational and ecological green corridors, SuDS, recreational open space, etc. The integration of GI also enhances people's lives through improved access to natural areas, healthier transport links, and improved place shaping design.

Part 2: Sustainable development and construction principles, guidance for Developers

5.1 Part 2 of this planning guidance focuses on how new development can design in and embed carbon reduction measures and this will likely depend on the scale, type and location. It is not the aim of this Part 2 guidance to prescribe any particular approach, but it is also clear that new development can do much to affect positive change. A checklist guide to assist developers in submitting planning applications attached as **Appendix 2**. The Midlands Energy Hub is at the time of writing preparing a Low Carbon Planning and Maintenance Checklist which is intended to be a straight forward practical guide for planners and developers and likely to be available early in 2021. It is recommended that practitioners make use of this Checklist when available and more information is available in **Appendix 2.**

Sustainable layout and design ('whole building' and 'whole layout' considerations)

5.2 Sustainability has to be part of the whole design process, from the very start of the project. The field of sustainable design seeks to balance the needs of these areas by using an integrated approach to create "win-win-win" design solutions. The Government has produced National Design Guidance[15] which is relevant in this context.

5.3 It is important that new development optimises the site's potential by considering how existing infrastructure and natural features (both nearby and on-site) can be best integrated and enhanced to help conserve energy, maximise renewable energy efficiency, improve air quality, enhance biodiversity, avoid and reduce flooding and improve the uptake of sustainable modes of transport (walking, cycling and bus).

5.4 When planning for and designing layouts, this needs to consider aspects such as building orientation, access to sustainable transport, connectivity, green infrastructure, water conservation and management, biodiversity net gains, etc. from the on-set of the design process. In doing so this can reduce costs and time by beginning to integrate cross-cutting policy needs early on in the

[15] https://www.gov.uk/government/publications/national-design-guide

process. Pre-application discussions and information gathering processes are encouraged to address the following:

- Considering different layout options to achieve maximum solar gain and integration of solar panels;
- Connectivity to existing community facilities, jobs and green infrastructure, bus routes and walking and cycling routes;
- Connectivity within the development to maximise routes that reduce car travel within the development and also seek to improve physical and mental wellbeing;
- Avoidance of flood risk through the use of sustainable drainage systems (SuDS) and how these can also can also minimise impacts and enhance water quality, amenity and biodiversity;
- Protecting and enhancing biodiversity on and adjacent to the site by understanding what should be conserved but also enhanced within the development and the relationship with nearby ecological networks and designated sites and to contribute to net gains in biodiversity;
- Design and integration of landscaping along busy roads and providing off-road walking and cycling green corridors in order to avoid and minimise impacts and improve air quality; and
- Design and integration of open spaces and green networks to promote urban cooling, access to nature and healthy places.

Maximising site potential

Solar Orientation

5.5 Using the suns energy and surrounding climate is called passive solar design and can achieve natural heating and cooling of a building. This is complex as the amount and power of the sun changes with the seasons although it is possible to model the amount of sun throughout the day and year. As a general principle, the building should be orientated to take maximum advantage of the sun's energy.

5.6 The Passivhaus[16] guidelines are that orientation should be preferably on an east to west axis and so the building is orientated within 30 degrees of due south as shown in Figure 1 below. Frequently used and habitable rooms should be on the southern elevation.

[16] Passivhaus - https://www.passivhaustrust.org.uk/what_is_passivhaus.php

5.7 It is not always practical or possible to orientate buildings to an east west direction. For building sites with a north south axis, a north to south alignment maximises morning and evening sunshine. Habitable rooms should be on the western elevation to maximise heat and light in the evenings, which can reduce the need or timing of heating these rooms. In both cases, consideration should be given to the size and position of window openings including the use of large glazing units being at least sufficient to provide adequate daylight to reduce the need for lighting and energy use. In general, most glazing should be on the south side.

5.8 Even where rooms face north it is possible to admit sunlight through using designs for example the house could be split in such a way that rather than the roof being equal on both sides one half is dropped to allow for clerestory glazing[17] at the highpoint to capture southern sun light.

5.9 The building size and compactness also has a major effect on energy consumption. Generally, more compact forms with a low surface area to volume ratio are the most energy efficient. The building fabric especially the level of insulation is critical to achieving greater gains from passive solar energy although the standards for energy efficiency in homes is outside the scope of these guidelines. The Passivhaus principles for maximising passive solar gain include:

- Massive insulation on average 300 mm thick
- Triple glazing;
- Air tightness; and
- Ventilation (see below)

5.10 The layout of homes on a site also needs to take account of the potential for passive solar gain. Planning policies generally seek to ensure that new development does not create issues of overlooking, overbearing or overshadowing. Separation distances between residential units and their siting and orientation within the scheme relative to one another should seek to maximise solar gain across the scheme as a whole. The elevation with the most potential for solar gain should have a minimum distance of 11 m from the next building.

[17] A **clerestory** is an interior wall built above part of the roof with high windows to let in light.

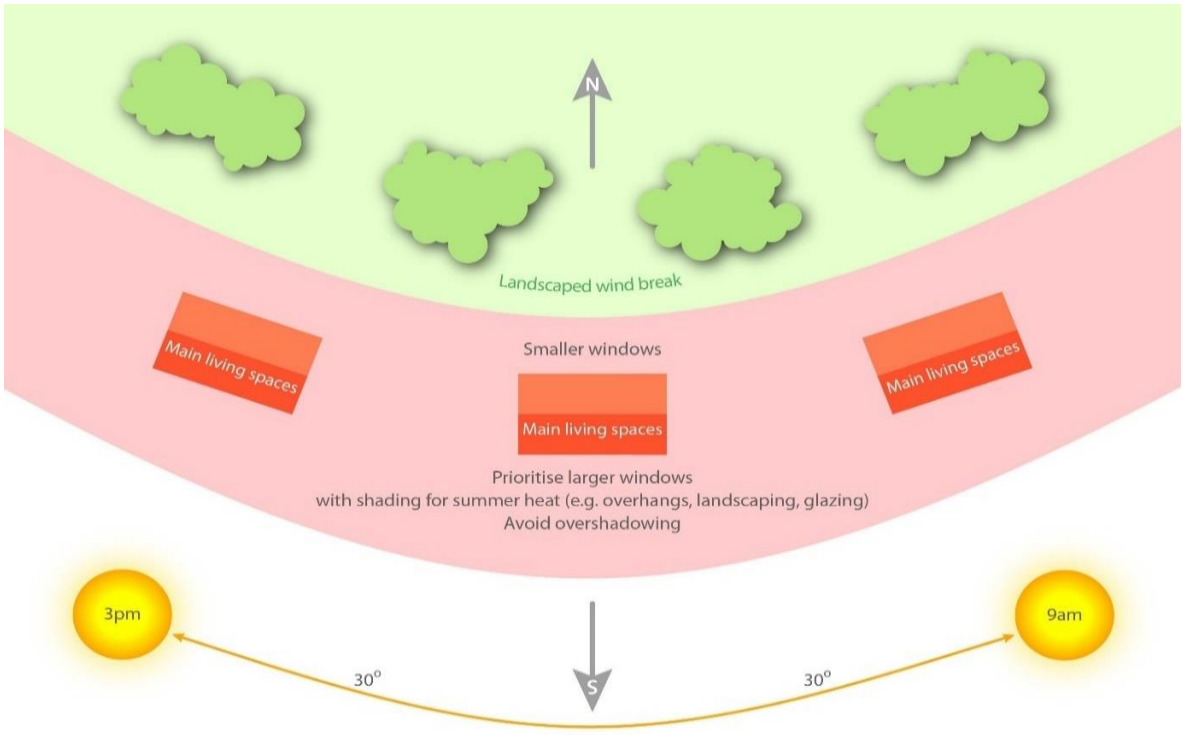


Figure 2: Solar Orientation residential dwellings

Commercial buildings – offices

5.11 These are best orientated in an east –west orientation with most glazing on the north side to avoid excessive heat gain, which can be an issue even in the winter months.

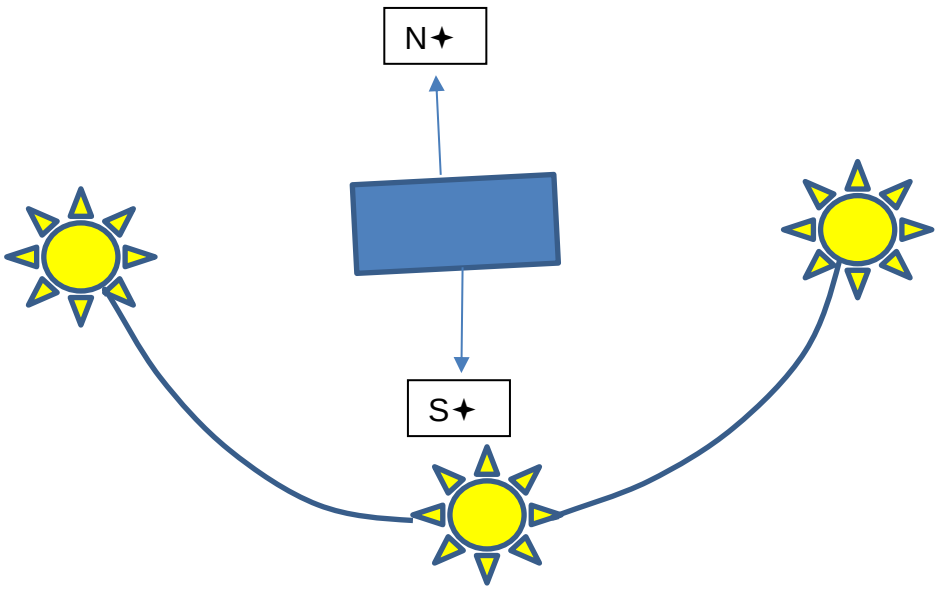


Figure 3: commercial/office orientated on an east – west axis

Minimising Energy Use

Glazing

5.12 Triple low-e glazed window panes with noble gas filling may be used with the glazing and frame having a U value of 0.8 W/(m2 K). Solar transmittance or g value should be 50% or more so as to allow more solar gain in winter months. Triple low e glazed slim units to fit wooden frames within Conservations Areas or heritage buildings may also be used.

Thermal Mass

5.13 Thermal mass can be placed in the floor or walls of a building. This needs to be a dense and heavy material, which can act as a good heat conductor. A simple form is a concrete slab although this should be tiled rather than have a carpet covering. Thermal mass is best placed where it can absorb heat in the colder months of the year and be shaded in hotter months. Thermal mass absorbs heat in hot weather and can therefore have a cooling effect giving out heat when the temperature falls having a warming effect.

Insulation

5.14 Most homes are built with a cavity wall, which can be filled with insulation including foam insulation injected through the external wall. It is considered that many homes nationally and locally could benefit from this relatively easy and cheap form of insulation. Solid walls can also be insulated using solid wall insulation boards either on internal walls or on external walls.

EV points, Domestic lighting and household appliances

5.15 Electric or hybrid-electric powered vehicles currently form a small percentage of the total number of vehicles on the road. However, electric/hybrid vehicles will become more popular, further advances in technology are anticipated, and the likelihood is that these vehicles will become less expensive. Currently there is a relatively limited availability of publicly accessible electrical charging points across the County especially in the more rural areas (see **Appendix 4**) and there is clearly a need to secure more charging points particularly to support new developments. External charging points can be provided for new homes. To allow for an easy upgrade to a Mode 3 (smart charging) in the future, the charging points should be supplied with a protected independent 16 amp radial circuit complying with BS7671 or equivalent; a 32 amp power supply would be

advisable to future proof the development. Further guidance is available in the Air Quality and Emissions Guidance for Developers[18].

5.16 Maximising solar gain through design and orientation is also the best means of making the most of natural light. Electrical lighting systems should be of the low energy type including for example, LEDs, compact fluorescent lamps and low energy bulbs. Household appliances can be obtained that meet independently tested low energy standards and there are various certification marks for this such as EKOEnergy.

Renewable Energy technology for buildings

5.17 There are a range of technologies available to deliver these requirements including; solar thermal panels, photovoltaic cells, small wind power generators, biomass heating and hot water systems, ground source heat pumps, micro combined heat and power systems (powered by a renewable fuel source) or energy efficient ventilation systems.

Solar Panels and ground source heat pumps

5.18 Solar panels also known as photovoltaic cells or PV capture the sun's energy and convert it into electricity. A roof area of 10 sq. m to 20 sq. m can deliver 20- 45% of the households electricity needs and the roof should ideally face south. Solar thermal panels can provide both hot water and electricity.

5.19 Ground source heat pumps capture the heat from underground, which has a relatively constant temperature of about 10 degrees C. The systems works on pipes laid under the ground in a loop with a mixture of water and antifreeze that is pumped around the loop. The loop heats up and passes through a heat exchanger that can be used to heat the home. Normally a fair sized garden area is required to accommodate the loop but they are relatively inexpensive to run and maintain.

Biomass Boilers

5.20 These appliances combust grown materials to produce heat and can be fitted with a back boiler to supply hot water. One disadvantage is that combustion

18 https://www.gedling.gov.uk/media/gedlingboroughcouncil/documents/planningpolicy/supplementaryplanningdocuments/GBC-EMAQN%20PLANNING%20GUIDANCE%20v2019.pdf

can give off air pollution and it is important that sustainable materials are burned.

Decentralised renewable energy

5.21 Most local plans across the County encourage connection to decentralised energy networks. For example, Nottingham City Land and Planning Policies Document (LAPP) Policy CC2 encourages connection to the existing decentralised energy and heat network shown on the LAPP Policies Map. Nottingham City currently has an extensive existing decentralised energy and heat network. In this case, the most significant facility within the City is the Eastcroft Energy from Waste facility, which feeds the EnviroEnergy district heating facility on London Road. The London Road heat station also includes a Gas Combined Heat and Power (CHP) backup. There are also CHP plants at Boots and Queens Medical Centre, and other smaller sites.

Photo Solar Farm at the former Gedling Colliery

Protect and conserve water

5.22 Government has set out that local planning authorities can opt for the higher National Standard for water consumption of up to 110 litres per person per day in their adopted local plans for example Nottingham City Council LAPP CC1 Sustainable Design and Construction

5.23 There are numerous installations within buildings that can conserve water including, low flush toilets, aerating taps, low flow showerheads and water butts.

Rainwater Harvesting

5.24 At its simplest this can be rainwater collection tubs connected to a drainpipe. However, more sophisticated systems including storing of rainwater collected from the roof of the building, which can either, be gravity fed or pumped for purposes not requiring drinking water standards such as flushing toilets, washing machines or for watering the garden. Water can be harvested from green roofs (see above) although it is less clean and may have contaminants.

Recycling Grey Water

5.25 Water used in the home called grey water can after treatment be used for non-drinking water purposes for flushing toilets or watering the garden.

Building space and materials

5.26 The environmental impact of the main building materials should be considered. Examples of low impact materials are timber, earth, straw, secondary aggregates, locally produced or recycled products; high impact materials include plastic, steel and aluminium. Repair is generally preferable to reuse, reuse to recycling and recycling to disposal/new materials. When using timber, preference should be given to products from well managed, sustainable, certified sources e.g. Forest Stewardship Council (FSC). Environmental ratings are published in the BRE Green Guide[19] and BREEAM Standards[20].

[19] https://www.bregroup.com/greenguide/podpage.jsp?id=2126

[20] https://www.breeam.com/BREEAMUK2014SchemeDocument/#09_material/material.htm%3FTocPath%3D9.0%2520Materials%7C_____0

Maximise indoor environmental quality

Ventilation

5.27 The Building Regulations and standards such as Passivhaus require very air tight forms of construction to improve energy efficiency and eliminate drafts for example, air tight fabric, taped and sealed wall joints. However, healthy homes need to be properly ventilated.

5.28 At its simplest passive ventilation can be achieved with all externally fitted windows being able to be opened. Skylights and roof glazing can also be used to allow the free flow of air through a building for cooling purposes.

5.29 Mechanical ventilation involves air extracted from the outside and pumped into the house through a heat exchanger where warm moist air from the house is pumped outward warming but not mixing with the incoming air.

5.30 As stated above, thermal mass can have a cooling or warming effect. A high thermal mass construction could be a brick and bloc wall with a plaster finish. A timber framed wall has a lower thermal mass. Thermal mass helps prevent buildings overheating in summer and in winter, absorbs heat during the day and releases it at night.

Operation of buildings and their maintenance

5.31 Future proofing[21] of buildings is critical and important to build in at the design phase. The key objective should be to achieve a sustainable low energy building that is adaptable to social, technological, economic and regulatory change and seek to maximise the life cycle of the building and minimise operating costs. Flexibility is often seen to be key in this context so that the building can continue to be efficiently used well into the future. This could include for example, moveable partitions or adaptable multi use space. Building in resilience to climate change including increased temperature or flood risk should be considered.

[21] https://www.designingbuildings.co.uk/wiki/Future_proofing_construction

Green infrastructure, including landscaping and green roofs

5.32 The integration of on-site green infrastructure (GI) provides multiple benefits such as reducing and attenuating surface water run-off, helping to improve air quality by absorbing particulate matter and restoring and enhancing biodiversity through habitat creation. These benefits are also known as 'ecosystem services' and help to regulate the impacts caused by climate change and also to help reduce CO2 emissions. The designing in of GI also provides health and wellbeing benefits for residents and can contribute to reduced energy costs, when designed in and utilised effectively.

5.33 Vegetated areas typically reflect more solar radiation away from the surface than dark, artificial surfaces. Consequently, less solar radiation will be absorbed, resulting in vegetated areas having cooler surfaces and lower air temperatures compared with built-up, non-vegetated areas. Vegetated areas also have lower heat storage capacities than many artificial materials and transfer energy rapidly to the air because of their multiple small leaves and branches which facilitate air movement.

5.34 The positive benefits from the integration of green infrastructure are reported in a European Commission publication on climate change and GI22. It reports that 'estimations have shown energy savings from green roofs at 15-45% of annual energy consumption, mainly from reducing costs for cooling. For example, in New York it was estimated that providing 50% green roof cover within the metropolitan area would lead to an average 0.1-0.8°C reduction in surface temperatures. It was noted that for every degree reduction in the urban heat island effect roughly 495 million KWh of energy would be saved. Urban trees also bring multiple benefits including energy savings from cooling and heating. A 20% tree canopy over a house results in annual cooling savings of 8 to 18% and annual heating savings of 2 to 8%'.

5.35 Research by Manchester Metropolitan University[23] also report the important roles that urban trees and grassed areas have in significantly reducing the heat island effect and reduce rainfall runoff.

5.36 This comes in many forms and scales, including, but not limited to:

- Green roofs and living walls
- Street trees, hedgerows, urban trees and woodland
- Open space and green corridors
- Semi-natural and natural habitats

[22] https://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_energy.pdf
[23] Gill, S.E., Handley, J.F., Ennos, A.R. and Pauleit, S. (2007). Adapting cities for climate change: the role of green infrastructure. Built Environment 33 (1), 115–133.

- Sustainable drainage systems
- Allotments and community orchards and
- Walking and cycling routes / networks.

5.37 The following provides a short summary of benefits and sign-posting:

A) Green roofs and living walls – These reduce energy heating but also cooling costs and contribute, to some degree, to reductions in surface water run-off. These also improve the local air quality and can be integrated on a variety of scales. It is important that maintenance is addressed, as this is a critical factor in their success. They can greatly add to the aesthetics and also to the uptake of buildings. They soften the urban form and provide net gains in biodiversity.

B) Trees, hedgerows and other semi-natural and natural habitats – Urban trees and woodland, hedgerows and other habitats, including grassland and wetlands help to minimise the relative heating of urban areas and thus can reduce the need for heating and cooling within buildings (they cool buildings and urban areas through evapotranspiration), therefore reducing carbon emissions. Strategic planting of shrubs and trees can help protect buildings from excessive summer heat through shading and from wind. Trees, hedgerows and habitats also provide visual amenity, enhance biodiversity and improve air quality in the area. The location and type of species are important factors when integrating these into development. Key factors when choosing appropriate species mixes include: soil type, co-occurring needs (e.g. improving air quality and biodiversity), location (e.g. within an urban park, street tree or near to natural area), and management needs. The restoration and creation of semi-natural habitats should enhance nearby ecological connections, across local and landscape scales. Key elements for successful adaptation of habitats include according to Lawton[24]: better quality through enhancing existing wildlife sites and habitats through management, restoration and creation of habitats; and bigger by buffering existing habitats and enhanced connections to nearby habitats.

[24] 2010 Lawton Report – Making Space for Nature
https://webarchive.nationalarchives.gov.uk/20130402170324/http:/archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf

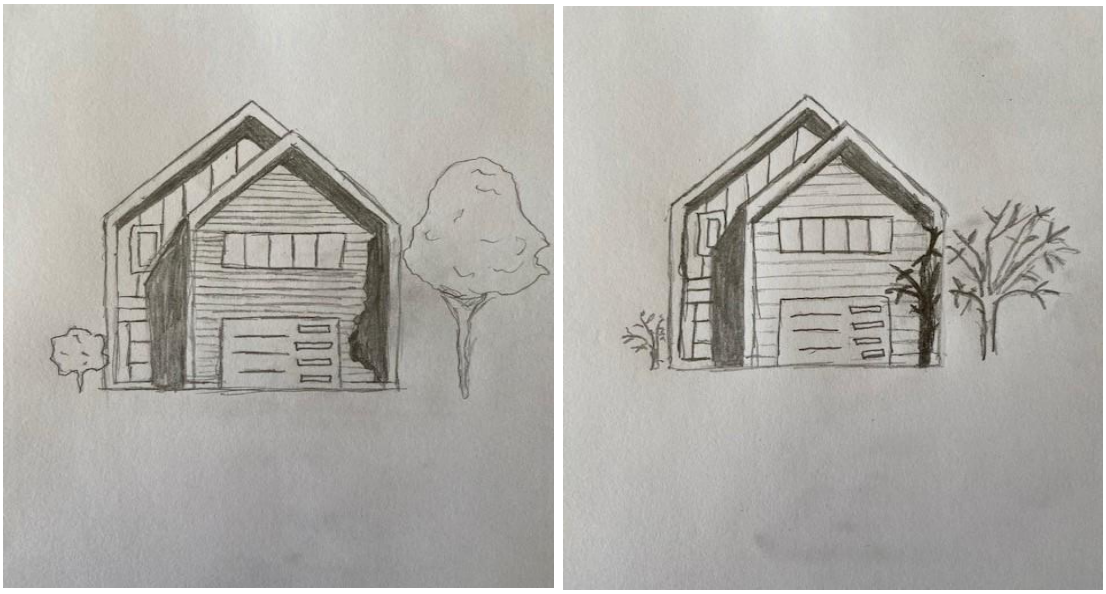


Figure 4: Deciduous trees provide natural shade in summer whilst allowing sunlight through in winter.

C) Key resources include:
Urban Tree Manual:
https://www.forestresearch.gov.uk/tools-and-resources/urban-tree-manual/
https://www.gov.uk/guidance/natural-environment

D) Urban parks and green corridors – The inclusion of urban green space not only creates healthier development, these also contribute to urban cooling and reduce run-off. The size of the greenspace is a key determinant: the bigger the greenspace, the greater the cooling effect, even some distance away. Other characteristics of greenspaces, which influence their cooling effectiveness, are their shape and density, the types of trees, shrubs and ground cover present in the greenspace, plant arrangement, the percentage of impervious area and topography. An increase in the ratio between perimeter and area of a greenspace, which increases the edge effect and the complexity of its shape, reduces the cooling intensity measured during the night. Adequate size of green space is approximately greater than 0.5 ha[25]. The integration of urban trees/ landscaping is also a key factor.

E) Sustainable Drainage Systems (SuDS) - SuDS seek to capture, delay or manage surface water flooding to copy natural drainage by adopting techniques that deal with surface water through collection, storage and filtering before it is released back into the environment. In addition to reducing flood risk from surface water flooding there are many benefits including a higher quality of environment, improved water quality and enhanced

[25] Forestry Research Note: The role of urban trees and greenspaces in reducing urban air temperatures Madalena Vaz Monteiro, Phillip Handley, James I. L . Morison and Kieron J. Doick, January 2019

biodiversity. The design of surface water drainage should be considered at the earliest possible stages of the planning process. Ground conditions, in particular permeability, need to be considered, although many SuDS measures are feasible without good infiltration e.g. storage in an underground reservoir (such as a crushed stone layer) before soaking into the ground. Circumstances where SuDS may not be reasonable include contaminated sites and brownfield sites with an existing drainage system. If SuDS cannot be provided on site, consideration should be given to making a contribution to off-site measures. The Construction Industry Research and Information Association (CIRIA) provides excellent guidance set out in their SuDs Manual 2015 (CD73)[26]. New guidance on adoption of SuDs by utilities companies is provided below[27].

Sustainable Urban Drainage Systems (SuDs)

Examples of types of SuDS include:

- Basins and ponds
- Permeable surfaces
- Filter strips and drains
- Swales

- SuDS measures should be maintained in perpetuity through suitable management arrangements, unless they form part of the highway network's drainage system.
- The design of SuDS should be multifunctional with opportunities for wildlife and recreation.
- One of the frequently cited barriers to SuDS is issues around adoption by water companies. However, water companies are now able to adopt SuDS provided they meet the definition of a sewer. For more information on this the reader is referred to the guidance in the footnote below

[26] https://www.ciria.org/ItemDetail?iProductCode=C753&Category=BOOK&WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91

[27] https://www.water.org.uk/wp-content/uploads/2020/01/Water-UK-SuDS-brochure.pdf

Best practice: Rain Garden, Ribblesdale Road, Sherwood, Nottingham

Type: Rain Garden

• Proven surface water capture and infiltration leading to reduced pressure on downstream sewer and watercourse.

• Increased understanding and awareness of the benefits of retrofit SuDS at a community and partner level.

This is a retrofit scheme to an existing Street, Ribblesdale Road a relatively quiet street with 67 properties. The road runs parallel to the Day Brook a heavily modified watercourse with relatively poor water quality as a result of diffuse pollution from its urban setting. This watercourse also poses a flood risk to a number of properties in the Nottingham area.

The schemes comprises 21 linear garden structures along the grass verge linked to the highway drainage system. Comprising top soil and stone filtration with void space underneath they have a capacity sufficient to manage water runoff from 5,500 sq. m of highway. The infiltration system also removes contaminants from motor vehicles washed off the highway. The scheme has greatly reduced the amount of surface water discharged on the downstream sewer and watercourse.

Source: Susdrain and Nottingham City Council

Photo of Rain Garden Ribblesdale Road, Nottingham

E) Allotments and community gardens and orchards – these are important in helping to reduce food mileage, improve healthy lifestyle choices and support community cohesion. Integrating community gardens and orchards within urban environments can offer both healthy living and biodiversity benefits.

F) Green corridors and walking and cycling routes – supporting the use of sustainable alternatives to car travel is a key element of sustainable design and layout. Building for Life 12 Standard provides guidance on how to assess and achieve this[28]. Integrating open space and green corridors into routes where people want and need to travel are key factors to consider. Often desire lines within developable sites give clues as to how an area is used and, where possible, this should be used to inform enhanced walking and cycling routes within and out of a new development. Designing open spaces that have natural surveillance reduces risk in anti-social behaviour developing. The quality of these routes is a key factor.

Best Practice: Sheffield's Green Roof Policy

Sheffield City Council Core Strategy Policy CS64 and Climate Change and Sustainability SPD Guideline CC1

Extract from Climate Change and Sustainability SPG Guidance 2011 (paragraph 4.1):

"Core Strategy policy CS64 deals specifically with climate change, resources and sustainable design. Paragraph 11.8 of the supporting text to this policy refers to the contribution of green roofs as a method of reducing surface water run-off, and highlights the link with policy CS67, which deals with flood risk management".

Guideline CC1 states that the green roof should cover at least 80% of the total roof area.

Sheffield has a strong track record of securing green roofs and has the highest number of green roofs of any UK city except for London. Notable in Sheffield is the development of green roofs which have high wildlife value and the green roof on Sharrow School has been designated as a Local Nature Reserve by Natural England. A number of other green roofs have been designed specifically to reduce run-off from the site and some to provide additional space for building users.

Source: Sheffield City Council

Further Information on the Sharrow School green roof is available from Sheffield University

https://sites.google.com/a/sheffield.ac.uk/green-roof-research/

[28] https://www.designcouncil.org.uk/resources/guide/building-life-12-third-edition

Sustainability Statement

5.38 Sustainability statements are submitted to the LPA at the planning application stage and not at the post planning stage in response to a condition. Sustainability Statements typically require the developer to consider all aspects of development form which can contribute to securing high standards of sustainable development from the outset, including but not limited to:

- Energy efficiency and carbon emissions of the building;
- Water conservation;
- Flood risk and drainage strategy;
- Transport;
- Health and Wellbeing including day-lighting analysis and thermal comfort;
- Material usage, wastage, responsible sourcing and environmental impact, including embodied carbon;
- Pollution issues, low NOx, low global warming potential (GWP), reducing need for mechanical cooling;
- Ecological aspects to enhance the proposed developments for flora and fauna; and
- Best practice management of the site.

Appendix 1:Local Plans

The various Local Plans contain a number of policies, which are intended to contribute to the low carbon agenda and are set out in the table below although this is not an exhaustive list as other policies may also contribute such as those relating to landscape and biodiversity. Information correct at time of writing.

Local Plan	Policy	Requirements
Broxtowe, Gedling and Nottingham Aligned Core Strategy ACS	The ACS includes a suite of strategic policies to successfully deliver sustainable development in the Plan Area to 2028. Policy 1: Climate Change includes policy principles: • Design and adaptation • Reducing Carbon emissions • Decentralised energy generation • Flood Risk	Includes the specific target for new development to achieve 105 litres/person/day of water No other specific requirements or targets are specified.
Erewash Core Strategy	Policy 1 (same as ACS Policy 1 above).	
Rushcliffe Core Strategy	Policy 2 (same as ACS Policy 1 above).	
Part 2 Local Plans with specific targets		
Nottingham City	CC1 Sustainable design and Construction CC2 Decentralised Energy and Heat Networks CC3 Water DE1 Building Design and Use DE2 Context and Place making	Energy efficient buildings – to achieve very good BREAM standards Sustainable design, grey water recycling, green roofs. Water consumption 110 litres per day per person Energy efficiency and low carbon energy generation above building regulations will be encouraged. Other than for water no specific standards

Table 2: Local Plans Nottingham Core Housing Market Area

Local Plan	Policy	Requirements
Ashfield District	2002 adopted Local Plan seeks to achieve sustainable development. Draft Local Plan anticipated to be published summer 2020	No specific standards
Bassetlaw District	Emerging Local Plan policy 13 seeks to maximise energy efficiency through design and orientation. Policy 14 supports proposals which maximise local opportunities for District heating and Decentralised energy.	No specific standards
Mansfield District	Policy P5 of the adopted Local Plan sets out a commitment to improving sustainability and environmental performance of all new development – with policies seeking influence design and layout. CC1 – CC4 promotes energy efficient development and requires SUDs	Other than SUDs no specific environmental standards
Newark & Sherwood District	Core Policy 9 requires new development to demonstrate a high standard of sustainable design. Requires development to be highly sustainable, capable of being accessible to all, to manage surface water and minimise waste and states that an SPD on sustainable design will be prepared.	No specific standards

Table 3: Local Plans in Nottingham Outer Housing Market Area

Appendix 2: Sustainability Checklist for Development

Note this checklist is intended as a guide only. The Midlands Energy Hub is preparing a Low Carbon Planning and Maintenance Checklist which is intended to be a practical tool to assist planners and expected to be available in 2021[29]

Sustainable Design, construction and climate change mitigation and adaptation

- Will the use of primary minerals be minimised e.g. in the use of renewable materials, recycled and secondary aggregates, and other recycled and reused materials?
- Will demolition/excavation material from the proposed works be re-used on site? Please provide details of where material will be derived and where they will be used.
- Will non-mineral construction waste (e.g. packaging, timber, plastics) be minimised?
- Will locally sourced materials be used?
- Will materials be sustainably sourced?
- Will the layout and design help to reduce the need to travel and promote use of non-private car modes of travel for example through good pedestrian and cycling connections and access to public transport;
- Has the layout of the site, landscaping and orientation of buildings taken account of solar gain and other environmental factors to reduce the need for mechanical heating and artificial lighting in the development?
- Will the internal layout of the buildings make best use of solar gain and natural light?
- Will operational energy demand be minimised through low energy design and the use of energy efficient fabric?
- Will passive cooling/ventilation measures be incorporated into the scheme?
- Will the scheme include mechanical cooling or air conditioning and if so why are passive measures not adequate?
- Will the scheme protect and enhance biodiversity and make provision for well-connected green and blue infrastructure on and off site

Water Efficiency

- If the scheme is for new dwellings will these be designed to the optional national standard of 110 litres of water per person per day?
- Will water efficiency measures such as low flush toilets or grey water recycling be incorporated into the scheme?

[29] Further information is available from the Regional Senior Projects Energy Officer, Midlands Energy Hub
Serena.Bacuzzi@nottinghamcity.gov.uk

- Will rainwater harvesting measures be included in the scheme?

Climate change adaptation

- Will the building be adapted to the full range of climate changes expected including hotter drier summers, warmer wetter winters, more frequent heatwaves and more frequent and severe heavy rainfall?
- Will soft landscaping and permeable surfaces be used instead of hard surfacing?
- Will sustainable urban drainage systems be incorporated. If not why not?

Energy

- Will the scheme include provision of low or zero carbon energy technologies, provide details of the type and location and energy yield?
- Will the development be located near a decentralised energy network?
- If the scheme is within the vicinity of a decentralised energy network will it be connected or connection ready?

Note: for information on assessing the energy rating of dwellings, the Standard Assessment Procedure for the Energy Rating of Dwellings (SAP) was developed by the Building Research Establishment (BRE). Guidance on calculations using the Standard Assessment Procedure (SAP) is available from the BRE website below [30] including:

- Energy consumption per unit floorspace
- CO_2 emissions by unit floor area
- The Dwelling Emission Rate (DER)

[30] https://www.designingbuildings.co.uk/wiki/Standard_Assessment_Procedure_SAP

Appendix 3: Standards

The Code for Sustainable Homes[31], which was mandatory if included in adopted local plans, has been wound down by Government on the basis that it intends to impose higher sustainability standards through a review of the building regulations. The code is no longer mandatory and is voluntary but provides a useful benchmark. In this context, the Ministerial Statement on Plan Making (March 2015) states that local authorities can set energy performance standards for new housing or the adaptation of buildings to provide dwellings, that are higher than the building regulations, but only up to the equivalent of Level 4 of the Code for Sustainable Homes.

Buildings are assessed during their design phase and after they have been constructed. Sustainability is measured against nine categories as follows:

- Energy and CO_2 emissions
- Water
- Materials
- Surface water runoff
- Waste
- Pollution
- Health and well being
- Management
- Ecology

Performance targets are set that are more demanding than the Building Regulations and independent assessment and certification process results in a star rating of 1 to 6 with the most sustainable being 6 or Level 6 of the Code for Sustainable Homes.

In 2015, the Home Quality Mark was established by the Building Research Establishment and is part of the BREEAM family. This works in a similar way to the Code for Sustainable Homes and BREEAM standards in independently accrediting new homes against a range of sustainability indicators resulting in a star rating of 1 to 5. This scheme is particularly aimed at the consumer to influence their choice of home and to encourage developers to differentiate themselves in the market place.

The BREEAM[32] standards are carried out by an independent assessor and scored against nine categories of environmental sustainability, which are weighted.

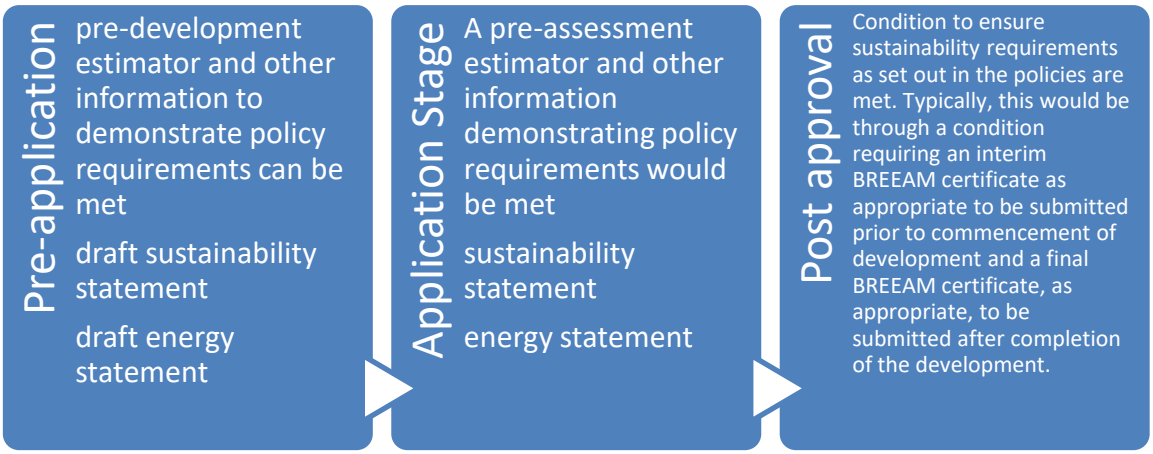
- Management
- Health and well-being

[31] https://www.designingbuildings.co.uk/wiki/Code_for_Sustainable_Homes
[32] https://www.breeam.com/

- Energy
- Transport
- Water
- Materials
- Waste
- Land use and ecology
- Pollution

The BREEAM assessment overall score is translated into one of the BREEAM ratings; unclassified, pass, good, very good, excellent or outstanding.

Diagram of BREEAM Process



Energyprong[33] is a set of zero carbon standards for the refursbishment of homes and for new build. The concept is that the standards can be achieved from funding saved in future lower energy bills and the budget for future maintenance and repairs.

Passivehaus Standards[34]
This uses the principle that a house can achieve sufficient indoor thermal comfort from post warming or post cooling of fresh air without the need for traditional heating

[33] http://www.energiesprong.uk

[34] https://www.designingbuildings.co.uk/wiki/Passivhaus

or cooling systems. The Passivhaus standard can be achieved by measures including:

- Shading.
- Pre-cooling of the supply air.
- Night purging.
- Natural ventilation.
- Ait-tightness.
- Mechanical ventilation heat recovery (MVHR).
- Insulation.
- Avoidance of thermal bridges.
- Passive solar gains.
- Exploitation of internal heat sources.

Appendix 4: Area Profile

Population, settlement and communications

1. There are around 823,000 people living in Nottinghamshire County and 330,000 in Nottingham City. Around two thirds of the overall population live in, or around, Nottingham, which is a major centre for employment and retail. The remainder live in, or close to, the other main towns of Mansfield, Kirkby in Ashfield, Sutton in Ashfield, Hucknall, Worksop, Newark and Retford. Outside these urban areas, the rest of the County is largely rural with scattered small villages, farmland, woodland and commercial forestry.

2. There are a number of nationally important roads links within the County as the area is connected to the M1 and the national motorway network via the A453 to junction 24, the A52 to junction 25 and the A610 to junction 26 and the A38 to Junction 28. The A52 provides a trunk road connection from Derby to Nottingham including to the A46, which runs between the M1 north of Leicester to the A1 at Newark. To the north of the County, the A614 links Nottingham to the A1 and A60 with wider links to Mansfield, which is also linked via the A617 to Newark.

3. Broadband ICT connectivity in Nottingham and Nottinghamshire is generally good. A new report has confirmed that Nottinghamshire is amongst the best places in the country for superfast broadband. The majority of properties can already access super-fast broadband but there is still a need for improvement especially in the more rural areas. An initiative called Better Broadband for Nottinghamshire is a £31m+ partnership between the County Council and a range of funding partners including Central Government, Openreach and the area's district, borough and City councils. The programme builds on the commercial rollout of fibre based broadband, which alone has provided superfast access to 86% of properties in Nottinghamshire. The Better Broadband for Nottinghamshire programme aims to bring superfast broadband to over 98% of the county by the end of 2020[35].

4. There are over 40 publicly available electric vehicle charging points in Nottingham and Nottinghamshire although more locations are under investigation according to data provided by the D2N2 LEP[36]. This excludes electric vehicle charging points at supermarkets. These available electric vehicle charging points tend to be concentrated within the main urban areas especially in Nottingham.

[35] https://www.nottinghamshire.gov.uk/business-community/better-broadband-for-nottinghamshire-programme/about-the-programme

[36] https://nottmcitycouncil.maps.arcgis.com/apps/webappviewer/index.html?appid=f0b7985e4ee945dab5c8d3770af7eaba

Employment

5. Nottinghamshire's economy generally compares well to the rest of the UK, and some of our urban areas are expected to be the focus of significant housing and commercial development in the future. However, there are wide inequalities in the rates of employment and income across the plan area, most notably in the former mining areas to the north and west and within parts of Nottingham. These areas can also experience inequalities in health, education and skills.

6. Mansfield, Worksop and Newark are important centres for warehousing and distribution whilst service, technology and research-based industries tend to cluster in around Nottingham. The energy industry also has a role with five[37] power stations along the River Trent, however, coal powered power stations are due to close or be replaced by 2025. Elsewhere, agriculture and forestry are no longer major employers but still make up much of the County's rural landscape.

7. As a regional economic hub, Nottingham City is the main work destination for the majority of residents living within the city and surrounding areas. Around 226,000 people are employed within Nottingham City. In and around Nottingham there is a strong focus for pharmaceuticals and optical goods, manufacturing, ICT technology and finance and banking.

Flood Risk

8. Flood risk, particularly in the Trent Valley and along its tributaries, presents planning and environmental issues, which is a significant constraint to most forms of built development. The expected impact of future climate change could result in higher rainfall and more extreme flood events.

Green Infrastructure

9. The area is characterised by a network of Green and Blue infrastructure network especially along the River Corridors of the Trent and Idle Valleys and their associated restored former sand and gravel mineral workings providing a rich water environment. The Sherwood Forest and the Greenwood Forest cover large parts of the area. There are numerous Historic Parks and Gardens including the Dukeries in the more northern parts of the area.

Air Quality

10. There are seven Air Quality Management Areas in Nottingham City and Nottinghamshire all in the Greater Nottingham area including one, which covers the whole of Nottingham City.

[37] Including the 400 mw energy plant at Cottam

11. The East Midlands Air Quality Network Air Quality and Emissions Mitigation Guidance for Developers 2019[38] identifies the mortality burden of exposure to human-made air pollution is estimated as an annual effect equivalent to between 28,000 and 36,000 deaths a year, with an associated loss of life of between 328,000 and 416,000 years. For the East Midlands, it has been estimated as an annual effect equivalent to 2,314 deaths, with an associated loss of years of life of 24,016 life years attributable to particulate air pollution.

Area	Recent Trend	Count	Value	95% Lower CI	95% Upper CI
England	-	-	5.2	-	-
East Midlands region	-	-	4.9	-	-
Leicester	-	-	5.6	-	-
Northamptonshire	-	-	5.3	-	-
Nottingham	-	-	5.2	-	-
Derby	-	-	5.0	-	-
Lincolnshire	-	-	5.0	-	-
Leicestershire	-	-	4.9	-	-
Rutland	-	-	4.9	-	-
Nottinghamshire	-	-	4.7	-	-
Derbyshire	-	-	4.3	-	-

Table 4: Fraction of Mortality Attributable to particulate air pollution

12. Data from Public Health England shows that the mortality rate attributable to particulates for Nottinghamshire is below the East Midlands and national averages. Nottingham City reflects the national average but is above that of the East Midlands. Guidance on mitigation for air pollution is set out in the The East Midlands Air Quality Network Air Quality and Emissions Mitigation Guidance for Developers 2019[39]

Energy Consumption

13. The three main sectors consuming energy are shown above which shows that the domestic sector within Nottingham and Nottinghamshire consumes most energy at 35%. This is slightly higher than the East Midlands and UK percentages of 31%. The other sectors are transport and industrial & commercial activities. In terms of Carbon Dioxide emissions, the transport sector is the largest contributor at 37% with domestic emissions at 31% as shown on the pie chart below. Almost all of these emissions are from motor

38 https://www.gedling.gov.uk/resident/planningandbuildingcontrol/planningpolicy/adoptedlocalplanandpolicydocuments/supplementaryplanningdocumentsandguidance/

39 https://www.gedling.gov.uk/resident/planningandbuildingcontrol/planningpolicy/adoptedlocalplanandpolicydocuments/supplementaryplanningdocumentsandguidance/

vehicles using motorways and roads contributing 97% of transport CO2 emissions in Nottinghamshire and Nottingham City.

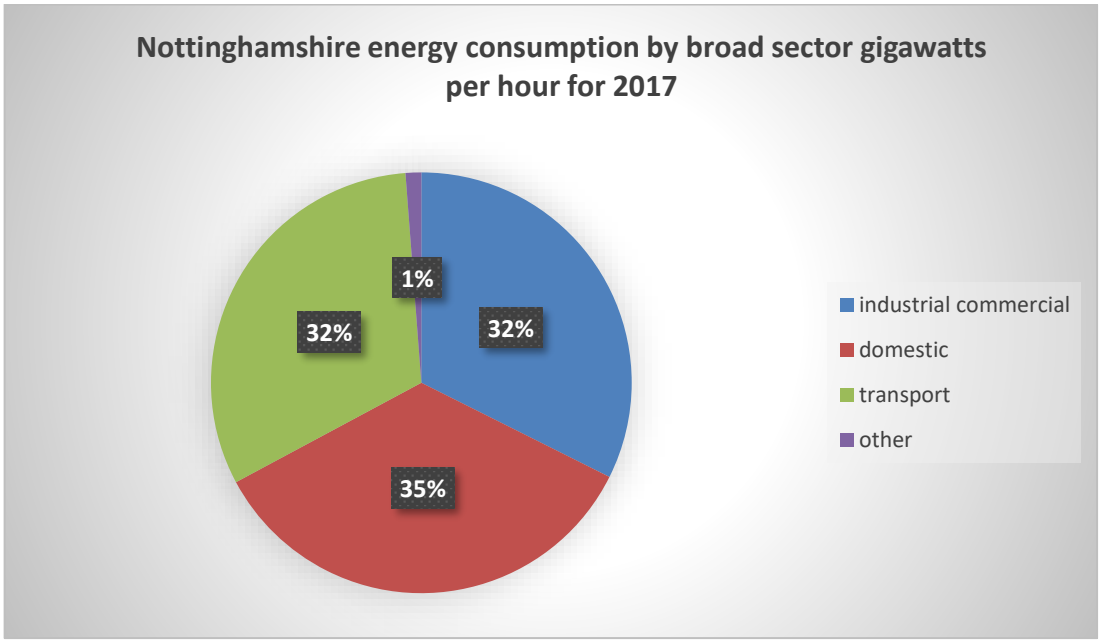


Figure 5: Energy Consumption in Nottingham and Nottinghamshire[40]

Carbon Dioxide Emissions

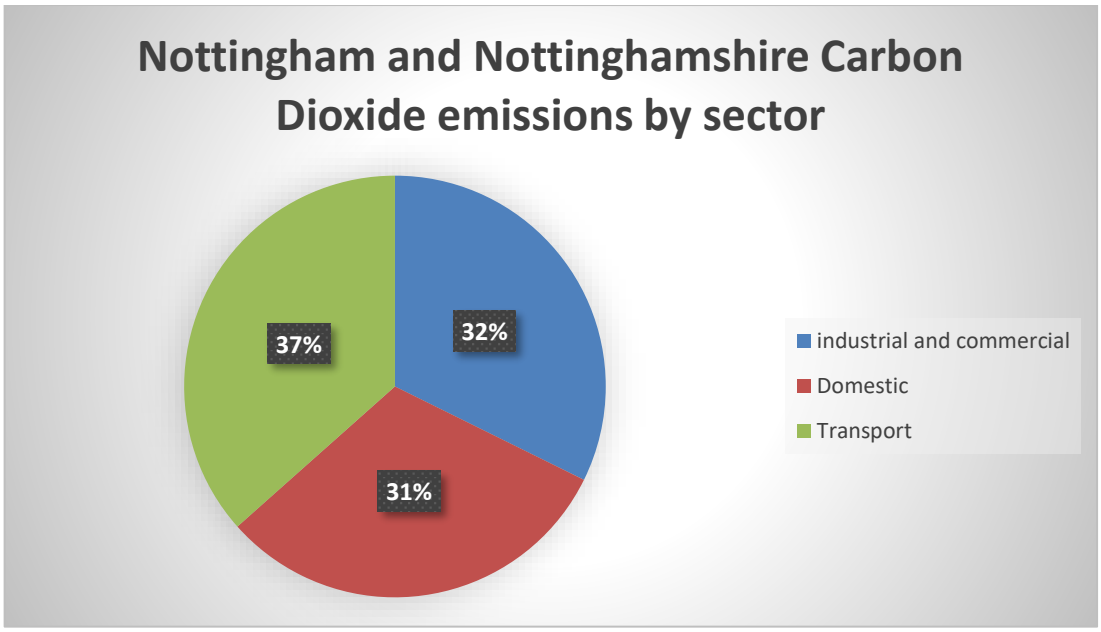


Figure 6: Carbon Dioxide Emissions Nottingham and Nottinghamshire

[40] https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2017

14. It is clear that positive step changes make a difference. There has been a significant fall in Carbon Dioxide emissions per person between 2005 and 2017 for both Nottinghamshire (-29%) and especially for Nottingham City (-49%) compared to the East Midlands average of -28% (see table below). These trends are due to significant reductions in both industrial/commercial and domestic sectors largely due to the decrease in the use of fossil fuel to provide electrical power to industrial/commercial premises and homes. Nottingham City also witnessed a significant drop in emissions from the transport sector of about 13% during a period when there has been considerable investment in "cleaner" public transport services in the City.

Carbon Dioxide emissions per capita Kt Co2 eq.			
	2005.0	2017.0	% reduction
Nottingham	7.0	3.6	-48.6
Nottinghamshire	8.2	5.8	-29.3
Total			

Table 5 Carbon Dioxide emissions per capita Nottingham City and Nottinghamshire 2005 - 2017[41]

House Energy Rating

Energy Rating New Build 2008 - 2019									
Local Authority	A	A %	B	B%	C	C%	D-G	D-G %	Total
Ashfield	3	0.07	2755	66	1300	31	77	1.8	4135
Bassetlaw	10	0.3	2064	63	1120	34	102	0.3	3296
Broxtowe	9	0.51	1298	74	357	20	86	4.9	1750
Gedling	6	0.17	2303	66	1093	31	101	2.8	3503
Mansfield	15	0.56	1474	55	1161	43	47	1.7	2697
Newark and Sherwood	23	0.53	2923	67	1221	28	207	4.7	4374
Nottingham City	279	4.48	3590	58	1650	27	704	11.1	6223
Rushcliffe	27	0.65	3187	77	829	20	85	2.0	4128
Nottinghamshire Including Nottingham City	372	1.4	19594	65	8731	29	1409	4.6	30106
Nottinghamshire Districts	93	0.39	16,004	67	7,081	30	705	2.9	23,883
National		1							

Table 6: Energy Rating New Builds (figures do not sum due to rounding).

Source: https://epc.opendatacommunities.org/domestic/search

[41] https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2017

15. The house energy rating (HER) is a standard measure of comparison between the relative energy efficiency of homes. The national target is for new homes is to be at least rated C by 2030. This shows that the majority (97%) of new homes built between 2008 and 2018 met the national target. However, only a very small percentage were rated A class with the bulk of these being built in Nottingham City. For all Councils 3% of new homes achieved rating below C with Nottingham City having the highest share at 11%.

Glossary

Aerosols - are defined as microscopic liquid or solid particles that enter the atmosphere through natural and man-made processes. Aerosols are more complicated than the typical greenhouse gas.

Air tightness - Air leakage is measured as the rate of leakage per m2 of external envelope per hour at an artificial pressure differential through the envelope of 50 Pa. i.e. x m3/hr/m2@50Pa.

Anthropogenic emissions - environmental pollution and pollutants originating in human activity such as anthropogenic emissions of sulphur dioxide.

BREEAM Standards - widely used means of reviewing and improving the environmental performance of buildings. BREEAM assessment methods generally apply to commercial developments (industrial, retail etc).

Building for Life: a tool for assessing the design quality of homes and neighbourhoods in England, comprising 20 criteria, to assess the design quality of new housing developments.

Building Regulations: building regulations in the United Kingdom are statutory instruments or statutory regulations that seek to ensure that the policies set out in the relevant legislation are carried out. Building regulations set out required standards for building work and materials and Building Regulations approval is required for most building work in the UK. Part L sets standards for the energy performance of new and existing buildings.

Carbon Neutral - is a building with zero net energy consumption, meaning the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on the site, or by renewable energy sources elsewhere. These buildings consequently contribute less overall greenhouse gas to the atmosphere than similar buildings. They do at times consume non-renewable energy and produce greenhouse gases, but at other times reduce energy consumption and greenhouse gas production elsewhere by the same amount.

Carbon Off-setting - Carbon offset means the increased carbon dioxide emissions from a new development are balanced by savings in carbon dioxide elsewhere, by making payment into a carbon offset fund.

Climate change: long-term changes in temperature, precipitation, wind and all other aspects of earth's climate. It is often regarded as a result of human activity and fossil fuel consumption.

Climate change adaptation - Adjustments to natural or human systems in response to actual or expected climatic factors or their effects, including from changes in rainfall and rising temperatures.

Climate change mitigation - Action to reduce the impact of human activity on the climate system, primarily though reducing greenhouse gas emissions.

Dwelling Emissions Rate (DER) - The DER is the estimated carbon dioxide emissions per m2 per year (Kg/CO2/m2/year) for the dwelling, as designed. It accounts for energy used in heating, fixed cooling, hot water and lighting.

Embedded Carbon - refers to the GHG emissions associated with the manufacturing, maintenance, and decommissioning of a structure. It has been estimated that approximately 20% of GHG emissions are embodied in. the construction sector.

Greater Nottingham: made up off the administrative areas of Broxtowe, Erewash, Gedling, Nottingham City and Rushcliffe Councils and the Hucknall part of Ashfield Council.

Green and Blue Infrastructure: a network of multi-functional greenspace, water resources, urban and rural which is capable of delivering a wide range of environmental and quality of life benefits and can include parks, open spaces, playing fields, woodlands, wetlands, grasslands, river and canal corridors, allotments and private gardens.

Green house gases - The greenhouse effect is a warming of Earth's surface and the air above it. It is caused by gases in the air that trap energy from the Sun. These heat-trapping gases are called greenhouse gases. The most common greenhouse gases are water vapour, carbon dioxide, and methane.

Infrastructure: facilities and services to meet the needs of the existing community and to meet the needs of new development. Includes transport infrastructure, public transport, education, health, affordable housing, open space, community facilities etc.

International Inter governmental commission on climate change: is the leading international body for the assessment of climate change, and a source of scientific information and technical guidance for Parties to the United Nations Framework Convention on Climate Change (UNFCCC), its Kyoto Protocol and Paris Agreement. The IPCC prepares comprehensive Assessment Reports about knowledge on climate change, its causes, potential impacts and response options. The fifth Assessment was published in 2014 and the Sixth is anticipated in 2022.

Local Plans: plans for the future development of the local area, drawn up by the local planning authority in consultation with the community. The current Aligned Core Strategies forms Part 1 of the Local Plan. Part 2 Local Plans include site allocations and development management policies.

Local Enterprise Partnership (LEP): a partnership body designated and established to determine economic priorities, drive sustainable economic growth and create jobs. Various funding streams are determined by the LEP. The D2N2 LEP covers Nottinghamshire and Derbyshire.

National Planning Policy Framework (NPPF): document setting out the Government's planning policies for England and how these are expected to be applied.

Standard Assessment Performance (SAP) - The Standard Assessment Procedure for the Energy Rating of Dwellings (SAP) was developed by BRE based on the BRE Domestic Energy Model (BREDEM) and was published by Building Research Establishment (BRE).

Sustainability Appraisal: examines the social, environmental and economic effects of strategies and policies in a local plan.

Sustainable development: The NPPF defines this as follows: "at a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs".

Renewable energy: includes energy for heating and cooling as well as generating electricity. Renewable energy covers those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of the oceans, from the sun and from biomass and ground heat.

Target Emission Rate – The **target** CO2 **emission rate** (TER) sets a minimum allowable standard for the energy performance of a building and is defined by the annual CO2 **emissions** of a notional building of same type, size and shape to the proposed building. TER is expressed in annual kg of CO2 per sq m.

U Value - The U-value is a measure of how readily heat will flow through the structure, and describes how much energy in Watts (W) can pass through 1m2 of material from inside to outside at a temperature differential of 1 Kelvin (K), or 1°C.