ARUP

Wokingham Borough Council

Local Plan Update Climate Change Evidence Base

Final Report

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Contents

Executive Summary

In 2018 the Intergovernmental Panel on Climate Change (IPCC) released a Special Report 15 (SR15)[1] which outlined advice that global temperature increases should be limited to below 1.5ºC and that action would be needed to reduce global greenhouse gas emissions by over half of their 1990 levels in just over a decade (by 2030). The targets are challenging, but the benefits are clear. Change now will help globally, halting rising global and sea temperature rise and preventing regular severe weather events. Locally, action responding to the challenge of climate change will benefit communities by avoiding flood damage costs, enhancing green spaces and improving air quality, lowering energy bills and reducing fuel poverty, and creating new jobs in the green economy.

In response to the call for international and national action, Wokingham Borough Council (WBC) declared a climate emergency in July 2019, committing itself to playing as full a role as possible in reducing the borough's carbon footprint to net carbon zero by 2030. WBC's Community Vision is for Wokingham Borough (hereafter referred to as Wokingham) to be 'A great place to live, learn, work and grow and a great place to do business.' Wokingham is already recognised as a great place to be today - most recently achieving national acclaim as England's 'healthiest place'.[2] But WBC has acknowledged that to become a 'Clean and Green Borough', addressing climate change needs to be at the forefront of everything it does. In WBC's Corporate Delivery Plan, success in this endeavour is summarised as the WBC being recognised as a "flagship authority in addressing the causes and impacts of climate change."

WBC is in the process of reviewing and updating its planning policies through the preparation of a new Local Plan (referred to as the Local Plan Update or LPU) which will replace the existing Core Strategy and Managing Development Delivery local plans. A LPU Draft Plan was published for consultation in February 2020. This set out proposals for the provision of a minimum of 13,900 new homes over the plan period to 2036, focused primarily on a series of strategic development locations. An updated Draft Plan (Right Homes, Right Places – Revised Growth Strategy[3]), published for consultation between November 2021 and January 2022, proposes a minimum of 15,513 net additional dwellings over an extended plan period (April 2018 to March 2038).

The LPU process provides the opportunity for an integrated approach in the management of new development to carbon reduction, low carbon transport, landscape enhancement, biodiversity net gain, and flood risk management.

This report has assessed Wokingham's emissions profile and future climate hazards. The baseline concludes that Wokingham, as with the rest of the UK, is likely to face significant changes in climate over the next sixteen years and beyond. Notably for the region this includes prolonged periods of extreme heat and cooling, and reduced precipitation during summer months. Conversely, in the winter it is likely that precipitation levels will increase and coupled with greater development, this could compound the potential for surface and fluvial flooding. This Climate Change Evidence Base (the Evidence Base) is therefore intended to provide the evidence to justify planning policy concerning climate change impacts within the WBC LPU. Through an extensive review of relevant literature, policy and best practice, along with consultation, baselining and identifying local opportunities and testing of proposed policy, the study provides recommendations on progressive standards for new development.

The Evidence Base aspires for as ambitious a commitment as viability and feasibility allows. It demonstrates the need for WBC to implement policies through its LPU to reduce emissions generated within the borough to net zero levels by 2030. Broadly, net zero means reducing greenhouse gas emissions to the lowest levels

[1] IPCC (2018) Special Report 15 (SR15), https://www.ipcc.ch/srccl/, accessed 05/08/20

[2] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/datasets/healthindexengland, accessed 05/08/20

[3] Wokingham Borough Council (2021) Right Homes, Right Places – Revised Growth Strategy, Revised Growth Strategy consultation - Wokingham Borough Council, accessed 12/05/22

possible and offsetting those emissions that cannot be reduced any further through, for example, tree planting and funding energy efficiency retrofits of the existing housing stock.

The WBC Draft Plan (2020) already signals clear intent to reduce the greenhouse gas emissions associated with new development across Wokingham. Many of its policies reflect best practice, for example around carbon neutral homes (Policy DH9), the higher water efficiency standard in homes (Policy DH9) and specifying BREEAM 'Excellent' standard for non-residential major development (Policy DH8). However, informed by a review of best practice planning policy and industry experience, this Evidence Base makes targeted recommendations for improvements in LPU policy where applicable.

The key recommendations for future iterations of LPU policy are:

[1] Replace reference to 'carbon neutral' in Policy DH9 with 'net zero'. While the two terms are widely used synonymously, they can indicate different approaches to balancing emissions. The emphasis with 'net zero' is on reducing emissions first and foremost.

[2] Include explicit references to the Future Homes Standard (FHS) in Policy DH9. Include the higher[4] FHS emissions reduction target in the LPU viability assessment for both minor and major residential development, seeking to 'leapfrog' the interim FHS target applicable between June 2022 and 2025. For major residential development, the requirement to be designed to achieve net zero should remain.

[3] Recognise that different definitions of 'net zero' refer to reducing different types, or combinations of types, of emissions. The most appropriate definition for the local plan must focus on the emissions which planning has greatest power to influence. The current legislative and policy framework for planning allows for targeted reductions in regulated emissions arising through the use (operation) of buildings. Regulated emissions are those arising from the use of energy sources from fixed building services and fittings and are regulated by Building Regulations. However, as illustrated in Figure 1, regulated operational emissions account only for those emissions arising during one stage of a building's lifecycle.

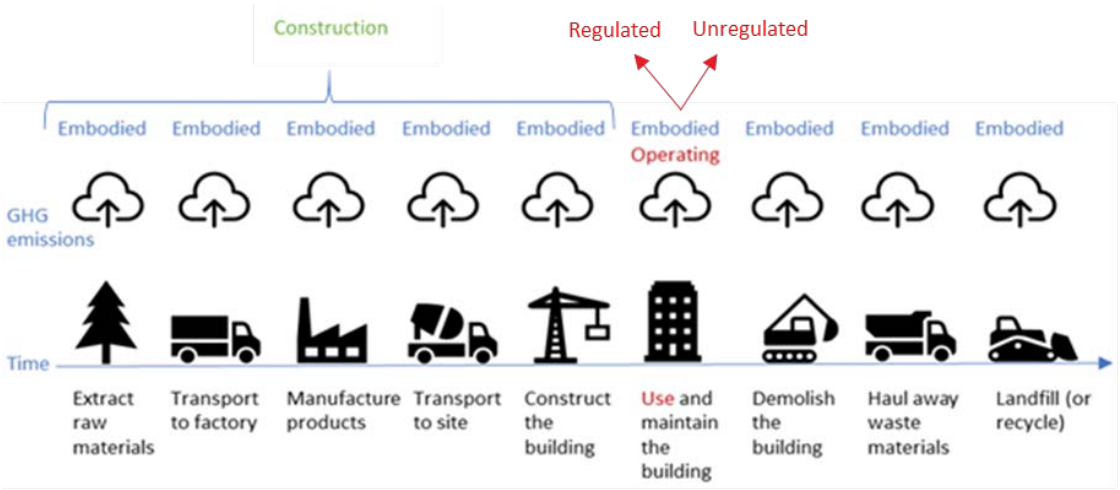


Figure 1: Types of emissions across building lifestyle stages (Source: adapted from C40 Cities)

[4] Recognising that operational emissions are only some of the emissions generated through new development (Figure 1), amend Policies DH8 and DH9 to require major development applications to submit an assessment of emissions across the entire life cycle of a building ("whole life cycle assessment"), demonstrating steps taken for their reduction. This assessment would be submitted as part of the Sustainability Statement. Treat this as a material factor, stating that strong performance in this matter will be weighed favourably in the planning balance. Embodied emissions – i.e., those

[4] 75-80% reduction on Part L Building Regulation emissions from 2025

emissions arising across the whole life-cycle of a building, from construction through to deconstruction and disposal – need to be recognised. At present, Policy DH9 includes a requirement for major residential development to be 'carbon neutral'. This applies only to regulated (operational) emissions. The LPU cannot set such a requirement for unregulated emissions (the energy consumption from systems in buildings, such as cooking appliances, IT equipment and refrigeration), nor for the embodied emissions. However, whole life cycle assessments require applicants to consider all emissions (Figure 2), sending a clear signal to developers that WBC will not overlook embodied emissions.

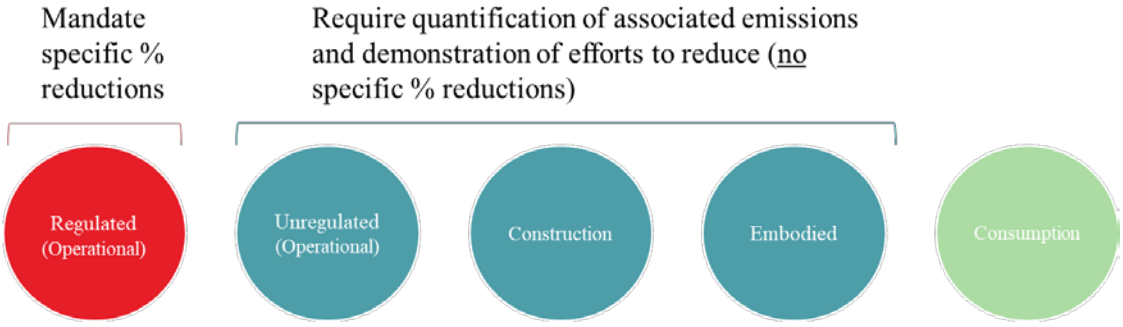


Figure 2: Illustration of Proposed Policy Approach to Dealing with Emissions

[5] For non-residential buildings, increase the energy standards for both major and minor development in Policy DH8 to be either in line with the Future Buildings Standard (entering into effect from June 2022), or – preferably due to the wider reach of BREEAM – BREEAM 'Excellent'. The BREEAM 'Very Good' reference should be removed, as this does not achieve the minimum 27% carbon reduction required of new development by the interim Future Buildings Standard.

[6] Include a specific policy to encourage the adoption of circular economy principles in all planning applications. Cross-reference the circular economy with embodied emissions, explaining that the re-use and recycling of materials, as well as modern methods of construction, are an important means of reducing emissions across the whole life cycle of a building.

[7] Continue with proposed requirement for developers to submit a Sustainability Statement where appropriate, demonstrating compliance with sustainable design standards, water efficiency, waste reduction and management, biodiversity net gain and renewable energy generation (amongst others). Include proposed requirement for whole life cycle carbon assessments. Publish explanatory Sustainable Design and Construction SPD.

[8] Carbon offset should be treated as a last resort measure for when on-site carbon savings measures have been maximised and where a development demonstrates that net zero carbon cannot be met on-site. The funds can be used to deliver a range of projects identified across Wokingham, ideally focusing on opportunities to cross-subsidise the interventions identified in the WBC Climate Emergency Action Plan.

[9] Various opportunities for standalone renewable and low carbon energy schemes across the borough have been identified. This includes opportunities for ground and roof mounted solar PV and two district heat network zones. Site feasibility studies will support the allocation of sites for solar in the LPU and the designation of Priority Heat Network Zones.

1. Glossary

The definitions set out below have been derived from the Intergovernmental Panel on Climate Change Special Report: Global Warming of 1.5° C Glossary[5], with the exception of those for the 'Future Homes Standard', 'Future Buildings Standard' and 'Passivhaus'.

Table 1: Glossary of terms

Term	Definition
Adaptation	A process or action of change that can be undertaken to better suit your environment
Baseline emissions	The greenhouse gas emissions that were emitted in the reference year against which you are reducing
Business as Usual scenario	A scenario of emissions change that assumes the implementation of no new policies
Carbon capture, utilisation and storage	A process in which CO_2 is captured and then either stored or used to produce a new product for long term removal from the atmosphere
CO2e	The amount of carbon dioxide (CO_2) that would be emitted to cause the same global warming impact as the total emitted mixture of Greenhouse Gases
Cumulative emissions	Total Greenhouse Gases emissions given out over a time period
Ecosystem services	Ecological process, systems and products that hold value for communities
Future Buildings Standard	Changes to the minimum energy efficiency standards for non-residential buildings. An interim uplift from June 2022 will require new buildings to produce 27% less (regulated) emissions compared to current Building Regulation standards. From 2025, new non-residential buildings will need to be "zero-carbon ready", with a full technical consultation on what this means starting in 2023.
Future Homes Standard	Changes to the minimum energy efficiency standards for residential buildings. All new homes built from 2025 will produce 75-80% less (regulated) carbon emissions than homes delivered under current regulations. From June 2022, an interim target of 31% applies.
Greenhouse gas emissions (GHGs)	Natural and anthropogenic gases that absorb and emit radiation within the spectrum that causes warming.
Mitigation scenario	A plausible scenario for the future which presents the emissions reductions from undertaking mitigating action
Net zero emissions	When anthropogenic emissions given out are balanced by the anthropogenic emissions that are removed over a specific period
Passivhaus	Passivhaus is a sustainability standard and methodology for low energy buildings. A Passivhaus uses 90% less energy to heat/cool than does an average home and 75% less than is standard practice for the average UK new build.
Representative Concentration Pathways (RCPs)	An RCP is a greenhouse gas concentration trajectory. The IPCC uses four different 21st century pathways as input to a range of climate model simulations to project their consequences for the climate system
Scope 1,2,3 emissions	Categories of emissions related to activity type. Scope 1 emissions are the direct emissions arising from the use of fuels, scope 2 emissions are indirect from the generation of

[5] IPCC, 2018: Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press

Term	Definition
	purchased electricity, and scope 3 emissions are further indirect emissions that are produced outside the boundary of an area for the purpose of providing services to that area
UKCP 18 projections	UK Climate Projections published in 2018 is a climate analysis tool which provide climate projections for the UK as a local, regional and global level[6]
United Nations Framework Convention on Climate Change (UNFCCC)	The Convention's ultimate objective is the 'stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.'
Urban heat island effect	The effect whereby urban areas are significantly warmer than their surrounding rural areas. One cause is the relative lack of bare earth and vegetation in urban areas, meaning that less energy is used up evaporating water, less of the sun's energy is reflected and more heat is stored by buildings and the ground in urban areas. The heat generated by heating, cooling, transport and other energy uses also contributes, as does the three-dimensional structure of the urban landscape which 'traps' heat

2. Introduction

2.1 Background

Ambitious international carbon reduction commitments have been agreed under the Paris Agreement in 2016 which outline that in order to avoid the worst impacts of climate change, it is vital to secure the increase in the global average temperature to well below 2ºC above pre-industrial levels. In addition, in 2021 the IPCC released their Special Report 15 (SR15) which outlined advice that global temperature increases should be limited to below 1.5 ºC and that action would be needed to reduce global greenhouse gas emissions by over half of their 1990 levels in just over a decade (by 2030). In 2021, the IPCC AR6 Climate Change 2021: The Physical Science Basis found that it was unequivocal that human influence has warmed the atmosphere, ocean and land.

In response to international commitments, the UK Government have set out their legal commitments and obligations relating to climate change. The national legislative context is underpinned by the Climate Change Act (2008), which introduced a statutory target for the UK to reduce Greenhouse Gas emissions by 80% by 2050. In June 2019, the Climate Change Act 2008 (2050 Target Amendment) Order amended this target to a 100% reduction (or net zero) by 2050.

In the policy environment, section 14 of the National Planning Policy Framework (NPPF) considers the role of planning in dealing with climate change and flood risk, noting the role of the planning system in supporting the transition to a low carbon future in a changing climate. Footnote 53 of paragraph 153 goes on to note that planning policies should be in line with the objectives and provision of the Climate Change Act 2008.

On the 18th of July 2019, Wokingham Borough Council (WBC) declared a Climate Emergency. Through this, WBC has committed itself to playing as full a role as possible in achieving a carbon neutral Wokingham Borough by 2030. In support of the declaration, a Climate Emergency Action Plan (CEAP) has been prepared. The CEAP sets out actions that WBC intends to take to meet its net zero carbon ambitions by 2030.

WBC are currently undertaking a review and updating its planning policies through the preparation of a new local plan - known as the Local Plan Update or LPU. Once adopted, the LPU will set out the ambitions for future development of Wokingham Borough (hereafter referred to as Wokingham) over the next 15 years. A robust study is required to support ambitious planning policies relating to climate change to align with corporate priorities and national legislations and policies. The future growth of Wokingham through new development has the potential to impose a large environmental footprint in terms of consumption of

[6] The Meteorological Office, 2018. UK Climate Projections.

resources and materials, the use of energy and the associated emissions of greenhouse gases that contribute towards climate change. Ambitious policies for new development are required to successfully move towards a net-zero carbon emissions future. This study is intended to fully evidence and justify planning policy for the full plan period.

2.2 Purpose and Structure of Study

The WBC Local Plan Update Climate Change Evidence Base has been commissioned to identify opportunities to embed ambitious climate change and renewable energy considerations into the local planning process, thereby supporting WBC's wider action on climate change.

The scope of the study involved the following key steps:

Undertaking a context review of legislation, policy and guidance to set the context for the study and development of policy (**Chapter 3**)

Examining the emissions profile and climate risk scenarios for Wokingham (**Chapter 4**)

Undertaking a review of best practice guidance and of best practice local authority policies to provide support for the development of policy (**Chapter 5**)

Identifying where local planning policy is less adept at managing GHG emissions in the built environment (**Chapter 6**)

Producing a Position Statement on the role and remit of the local plan in addressing climate change (**Chapter 7**)

Defining 'net zero' for the local plan (**Chapter 8**)

Review of appropriate energy standards for residential and non-residential development that new development must achieve, including opportunities for on-site renewables and low carbon technologies (**Chapter 9**)

Identifying opportunities to promote sustainable design and construction beyond energy performance and low carbon supply (**Chapter 10**)

Analysis of renewable energy capacity including supporting and enabling renewable and low carbon energy, and community led energy schemes (**Chapter 11**)

Identifying circular economy principles in local planning policy (**Chapter 12**)

Summarising policy recommendations to guide policy making for the Local Plan, drawing on the evidence and best practice from the study (**Chapter 13**).

This Evidence Base focusses primarily on the potential interventions through land use planning for net zero carbon development, sustainable building design and renewable energy. Where relevant information has been highlighted for wider policy agendas, such as green infrastructure, transport and flood risk, these have been presented to provide added value and to feed into work being undertaken on parallel commissions to support wider policy development on these topics. Similarly, this commission does not seek to provide evidence or advice for wider action on climate change outside of land use planning.

The study is supplemented with a series of technical appendices which provide further detail.

3. Literature Review

3.1 Methodological Approach

The literature review focusses on legislative and policy drivers relevant to embedding climate change and renewable energy into the local planning process. The aim of the literature review is to identify and summarise the legislative and policy parameters for local planning authorities in England when devising new policy to address the climate emergency. This exercise therefore forms an evidence base underpinning planning policy development by WBC as part of their local plan process. The Literature Review section below summarises the findings at each scale.

3.2 Drivers for Change

Climate change has become a defining issue of our times, gaining significant attention on an international stage. Whilst it is a long-term challenge, it is clear that significant action needs to be taken now, at scale and pace, to address the causes and effects of climate change and shape how it will impact on people, the economy and the environment into the future.

Ambitious international carbon reduction commitments were agreed under the Paris Agreement, signed in 2016[7]. This outlined that to avoid the worst impacts of climate change, it is vital to limit the increase in the global average temperature to well below 2ºC above pre-industrial levels. Subsequently, in 2018 the Intergovernmental Panel on Climate Change (IPCC) released their Special Report 15 (SR15)[8], which outlined that latest science indicated that 1.5 ºC was a more realistic target and that action would be needed to reduce global greenhouse gas emissions by over half of their 1990 levels in just over a decade (by 2030).

With the built environment responsible for approximately 40% of the UK's total carbon emissions[9], the planning system is a vital tool for ensuring that future development does not impede national emissions reduction efforts. Planning can create places suitable for low-carbon lifestyles and that are resilient to the unavoidable risks of climate change. It is also the gateway to gaining consent for the low-carbon technologies that are needed to power society now and over the coming decades.

The IPCC's report, and growing international activism, has led to the UK Parliament, the European Union Parliament, and numerous local Governments across the world declaring climate emergencies. WBC has declared a climate emergency in recognition of the pressing need to address climate change, together with more than 500 local councils across the UK (as of April 2021).

In advance of the UK hosting the 26th United Nations Climate Change Conference of the Parties (COP26) in November 2021, the UK Government accelerated its action towards meeting the goals of the Paris Agreement, committing to reduce greenhouse gas emissions by 78% by 2035.

3.3 Why is policy relevant?

There are a significant number of intersecting legislations and policy which impacts on the planning regime for climate change. Local authorities need to comply with these, while recognising their duty to balance local growth with the health of the global environment. The following review discusses the priority legislative and policy framework that introduce how and why local authorities can proactively plan to mitigate and adapt to climate change.

[7] United Nations (2016) The Paris Agreement, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement, accessed 23/04/21

[8] IPCC (2018) Special Report 15 (SR15), https://www.ipcc.ch/srccl/, accessed 23/04/21

[9] World Green Building Council (2019) Bringing Embodied Carbon Upfront: Coordinated Action for the Building and Construction Sector to Tackle Embodied Carbon, https://www.worldgbc.org/sites/default/files/WorldGBC_Bringing_Embodied_Carbon_Upfront.pdf, accessed 12/05/21

3.4 National Context

3.4.1 National Legislation

The UK Government has legally committed to reducing greenhouse gas emissions to net zero.

The UK Government have set out their legal commitments and obligations relating to climate change. The national legislative context is underpinned by the Climate Change Act (2008)[10], which introduced a statutory target for the UK to reduce greenhouse gas emissions by 80% by 2050. This has since been updated in June 2019 under the Climate Change Act 2008 (2050 Target Amendment)[11] Order to a 100% reduction (or net zero) by 2050. The current legislation allows for a limited amount of greenhouse gas emissions to be addressed through offsetting to meet the net zero target, e.g., through removal of carbon from the atmosphere and/or trading in carbon units. The Climate Change Act places obligation on central Government (but not local Government) to prepare policies to meet these targets.

In order to reach emissions targets, the Climate Change Act established carbon budgets within the UK. Carbon budgets are a cap on the amount of carbon the country can produce, set in 5-year periods. This is a stepped target in which the budget gets progressively tighter. The UK has succeeded in meeting the first two budgets and is on track to meet the third budget set for 2018- 2022 (a 37% reduction). In April 2021, the UK Government announced it will set in law the world's most ambitious climate change target for its sixth Carbon Budget (2033 to 2037), cutting emissions by 78% by 2035 compared to 1990 levels. The figure aligns with the recommendation from the Climate Change Committee and will take the UK more than three-quarters of the way to reaching net zero by 2050. Notably, the emissions boundary for the sixth Carbon Budget has been expanded to include the UK's share of aviation and shipping emissions for the first time.

The UK Government is legally obliged to assess and prepare for the impacts of climate change.

The Climate Change Act also sets out a framework for climate change adaptation (increasing resilience to climate change). It requires the UK Government to produce a UK Climate Change Risk Assessment (CCRA) every five years, which assesses current and future risks to and opportunities for the UK from climate change. In response to the CCRA, the Government must produce a National Adaptation Programme (NAP) detailing the actions that Government and others will take to adapt to the challenges posed by climate change. The NAP recognises that there are synergies between taking adaptive action and mitigating climate change, and that these should be sought out wherever possible. For example, maintaining high quality natural environments can reduce the severity of heatwaves, while also sequestering carbon from the atmosphere.

The UK's climate change commitments are reflected in planning legislation.

The UK's climate change commitments have been reflected within planning legislation to enable plan-making and decision-making which will support reaching these commitments. This national ambition is brought into the context of local planning through The Planning Act (2008)[12] and the Planning and Compulsory Purchase Act (2004)[13]. Section 182 of the Planning Act 2008 puts a legal duty on local authorities to include policies on climate change mitigation and adaptation in Development Plan Documents, thereby amending the Planning and Compulsory Purchase Act (2004).

Government will introduce higher energy efficiency standards nationally for domestic buildings through the Future Homes Standard, which targets regulated emissions. Local authorities will continue to have the power to demand higher energy efficiency standards of new development than central Government.

[10] UK Government (2008) The Climate Change Act, https://www.legislation.gov.uk/ukpga/2008/27/contents, accessed 23/04/21

[11] UK Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019, https://www.legislation.gov.uk/ukpga/2008/27/contents, accessed 23/04/21

[12] UK Government (2008) Planning Act 2008, https://www.legislation.gov.uk/ukpga/2008/29/contents, accessed 26/04/21

[13] UK Government (2004) Planning and Compulsory Purchase Act, https://www.legislation.gov.uk/ukpga/2004/5/contents, accessed 26/04/21

The Planning and Energy Act (2008)[14] sets out powers for local authorities to have development plan policies which impose reasonable requirements for a proportion of energy used by developments in their area to be energy from renewable sources and/or to be low carbon energy from sources in the locality of the development. As such, this allows local planning authorities to set energy efficiency standards in their development plan policies that exceed the energy efficiency requirements of the Part L Building Regulations.

Section 43 of the Deregulation Act 2015 would have withdrawn this power to set energy efficiency standards from local authorities, however this has not yet been enacted and Government has said that it does not intend to enact it.

In 2020, the Government consulted on proposed updates to the Building Regulations and the introduction of the Future Homes Standard[15]. Through this, Government set out its intention to "introduce in 2020 a meaningful but achievable uplift to energy efficiency standards as a steppingstone to the [2025] Future Homes Standard."

In 2021, the Government published the outcome of the Future Homes consultation[16], outlining what changes will be made and at what pace. The new Standard will ensure that all new homes built from 2025 will produce 75-80% less carbon dioxide emissions than homes delivered to current Building Regulations standards, with low carbon heating and very high fabric standards. From 2025, all new homes will be 'zero-carbon ready', requiring no further energy efficiency retrofit work to enable the homes to become zero-carbon as the electricity grid decarbonises.

For the interim period to 2025, updated Building Regulations will require new homes built from June 2022 to produce 31% less carbon emissions compared to current standards. Transitional arrangements are in place which means that if a building notice, initial notice, or full plans for building work are submitted to a local authority before 15 June 2022, then, provided the building work commences by 15 June 2023, work on that individual building is permitted to continue under the previous standards. In 2023, the Government will hold further consultation about the technical aspects of the Future Homes Standard, before updating the Regulations again to come into force in 2025.

It is important to note that the new emissions reduction requirements apply only to the emissions arising from regulated energy, i.e., lighting, ventilation and heating space and water. Unregulated energy in buildings is energy consumption that is not 'controlled' by Building Regulations - in homes the primary source of unregulated energy is electrical appliances. The Future Homes Standard reduction targets do not apply to emissions resulting from unregulated energy, meaning that a proportion of domestic operational emissions are still unaccounted for.

Government recognises this limitation in its response to the consultation, stating that it will "carry out wider work to consider the future of energy efficient and low carbon buildings, looking beyond the scope of Building Regulations...examin[ing] some of the broader and more fundamental questions around how we can ensure that all new buildings are *designed* and *constructed* to be fit for a zero-carbon future"[17]. No date is given by which this work can be expected, although it is promising to see the Government's intention to include not just unregulated energy but also construction emissions in its future analysis.

In response to the consultation proposal to remove the power of local authorities to set higher energy efficiency standards than those in the Building Regulations, the Government has chosen to continue allowing

[14] UK Government (2008) Planning and Energy Act, http://www.legislation.gov.uk/ukpga/2008/21/section/1, accessed 26/04/21

[15] UKGBC (2019) The Policy Handbook, https://www.ukgbc.org/wp-content/uploads/2020/03/The-Policy-Playbook-v.1.5-March-2020.pdf, accessed 27/04/21

[16] Department for Levelling Up, Housing and Communities (2021) The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf, accessed 28/04/21 (p.10)

[17] Department for Levelling Up, Housing and Communities (2021) The Future Buildings Standards Consultation on Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/956037/Future_Buildings_Standard_consultation_document.pdf, accessed 29/04/21 (p.10, emphasis added)

local authorities to have this power over development in their local area. This is especially important for ambitious local authorities who are striving to reach net zero ahead of national targets.

Government intends to introduce higher energy efficiency standards nationally for non-domestic buildings through the Future Buildings Standard.

In December 2021, the Government published its response to the Future Buildings Standard consultation on proposed changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations[18]. Where the Future Homes Standard addresses residential buildings, the Future Buildings Standard addresses non-residential buildings (in addition to overheating in new residential dwellings). With regards to non-domestic Part L, an interim uplift in energy efficiency will enter into effect in June 2022, requiring a 27% reduction in emissions compared to current standards. This will rely on increased efficiency as well as fabric improvements.

3.4.2 National Policy

The UK Government has responded to its obligations to prepare policies to meet climate targets through the production of numerous sector specific policies and strategies.

The UK Government has responded to its obligations to prepare policies to meet climate targets through the production of numerous sector specific policies and strategies relevant to this study, including the Clean Growth Strategy (2017)[19], Industrial Strategy White Paper (2017)[20], draft UK National Energy & Climate Plan (2019)[21], Decarbonising Transport Plan (2021)[22], Net Zero Strategy (2021)[23], Heat and Buildings Strategy (2021)[24] and the Ten Point Plan for a Green Industrial Revolution (2020)[25].

The Ten Point Plan for a Green Industrial Revolution, published in November 2020, set out Government's Plan for a green industrial revolution which will create up to 250,000 jobs. The plan will mobilise £12 billion of Government investment, and potentially three times as much from the private sector, to invest in making the UK a "global leader in green technologies." The plan focuses on increasing ambition in the following areas:

[18] Department for Levelling Up, Housing and Communities (2021) The Future Buildings Standard: 2021 Consultation on changes to Part L and Part F of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings, The Future Buildings Standard: summary of responses, and Government response (publishing.service.gov.uk), accessed 13/05/22

[19] UK Government (2017) Clean Growth Strategy,

https://www.gov.uk/Government/publications/clean-growth-strategy, accessed 27/04/21

[20] UK Government (2017) Industrial Strategy: building a Britain fit for the future, https://www.gov.uk/Government/publications/industrial-strategy-building-a-britain-fit-for-the-future, accessed 27/04/21

[21] Department for Business, Energy & Industrial Strategy (2019) The UK's Draft Integrated National Energy and Climate Plan (NECP), https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/774235/national_energy_and_climate_plan.pdf, accessed 27/04/21

[22] Department for Transport (2021) Decarbonising Transport: A Better, Greener Britain, Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk), accessed 13/05/22

[23] UK Government (2021) Net Zero Strategy: Build Back Greener, net-zero-strategy-beis.pdf (publishing.service.gov.uk), accessed 13/05/22

[24] UK Government (2021) Heat and Buildings Strategy, HM Government – Heat and Buildings Strategy (publishing.service.gov.uk), accessed 13/05/22

[25] UK Government (2020) The Ten Point Plan for a Green Industrial Revolution, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf, accessed 26/04/21

advancing offshore wind

driving the growth of low carbon hydrogen

delivering new and advanced nuclear power

accelerating the shift to zero emission vehicles

green public transport, cycling and walking

'jet zero' and green ships

greener buildings

investing in carbon capture, usage, and storage

protecting our natural environment

green finance and innovation

The plan created the foundations for a suite of new publications, including the Energy White Paper (2020), the National Infrastructure Strategy (2020)[26], the Industrial Decarbonisation Strategy (2021)[27] and the Decarbonising Transport Plan (2021), each of which highlight decarbonisation as an overarching priority.

The Net Zero Strategy (2021)[28] set out Government's vision for transitioning to a net zero economy, building on the various sectoral plans published in 2020/21. It detailed key policies for achieving net zero by 2050, including:

- Ending the sale of new petrol and diesel cars and vans by 2030;
- Powering the UK entirely with clean electricity by 2035;
- Providing grants to upgrade home heating systems from gas boilers to heat pumps and other low-carbon heating systems; and
- Tripling the rate of woodland creation in England, planting at least 30,000 hectares of new woodland per year.

The Energy White Paper[29], published in December 2020, provided further detail on the Government's preferred direction for energy development. The overarching objective is to transform the UK's energy system to support reaching net zero by 2050. In the paper, Government states that it is not targeting a particular energy generation mix for 2050, yet it places particular emphasis on the following technologies: offshore wind; electric heat pumps; hydrogen and nuclear. Carbon capture, utilisation and storage also receives special attention and will benefit from Government investment.

With regards to community energy, the Community Energy Strategy[30] was published in 2014. The strategy aims to make a step towards meeting the UK's commitment to encourage community owned renewable energy schemes. The strategy focuses on creating a supportive environment for community energy and

[26] HM Treasury (2020) National Infrastructure Strategy, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/938539/NIS_Report_Web_Accessible.pdf, accessed 26/04/2021

[27] Department for Transport (2020) Decarbonising Transport: setting the Challenge, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/932122/decarbonising-transport-setting-the-challenge.pdf, accessed 27/04/21

[28] UK Government (2021) Net Zero Strategy: Build Back Greener, net-zero-strategy-beis.pdf (publishing.service.gov.uk), accessed 13/05/22

[29] Department for Business, Energy & Industrial Strategy (2020) Energy White Paper, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf, accessed 23/04/2021

[30] Department for Energy & Climate Change (2014) Community Energy Strategy: Full Report, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/275163/20140126Community_Energy_Strategy.pdf, accessed 28/04/21

removing specific barriers to growth. The strategy supports communities to produce, reduce use of, manage and purchase energy.

National planning policy stipulates that the planning system should support the transition to a low carbon and resilient future.

The National Planning Policy Framework (NPPF) (2021)[31] is the key guiding document in local authority plan-making and development management. It requires plans to take a proactive approach to climate change mitigation and adaption, in line with the objectives and provision of the Climate Change Act (2008). Climate change is referenced throughout the NPPF, including acknowledgment that climate change adaptation and mitigation is one of the key pillars of sustainable development. Other guidance includes encouraging the reduction of greenhouse gas emissions, encouraging the reuse of existing resources, supporting renewable and low carbon energy, supporting community-led initiatives for renewable and low carbon energy development, and guidance on utilising Section 106 and Community Infrastructure Levy contributions for climate change mitigation.

To sit alongside the NPPF, National Policy Statements (NPS)[32] have been produced to guide decision making on Nationally Significant Infrastructure Projects (NSIP). As the majority of major energy schemes are likely be NSIPs, there is a suite of NPS focused on energy developments (released in 2011). The Overarching National Policy Statement on Energy (EN-1) sets out guidance and existing policies that guide energy infrastructure and the contribution that NSIPs can make to meeting the UK's energy goals. The technology-specific NPS for Renewable Energy Infrastructure (EN-3) (2011) sets out guidance specifically for the development of energy from biomass and/or waste (>50 MW), offshore wind (>100 MW) and onshore Wind (>50 MW). In April 2021, the Department for Business, Energy and Industrial Strategy (BEIS) took the first step to reviewing the six current Energy NPS, publishing the Appraisal of Sustainability (AoS) and Habitat Regulations Assessment (HRA) for consultation with statutory and relevant technical experts.

3.4.3 National Guidance

The Climate Change Committee has published multiple guidance documents aimed at central and local Government, which identify focus areas for climate action and the pathway to net zero.

In 2019, the UK Climate Change Committee (CCC) released two reports of relevance: 'UK Housing: Fit for the future?'[33] and 'Net Zero – The UK's contribution to stopping global warming'[34]. The following year, the CCC followed up with three further key publications: 'The Sixth Carbon Budget - The UK's path to Net Zero' (2020)[35], 'Local Authorities and the Sixth Carbon Budget' (2020)[36] and 'Land use: Policies for a Net Zero UK' (2020)[37].

The CCC Housing Report warns that the UK housing stock is not contributing sufficiently to emissions reductions and that without the near-complete elimination of greenhouse gas emissions from buildings, national climate targets will not be met. Progress to date in reducing building emissions has been slow; and energy use in homes - which accounts for 14% of total UK emissions - actually increased between 2016 and

[31] UK Government (2021) National Planning Policy Framework, National Planning Policy Framework - GOV.UK (www.gov.uk)

[32] UK Government (2011) National Policy Statements for energy infrastructure, https://www.gov.uk/Government/publications/national-policy-statements-for-energy-infrastructure, accessed 26/04/21

[33] UK Climate Change Committee (2019) UK housing: Fit for the future? - Climate Change Committee (theccc.org.uk), accessed 04/05/21

[34] UK Climate Change Committee (2019) Net Zero – The UK's contribution to stopping global warming https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/, (p.11) accessed 27/04/21

[35] UK Climate Change Committee (2020) The Sixth Carbon Budget - The UK's path to Net Zero, https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf, accessed 12/05/21

[36] UK Climate Change Committee (2020) The Sixth Carbon Budget - The UK's path to Net Zero, https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf, accessed 12/05/21

[37] UK Climate Change Committee (2020) Land use: Policies for a Net Zero UK, https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/, accessed 12/05/21

2017. The report also finds that measures to adapt the UK housing stock to climate risks are not being implemented at anywhere near the required level.

With regards to new build homes, the report calls for an ambitious trajectory of standards, regulations and targets, identifying low carbon/renewable heat systems, energy efficiency, passive cooling measures and improved water efficiency as central to this. Additionally, the report states that greater emphasis must be placed on reducing the whole-life carbon impact of homes, including embodied[38] and sequestered[39] carbon. The issue of decarbonising buildings is picked up again in the CCC's 'The Sixth Carbon Budget - The UK's path to Net Zero' report[40]. This report presents the Committee's recommendations to Government for the UK's Sixth Carbon Budget, which will run from 2033 to 2037. The report considers ambitious but realistic sector-based 'pathways' (scenarios) for reaching net zero. To be on track for the 'Balanced Net Zero Pathway'[41], four priorities are identified over the coming decade for residential buildings: deliver on plans to upgrade all properties to EPC C; scale up the market for heat pumps as a vital technology for decarbonising space heating; expand the rollout of low-carbon heat networks in dense areas; prepare for a potential role for hydrogen in heating. The Balanced Pathway requires investment across all buildings (residential and non-residential) at an average rate of around £12 billion per year to 2050, partly offset by reductions in operating costs of around £5 billion per year. At a household level, total investment costs are less than £10,000 per home, with 63% of homes needing to spend no more than £1,000 on retrofitting energy efficiency measures. Upgrading the building stock will not only reduce emissions, but also deliver significant wider benefits in terms of improved health and comfort levels and adapting to a changing climate.

The CCC Net Zero report[42] advised that by 2030, current emissions reduction plans would at best deliver around half of the required reductions. The Committee concluded that current policy is insufficient and that "clear, stable and well-designed policies" to reduce emissions must be implemented rapidly and across the whole economy"[43]. The report stressed that emissions reduction cannot be left to central Government departments; every level of Government must contribute. It adds that city and local authorities are well placed to understand the needs and opportunities in their local area, and they have important roles on transport planning, including providing high-quality infrastructure for walking and cycling, provision of charging infrastructure for electric vehicles, and ensuring that new housing developments are designed for access to public transport.

The critical need for bottom-up action, enacted at the local authority level, is reinforced in the CCC's 'Local Authorities and the Sixth Carbon Budget' report[44]. It identifies that while emissions reduction progress to date has largely been driven through central policy to phase out coal for electricity production, more than half of the emissions cuts needed to comply with the Sixth Carbon Budget rely on people and businesses taking up low-carbon solutions. These decisions - such as installing low-carbon heating or switching to an electric vehicle - are made at a local and individual level, and often depend on having supporting infrastructure and systems in place. Local authorities have a key enabling and encouraging role in this behaviour change. Moreover, through their duties and powers, the report finds that local authorities have power or influence over roughly one third of emissions within their local area. To ensure that local authorities have sufficient power, capacity and finance to deliver the changes needed for net zero, as well as

[38] Embodied carbon means all the CO2 emitted in producing materials. The embodied carbon of a building can include all the emissions from the construction materials, the building process, all the fixtures and fittings inside, as well as from deconstructing and disposing of it at the end of its lifetime.

[39] Sequestered (or embedded) carbon refers to the quantity of carbon that is physically stored in a material.

[40] Based on insights from all scenarios, the CCC identifies a Balanced Pathway, which forms the basis of their recommended Sixth Carbon Budget. This pathway makes moderate assumptions regarding behavioural change and technological innovation.

[41] UK Government (2019) Climate Change, https://www.gov.uk/guidance/climate-change, accessed 23/04/21

[42]Climate Change Committee (2019) Net Zero; https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/, accessed 23/04/21

[43] Climate Change Committee (2019) Net Zero; https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/, accessed 23/04/21

[44] UK Climate Change Committee (2020) The Sixth Carbon Budget - The UK's path to Net Zero, https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf, accessed 12/05/21

that local plans and policies are coordinated (rather than fragmented), the report makes four priority recommendations for central Government.

National planning practice guidance elaborates on planning's role in addressing climate change.

National Planning Practice Guidance (NPPG)[45] provides additional guidance to support the understanding and implementation of the NPPF. The section on climate change provides advice on how to identify suitable mitigation and adaptation measures in the planning process to address the impacts and causes of climate change. The NPPG provides examples of how local plans can mitigate climate change by promoting a reduction in emissions, as well as adapt to climate risks:

- Reducing the need to travel and providing for sustainable transport;
- Providing opportunities for renewable and low carbon energy technologies e.g. through district heating networks that include tri-generation (combined cooling, heating and power);
- Providing opportunities for decentralised energy and heating e.g. maximising summer cooling through natural ventilation in buildings;
- Promoting low carbon design approaches to reduce energy consumption in buildings, such as passive solar design;
- The provision of multi-functional green infrastructure; and
- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.

The Renewable and Low Carbon Energy guidance[46] expands upon paragraph 155 of the NPPF, which states that plans should maximise the potential for renewable energy generation. The guidance sets out how local plans should account for renewable and low carbon energy and heat, including through the provision of a positive strategy on such matter, and considering the identification of suitable areas for energy generation and supporting infrastructure. The guidance acknowledges that community led renewable energy initiatives are likely to play an increasingly important role and that these should be encouraged as a way of providing positive local benefit from renewable energy development. It follows on to suggest that local planning authorities may wish to establish policies which give positive weight to renewable and low carbon energy initiatives which have clear evidence of local community involvement.

The Housing Standards Review (2015)[47] was intended to consolidate the numerous standards, regulations and guidance surrounding housing development. Crucially, one outcome of the review was that the Code for Sustainable Homes could no longer be required within planning conditions and instead was replaced by Building Regulations. As a result, Building Regulations Part L energy requirements were then set equivalent to the CSH level 4 (equivalent to a 19% improvement on the dwelling emission rate over previous regulations). This 19% improvement is now commonly seen in recent local plans. As the UK Government stated in their 2021 Response to the Future Homes Standard consultation, local authorities will maintain the ability to set their own energy performance standards beyond the 19% improvement in their planning policies.

[45] National Planning Policy Guidance (2019) https://www.gov.uk/Government/publications/national-planning-policy-framework--2, accessed 12/05/21

[46] UK Government (2015) Renewable and Low Carbon Energy, https://www.gov.uk/guidance/renewable-and-low-carbon-energy, accessed 26/04/21

[47] UK Government (2015) Housing standards review: technical consultation, https://www.gov.uk/Government/consultations/housing-standards-review-technical-consultation, accessed 27/04/21

3.5 Regional Context

3.5.1 Local Enterprise Partnerships

The Thames Valley Berkshire Local Enterprise Partnership (LEP) has a vision to "build a sustainable Berkshire, in full alignment with the Government's target of a 'net zero' carbon economy by 2050"[48]. The LEP is proactively working with the six Berkshire authorities to deliver climate action. In the summer of 2021, the LEP published the Berkshire Net Zero Carbon Research document[49], which baselines the strength of each authority's local plan and makes a series of recommendations.

The Thames Valley Berkshire LEP published its Strategic Economic Plan (SEP)[50] for the period 2015/16 – 2020/21. The SEP sets out in detail the LEP's vision and investment priorities, and presents evidence underpinning both. The document is focused on ensuring continued economic growth across the LEP area, which comprises six unitary authorities (Wokingham, Windsor and Maidenhead, Reading, Bracknell Forest, West Berkshire, and Slough). The Plan does not identify climate change as a major risk to economic growth; transport and communications infrastructure are instead identified as posing the single biggest risk to the economic future of the area. However, in calling for investment in local sustainable transport networks that promote active travel and public transport, in addition to investment in energy infrastructure and flood defences, the Plan has implications for both the mitigation of and adaptation to climate change.

The Thames Valley Berkshire LEP also published the draft Berkshire Local Industrial Strategy[51] (BLIS) in 2019 in response to the UK Industrial Strategy White Paper (2017). The vision of the BLIS is that: "Berkshire should grow with ambition and intent. We want to accelerate the pace of economic growth – consistent with the strength of our assets – and then to sustain it at a high level, but we also want to see good growth. By this, we mean growth that is smart, knowledge-intensive, inclusive and resilient." This vision does not incorporate the essential need for growth to be 'clean' and 'green'.

The same year, the Thames Valley Berkshire LEP published its Energy Strategy[52] for the region. Local Energy Strategies are underpinned by the Government's Clean Growth Strategy (2017) and Industrial Strategy (2017), as well as the Climate Change Act. Energy Strategies are funded by BEIS and the Greater South East Energy Hub coordinated the efforts of the 11 LEPs across the region, providing expert technical assistance with the production of the six regional strategies. The Energy Strategy aligns with the UK's net zero carbon trajectory, outlining the current risks to growth relating to energy structure and the role of the LEP in promoting clean growth and how this will be achieved through the low carbon transition period. The Energy Strategy builds upon the LEP's SEP, which identified that economic growth in Berkshire is likely to out-pace appropriate energy infrastructure, putting future growth at risk. The key takeaways are:

Thames Valley Berkshire has a successful, growing economy. It provides the UK's largest Gross Value Added (GVA)[53] per annum outside of London and the economy continues to expand. Berkshire has already had success in decoupling economic growth from carbon emissions, although there is still a long way to go in reducing reliance on fossil fuels. Fossil fuels remain the largest source of energy consumed in the area, comprising 70% of all energy sources consumed.

The capacity for the delivery of large-scale renewable energy infrastructure within the Thames Valley is restricted by its geography, statutory environmental designations, and limited natural resources (e.g. wind

[48] Thames Valley Berkshire LEP (2021) Recovery and Renewable Plan, Thames Valley Berkshire LEP Recovery and Renewal Plan-compressed.pdf, accessed 12/05/202

[49] Bioregional (2021) Berkshire Net Zero Carbon Research, Berkshire Net Zero Research Gap Analysis and Recommendations.pdf (thamesvalleyberkshire.co.uk), accessed 12/05/22

[50] Thames Valley Berkshire LEP (2014) Strategic Economic Plan: Delivering national growth, locally, https://www.lepnetwork.net/media/1099/thames-valley-berkshire-sep.pdf, accessed 28/04/21

[51] Thames Valley Berkshire LEP (2019) Berkshire Local Industrial Strategy Framework Document for Consultation http://www.thamesvalleyberkshire.co.uk/getfile/documents/Berkshire%20Local%20Industrial%20Strategy%20-%20Framework%20Document.pdf, accessed 28/04/21

[52] Thames Valley Berkshire LEP (2019) Energy Strategy, https://www.energyhub.org.uk/wp-content/uploads/2019/09/Thames-Valley-Berkshire-Energy-Strategy-May-2019.pdf, accessed 28/04/21

[53] Gross Value Added is the measure of the value of goods and services produced in an area, industry or sector of an economy.

regimes poorly suited for onshore wind). However, there is great potential for the delivery of microgeneration to cumulatively generate a significant proportion of renewable energy needs. Local plans must encourage renewable energy generation.

The six unitary authorities of Berkshire have already acted towards delivering the goals set in the UK Clean Growth Strategy by establishing low carbon planning policies, specialist energy projects and undertaking Government funded heat network assessments. There will be a continual need for these policies to be updated as the nature of energy consumption changes over the next decade, especially with the increased electrification of vehicles and heating in line with net zero trajectories.

The transition to net zero presents an important economic opportunity for the area, with growth in the energy and environment business sector identified as key to continued economic success.

3.6 Local Context

3.6.1 Wokingham Borough Council Climate Emergency

WBC declared a climate emergency on 18 July 2019, whereby the council committed itself to playing as full a role as possible - leading by example as well as through encouragement - in achieving a carbon neutral Wokingham borough by 2030.

Following WBC's climate emergency declaration, a Climate Emergency Action Plan[54] (CEAP) has been prepared and adopted. The CEAP sets out Wokingham's baseline emissions and lays out the activities that WBC intend to take to achieve net zero carbon by 2030.

The CEAP sets out Wokingham’s carbon emissions baseline, based on the Department for Business, Energy & Industrial Strategy (BEIS) local authority emissions data. Emissions are broken down across three sectors: transport (32%), industry and commercial (23%) and domestic (45%). In 2019, the carbon emitted from these sectors created an overall carbon footprint of 557 ktCO2 for Wokingham. As an organisation, WBC accounts for 1.36% of the borough's carbon footprint.

The CEAP identifies eight priority areas for reducing the borough's emissions to net zero:

Reduce carbon dioxide emissions from transport

Reduce carbon dioxide emissions from domestic and business property

Generate more renewable energy in the borough

Create a local plan that specifies net zero carbon construction and infrastructure

Increase the levels of carbon sequestration in the borough through greening the environment

Engaging with young people and supporting sustainable schools

Reduce waste send to landfill

Encouraging behaviour change.

This present commission will create a climate change evidence base for the LPU, which will support the production of a planning policy framework that addresses priority action 4 above.

[54] Wokingham Borough Council (2020) Climate Emergency Action Plan, https://www.wokingham.gov.uk/council-and-meetings/open-data/climate-emergency/, accessed 26/04/21

3.6.2 Wokingham Borough Council Development Plan

WBC's current adopted development plan comprises the Core Strategy (2010)[55] and the Managing Development Delivery (MDD) local plans (2014)[56]. Minerals and waste related development is additionally guided by the Replacement Minerals Local Plan for Berkshire (2001) and Waste Local Plan for Berkshire (1998). The Core Strategy contains reference to the since-revoked South East Plan Regional Spatial Strategy[57]. Both the Core Strategy and MDD local plans are designed to manage development to 2026. The LPU, however, will set out a strategy to manage development over a longer period, currently proposed to be until 2037/38.

WBC published and consulted upon a LPU Draft Plan[58] in 2020. This document set out proposals for the provision of a minimum of 13,900 new homes over the Plan period (at that point to 2036). An updated spatial strategy (Right Homes, Right Places – Revised Growth Strategy[59]), published for consultation between November 2021 and January 2022, proposes a minimum of 15,513 net additional dwellings over an extended plan period (April 2018 to March 2038). Once adopted, the LPU will replace all policies in the Core Strategy and MDD local plan. Minerals and waste planning is being reviewed and updated jointly with neighbouring local authorities through a separate plan process.

Published following WBC's declaration of a climate emergency, the LPU Draft Plan recognises the opportunities for Wokingham to take positive climate action. The LPU Draft Plan vision identifies sustainability as one of the three core themes and the plan contains a number of policies to drive the transition to a net zero, resilient Wokingham.

Policies DH7, DH8 and DH9 are of special relevance for this commission. These policies set out that major new residential development must be net zero and minor residential must achieve at least a 19% improvement in the dwelling emission rate, as defined in Building Regs Part L. For non-residential development, major developments are expected to achieve BREEAM ‘Excellent’ standard and minor developments ‘Very Good’ standard.

Other policies of particular relevance to the findings of the Renewable Energy Capacity Analysis are Policy SS13 and SS14. Policy SS13 'Development in the Countryside' has regard to managing development in the countryside, as defined on the policies map. Specific development types will be permitted, including low carbon and renewable energy generation schemes in accordance with Policy DH10. Policy SS14 'Development in the Green Belt' seeks to protect and uphold the Green Belt, permitting only limited instances of development. This does not allow for low carbon and renewable energy generation, unless very special circumstances can be demonstrated. The implications of this Green Belt policy will be considered further in the Renewable Energy Capacity Study (Section 13 of this commission).

[55] Wokingham Borough Council (2010) Core Strategy, https://www.wokingham.gov.uk/planning-policy/planning-policy-information/local-plan-and-planning-policies/, accessed 04/05/21

[56] Wokingham Borough Council (2014) Managing Development Delivery Plan, https://www.wokingham.gov.uk/planning-policy/planning-policy-information/local-plan-and-planning-policies/, accessed 04/05/21

[57] Government Office for the South East (2009) South East Plan: Regional Spatial Strategy for the South East of England, revoked on 23 Mach 2013 (other than policy NRM6: Thames

Basin Heaths Special Protection Area) https://webarchive.nationalarchives.gov.uk/20100528160926/http://www.gos.gov.uk/gose/planning/regionalPlanning/815640/, accessed 27/04/21

[58] Government Office for the South East (2009) South East Plan: Regional Spatial Strategy for the South East of England, https://webarchive.nationalarchives.gov.uk/20100528160926/http://www.gos.gov.uk/gose/planning/regionalPlanning/815640/, accessed 27/04/21

[59] Wokingham Borough Council (2021) Right Homes, Right Places – Revised Growth Strategy, Revised Growth Strategy consultation - Wokingham Borough Council, accessed 12/05/22

4. The Case for Local Climate Change Policy in Wokingham

This section provides further insight into the climate change impacts that Wokingham can expect to experience over the coming decade under different climate change scenarios. It also examines the emissions profile for Wokingham and how new development, if not built to the highest possible standards, could contribute to increasing emissions and undermine progress towards the borough's net zero ambition.

4.1 Approach to Emissions Profiling

The first part of this section summarises the existing work undertaken by WBC across climate change mitigation and adaptation. It then provides a brief examination of the existing geographical and environmental features of the borough which may influence the scale of climate impacts, including its location near to rivers and the quantum of green belt in the borough.

Section 4.4.3 and Section 4.4.4 then presents the current and future climate change impacts in the UK and specifically within Wokingham from now until 2100 across different Representation Concentration Pathways (RCPs). Different RCPs reflect differing pathways of greenhouse gas concentrations and therefore result in different projected changes to the climate system.

Section 4.5 then builds on the existing emissions work undertaken as part of the Wokingham CEAP[60] and the accompanying annual update report[61] to build out a greenhouse gas emissions business as usual pathway based on UK Climate Change Committee's (CCC) modelled 'Existing policies' scenario, and the contribution that net zero development may make to ensuring the borough aligns with the net zero pathway. This section also identifies emission hotspots within the region through the use of the National Atmospheric Emissions Inventory to provide guidance on avoiding potential future developments of a similar nature.

4.2 Limitations

This report presents the best available, most-up-to-date, publicly available data on Wokingham's emissions and climate risks at the time of writing. The BEIS annual emissions data for local authorities, which is used as a basis of the preparation of the business as usual (BAU) and mitigation pathways, are only published with a two-year lag and therefore the latest annual data is from 2019.

The UKCP18 projections are based on different Representative Concentration Pathway (e.g. RCP 4.5), which are climate pathways defined by level of radiative forcing at the end of century. More recently, the international climate science community have been using a set of new pathways that seek to determine how combinations of global social, demographics and economics will drive emissions – Shared Socioeconomic Pathways (SSPs).[62] These SSPs are being input into the latest climate models and are included for the first time in the latest (sixth) IPCC assessment (published following completion of this Evidence Base chapter).

[60] Wokingham Borough Council, 2020. Climate Emergency Action Plan. [Online] Available at: https://www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=519504#:~:text=Wokingham%20Borough%20Council%20declared%20a%20Climate%20Emergency%20on%2018th%20July%202019.&text=The%20motion%20committed%20Wokingham%20Borough,working%20group%20to%20monitor%20progress.

[61] Wokingham Borough Council, 2021. Climate Emergency Action Plan Second Progress Report. [Online] Available at: https://www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=600263

[62] Hausfather, Z., 2018. Explainer: How 'Shared Socioeconomic Pathways' explore future climate change. [Online] Available at: https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

4.3 Wokingham Borough Council's Existing Climate Change Evidence

Wokingham is a unitary authority area in Berkshire, spanning 178 sq. kilometres and home to 177,500 people.[63] The ONS predicts that by 2038 (the end date currently proposed for the LPU), the population will have increased by a further 17,700 people.[64]

Wokingham benefits from good transport and connectivity to the wider Berkshire including to region Reading, Oxford, West and Central London, and international destinations via Heathrow and Gatwick Airport. In addition, the M4, M3 and M25, which are the country's busiest major roads, run close to the borough, and Wokingham is served by regular rail services to London.

The borough sits within the Thames River basin district and several main rivers run through the area including the River Thames and its tributary the Foudry Brook, and the River Loddon and its many feeder rivers including Emm Brook. The high concentration of river systems has led to periodic flooding. Given the location and to align with the NPPF requirements, WBC published a Strategic Flood Risk Assessment in January 2020 to inform the preparation of the flood risk sequential test. This assessed land promoted for development and ranked them in order of least flood risk to highest.

As of 2020 16.2% of the borough was designated green belt, a policy designation for controlling further growth around urban areas Wokingham Borough's green belt is part of the Metropolitan Green Belt which surrounds London, as shown in Figure 1. In 2016, WBC in conjunction with Bracknell Forest Borough Council completed a Green Belt Review which concluded that the green belt is currently serving its purpose as a recreational and environmental space, offering key health benefits e.g. cleaner air. It was also noted to help to mitigate against weather events such as flooding through doubling as a floodplain, particularly in the North West of the borough. The borough also has four Sites of Special Scientific Interest (SSSI), with 134 Wildlife Heritage Sites and one regionally important Geological site. Currently 20% of the borough lies within the 5km area around the Thames Basin Heath Special Protection Area (SPA) in which mitigation is required to resolve recreational pressure on the health and the associated impacts on important bird populations.

[63] ONS, 2021. Census Data. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationandhouseholdestimatesenglandandwalescensus2021

[64] ONS, 2020. 2018-based subnational population projections.

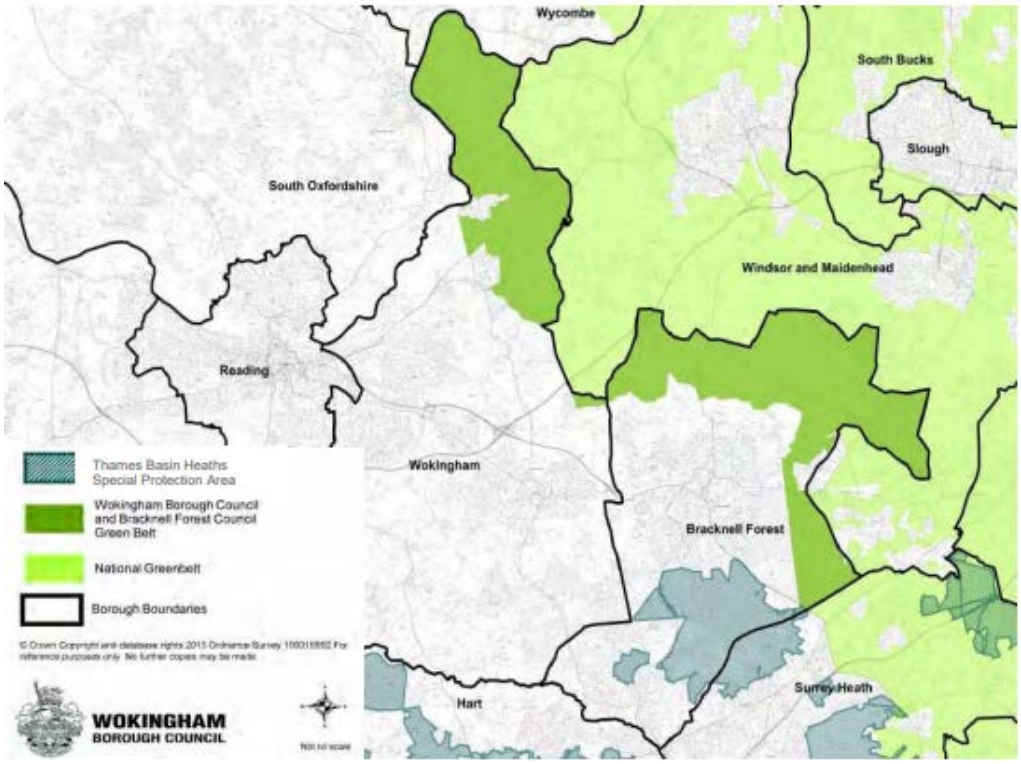


Figure 3 Green belt area in Wokingham (Wokingham Borough Council, 2016)

In July 2019, WBC declared a climate emergency. This declaration was in recognition of the growing international and national consensus on the need for significant and far-reaching climate action. Wokingham's declaration was supported by the publication of their CEAP in January 2020.

The CEAP provided a breakdown of Wokingham's CO_2 footprint and the projected rates of reduction required through to 2030 in order to reach net zero. In baselining emissions, it identified domestic gas, road transport and industrial and commercial electricity as priority areas to cut emissions.

The CEAP also discussed the challenges to take action on climate change, notably the predicted steady population growth in the period to 2037/2038, the existing older housing stock which will need to be retrofitted to reduce energy consumption, and the fragmented nature of settlements which makes the deployment of an effective public transport system challenging.

As a result of this high population growth, there will continue to be a high level of house building and new infrastructure provision, which the CEAP noted "will increase carbon dioxide emissions in the borough through both construction work and population growth".[65] It is therefore vital to minimise these emissions wherever possible.

The development of the CEAP aligns with national and regional legislation and policy, including the regional draft Berkshire Local Industrial Strategy (BLIS) and the Thames Valley Berkshire Local Economic Partnership Strategic Economy Plan.

This recent phase of work following the climate emergency declaration builds on WBC's history of local climate action, dating back to 2010 and the publication of their Sustainable Environment Strategy (2010-2020).

[65] Wokingham Borough Council, 2020. Climate Emergency Action Plan. Pp.9 – 10. [Online] Available at: https://www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=519504#:~:text=Wokingham%20Borough%20Council%20declared%20a%20Climate%20Emergency%20on%2018th%20July%202019.&text=The%20motion%20committed%20Wokingham%20Borough,working%20group%20to%20monitor%20progress.

4.4 Wokingham's Climate Change Impacts

This section presents a picture of current and future climate risks by reviewing climate change data available from UKCP18 for Wokingham, considering key sectors and hazards of interest, and 5 locations of special interest and their potential climate risk. The key climate hazards that have been considered here include:

a. Primary weather events:
   - Temperature
   - Precipitation
   - Wind storms
b. Associated secondary weather events:
   - Flooding (fluvial and surface, although other potential types include)
   - Drought
   - Extreme heat/ heatwave events

This report presents the current risks from these climate hazards and the future climate hazards out to 2100 under RCP 2.6, 4.5 and 6.0.

4.4.1 National context

With global emissions worldwide continuing to increase, and a global increase in temperature of 0.85°C since 1880, the UK will face increasing risks from climate change.

The UK Climate Change Committee (CCC) in the second Climate Change Risk Assessment predicted that the current observed climate hazards are:

c. Temperature over land
d. Sea level increase
e. Rainfall
f. Wind storms

These primary hazards have a compounding impact to generate the following six key risks for the UK, its people and infrastructure:

g. Flooding and coastal change risk
h. Risks from extreme temperature and hot days to health and wellbeing
i. Public water supply shortage
j. Risks to natural capital including biodiversity and soils
k. Risks to domestic and international food production and trade
l. New and emerging diseases

The extent of their impact will vary depending upon the RCP[66] scenario considered and efforts to adapt.

The latest UK Climate Projections (UKCP) were produced by the UK Meteorological Office in 2018 based on the impacts of 2°C and 4°C warming scenarios out to 2100. For the UK, the latest projections suggest a trend towards a higher frequency of warmer and wetter winters across the country. Cold winters and drier winters are still likely to occur due to natural variations but are expected to be less frequent. In summer, the trend is towards a greater frequency of hotter and drier summers, but again with some colder summers and some wet summers.[67] Some specifics from the latest UKCP research include:

m. By the end of the 21st Century all areas of the UK are expected to be warmer and across all seasons – by 2070 this could be up to 5.4°C in summer and 4.2°C in winter.

[66] Representative Concentration Pathway – differing scenarios of GHG emissions concentrations in the atmosphere

[67] Met Office, 2018. UKCP Overview Report. [Online] Available at: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf

n. Warmer summers are expected to be increasingly common, with hot summers[68] occurring 50% of the time by 2050s across both low and high emissions scenarios. Extreme hot days[69] are also expected to be a more frequent occurrence under a high emissions scenario (RCP 8.5) for all areas of the UK.
o. Rainfall projections are more varied across the UK and by season. By 2070, under a high emission scenario, rainfall will range from -47% to +2% in summer, and -1% to +35% in winter.
p. Rainfall events that do occur in summer are expected to be more intense with significant increases in hourly precipitation extremes in the future.

4.4.2 Methodology approach

The following sections explore the existing and projected changes in temperature and rainfall and their secondary impacts e.g., flooding for the UK based on the latest UKCP18 figures. These hazards have been selected as a reflection of the hazards identified by the UKCCC in the Second Climate Change Risk Assessment; this assessment also identified sea level rise as another risk of concern, however, Wokingham's inland location means that this hazard is likely to have no bearing on the authority. In addition, wind storms were identified as another potential risk however, the uncertainties with its future impacts are higher and speeds have shown a slight decline, therefore it was not considered to be of considerable enough risk to evaluate.

The UK Climate Projection (UKCP18) figures include 'probabilistic projections' which are calculated for the period 1961 -2100 in relation to a range of Representative Concentration Pathways (2.6, 4.5, 6.0. 8.5) representing different future scenarios of global temperature rises. For example, RCP8.5 is a "very high baseline" emission scenario brought about by rapid population growth, high energy demand, fossil fuel dominance and an absence of climate change policies. This scenario is the highest of the RCPs and sees atmospheric CO_2 rise to around 935ppm by 2100, equivalent to 1,370ppm once other forcings are included (in CO2e). The likely range of global temperatures by 2100 for RCP8.5 is 4.0-6.1C above pre-industrial levels.

This section provides the full projections out to 2100, as the LPU is currently planned to cover the period to 2038, and infrastructure produced in that period with a lifetime of 60 years could still potentially be in operation facing the climate risks in 2090s.

The Met Office and UKCP also provide 'derived projections' based on global model projections which provide estimates of future UK climate in a world where global average temperatures are 2°C or 4°C above pre-industrial levels which represent strong mitigation of greenhouse gas emissions (2°C) and weak mitigation (4°C) i.e., RCP 2.6, 4.5, and 6.0 which will be considered here. RCP 8.5 scenario has been most recently considered unrealistic due to its assumption around high future emissions and a dramatic expansion of coal use – and therefore will not be a focus of this study.[70]

4.4.3 Current Climate Hazards

4.4.3.1 Temperature

The most recent decade has been on average 1°C higher than when compared with pre-industrial levels, with the ten warmest years on record in the UK having occurred since 2002. Four new national high temperature records were set in 2019: a new UK all-time record, a new UK winter record, a new UK December record and a new UK February highest minimum record.[71]

Anomalously high temperatures were more likely to be observed within East Anglia and the South East, whilst the same region was the least likely to observe anomalies in minimum temperature. This was reflected

[68] A hot summer is defined as summer where for an extended period of time the weather is hotter relative to the expected conditions of the area at that time of year

[69] Defined as a maximum daytime temperature exceeding 30 °C for two or more consecutive days

[70] Hausfather, Z., 2019. Explainer: The high emissions 'RCP8.5' global warming scenario.

[71] Kendon, M., et al. (2020) State of the UK Climate 2019. International Journal of Climatology, 40, pp1 – 69.

in the spells of hot weather in the summer of 2019 which were mostly located in the South East of England, which saw 40 – 60 cooling degree days (see Figure **4**).[72,73]

Researchers have found that in previous heatwaves for every 1°C increase above average levels the risk of dying from cardiovascular or respiratory diseases increased by over 10% for the South East region compared to other UK regions.[74] This demonstrates a particular population vulnerability, that may be attributed to an older population and needs to be considered in the update of planning requirements to ensure that resilience is sufficiently considered in developments.

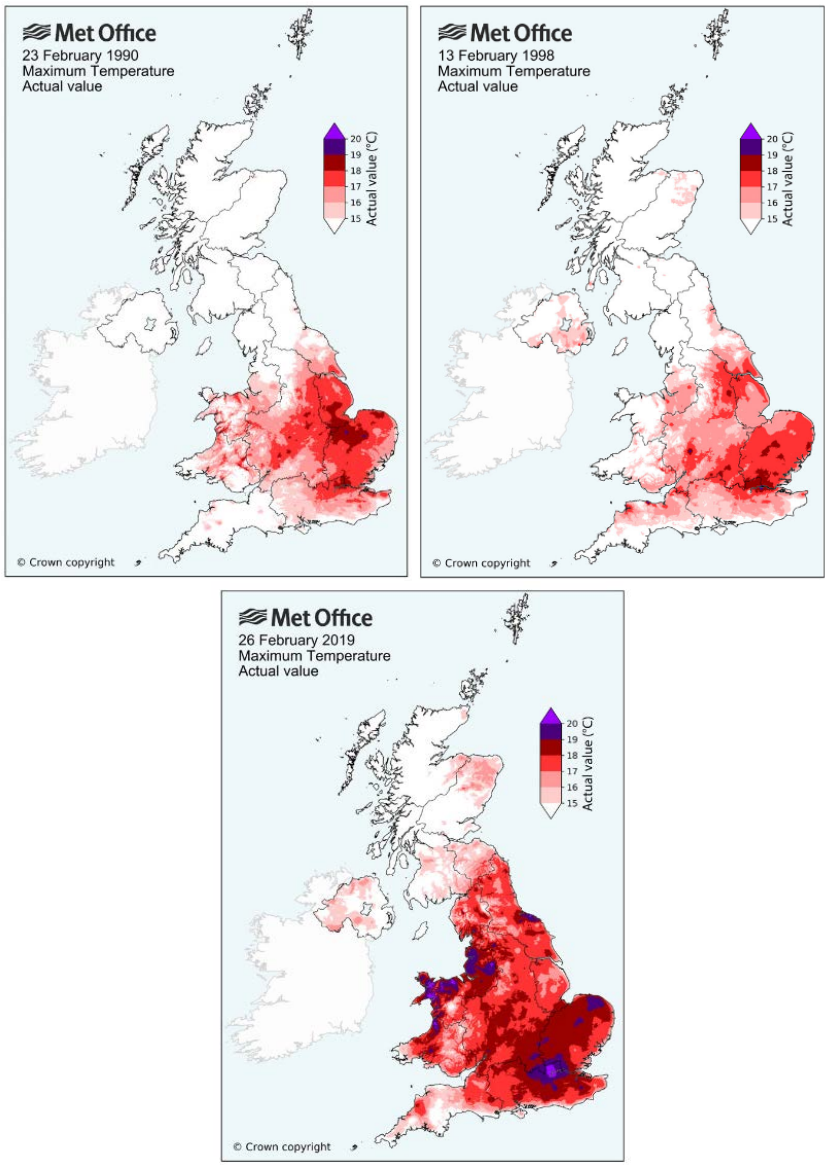


Figure 4 Daily maximum temperatures (Celsius) compared for (a) 23 February 1990, (b) 23 February 1998 and (c) 26 February 2019 © Crown Copyright Met Office 2019 (Source: Kendon et al., 2020)

Events of extreme heat over the last few years within the South East and Wokingham areas have led to significant increases in risk to populations and infrastructure. In 2019, the rail network in Wokingham and

[72] Kendon, M., et al. (2020) State of the UK Climate 2019. International Journal of Climatology, 40, pp1 – 69.

[73] The number of cooling degrees in a day is defined as the difference between the mean temperature (average of the daily high and daily low) and 18°C.

[74] Imperial College London (2014) Southeast England most at risk of rising deaths due to climate change.

other neighbouring counties was severely affected, experiencing track buckling which led to cancellations. It is also estimated that in England there were 500 excess deaths in 65+ year olds as a result of the event.[75]

4.4.3.2 Precipitation

Precipitation levels have continued to increase, with the UK overall figure in 2019 112% higher than the 1961-1990 average. Similar to temperature, six of the ten wettest years for the UK in a series of decades since records began have occurred after 1998.[76,77,78] However, within the South East region average rainfall increases have not been observed, and in spring 2019 there was 70% less rainfall in this region.

Wokingham has experienced flood events of various extents in recent years. In 2013/14 a number of properties were also flooded as a result of a long duration of rainfall which led to the lower end of the River Loddon bursting its banks.[79] There have been 17 examples of groundwater flooding, but these have all pre-dated 2009 and do not demonstrate a trend of worsening.[80] Knowledge of the underlying ground characteristics can significantly help with reducing the likely risk from groundwater flooding. More information regarding flooding events can be viewed in the 2020 Strategic Flood Risk Assessment.

The Thames Catchment Flood Management Plan, referenced in Wokingham's Strategic Flood Risk Assessment, identified that currently Wokingham has between 500 to 1,000 properties at risk from a 1%AEP[81] fluvial flooding event.[82]

4.4.3.3 Wind Storms

The UK Climate Change Committee reported in the second Climate Change Risk Assessment that although the frequency of severed autumn and winter wind storms did increase between 1950 and 2003, more recent levels of storminess are more aligned with earlier periods. There has only been a slight increase in wind speed in the South East and declines across the rest of the country.[83]

4.4.4 Future Climate hazards

4.4.4.1 Temperature

Temperature can be measured as average annual/seasonal temperature (prolonged may be considered a heatwave) or extreme heat days/cooling degree days, which can lead to direct events such as heatwaves or contribute to secondary events such as drought.

Heatwaves and extreme summer temperatures are expected to become the norm in the UK by the 2040s, with the average number of premature heat-related deaths expected to triple by the middle of the century (this figure already stands at 2,000 people per year).

The risk of excess deaths is exacerbated by an ageing population and a lack of adaptation of housing and other buildings. The UK Climate Change Committee identified in their latest progress report for parliament on preparing for climate change that "new designs are needed to avoid lock-in to a maladapted housing stock

[75] Public Health England, 2019. Heatwave Mortality Monitoring.

[76] Met Office, 2019. UK Climate Projections: Headline Findings.

[77] UKCCC: Adaptation Committee. UK Climate Change Risk Assessment 2017. Synthesis report: priorities for the next five years.

[78] Kendon, M., et al., 2020. State of the UK Climate 2019. *International Journal of Climatology*, **40**, pp1 – 69.

[79] Environment Agency, 2014. How the Loddon catchment floods.

[80] Wokingham Borough Council, 2020. Strategic Flood Risk Assessment.

[81] Annual Exceedance Probability.

[82] Wokingham Borough Council, 2020. Strategic Flood Risk Assessment.

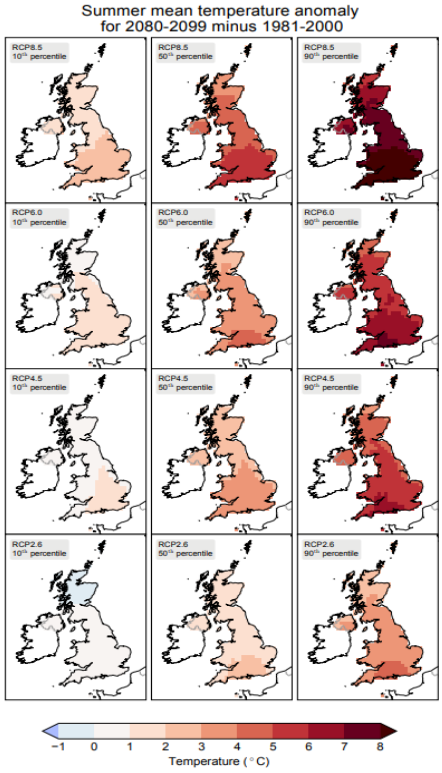
[83] UKCCC: Adaptation Committee. UK Climate Change Risk Assessment 2017. Synthesis report: priorities for the next five years.

with new steps to reduce overheating risks".[84] Similarly, commercial and industry stock needs to be sufficiently adapted or constructed, as failure to adequately heat working environments can lead to productivity impacts on employees.[85]

Insufficient measures are currently being taken to reduce the impact of the urban heat island effect, which has the potential to exacerbate future temperature increases. Urban green space is crucial to help reduce the urban heat island effect and provide cooling.

Probabilistic projections

The latest UKCP18 figures shows a trend towards a higher frequency of warmer winters and a more pronounced north/south contrast, with greater increases in maximum summer temperatures in the south compared to the north of the UK (as shown in Figure 5 and Figure 6).



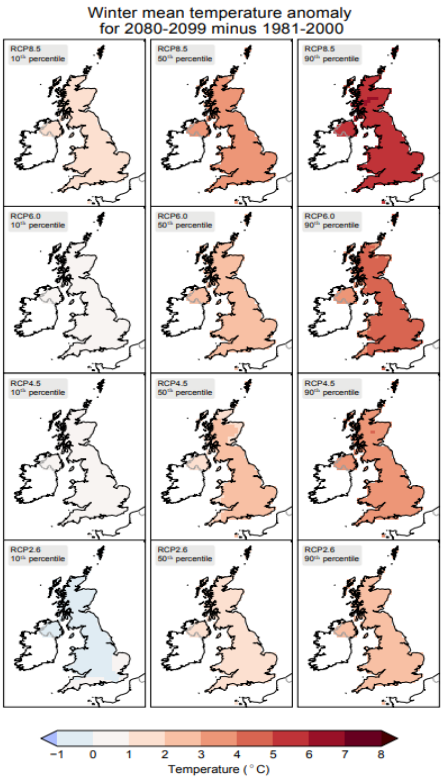


Figure 5 (left): Projected annual summer temperature changes for the UK for the range of emissions scenarios for the probabilistic projections

Figure 6 (right): Projected annual winter temperature changes for the UK for the range of emissions scenarios for the probabilistic projections

Derived projections for 2°C and 4°C

On the basis of the derived projection data, UKCP projections suggest that at 2°C of global mean warming which is highly likely under a RCP 4.5 scenario (Figure 7), the largest warming in the UK will be in the South East where summer temperatures may increase another 3 to 4°C relative to present day (1981-2000). At 4°C of global warming (Figure 8) i.e. an RCP 6.0 scenario, summer temperatures are expected to rise by another 4 to 5°C in the south of England, possibly exceeding 5°C in the South East.[86]

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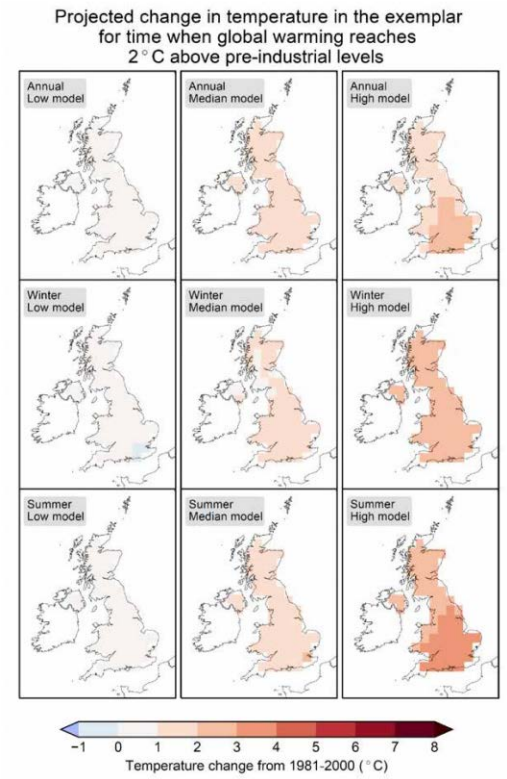
[84] UKCCC: Adaptation Committee, 2019. Progress in preparing for climate change: 2019 Report to Parliament. Pp. 147. [Online] Available at: https://www.theccc.org.uk/wp-content/uploads/2019/07/CCC-2019-Progress-in-preparing-for-climate-change.pdf

[85] UKCCC: Adaptation Committee, 2019. Progress in preparing for climate change: 2019 Report to Parliament. [Online] Available at: https://www.theccc.org.uk/wp-content/uploads/2019/07/CCC-2019-Progress-in-preparing-for-climate-change.pdf

[86] Met Office, 2019. UKCP18 Fact sheet derived projections. [Online] Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-derived-projections.pdf



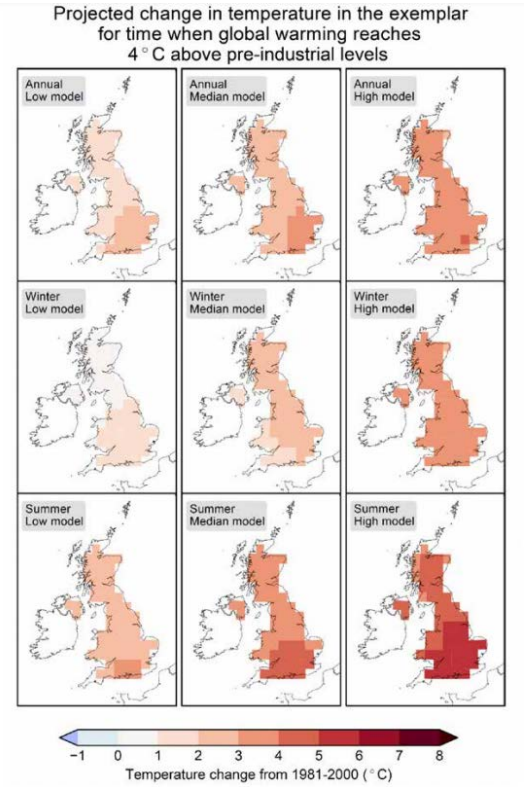


Figure 7 (left): Projected changes in UK temperatures at a global mean warming of 2°C (GWL2) above pre-industrial (1850-1900). Changes are shown relative to present day (1981-2000). Rows show annual (top), winter (December-February; middle) and summer (June-August; bottom) changes.

Figure 8 (right): Projected changes in UK temperatures at a global mean warming of 4°C (GWL4) above pre-industrial (1850-1900). Changes are shown relative to present day (1981-2000). Rows show annual (top), winter (December-February; middle) and summer (June-August; bottom) changes.

Summer

Summer temperatures are rising in Wokingham. Over the last 30 years, the hottest summer day was 35.8°C and projections suggest that if global temperatures increase 2°C, the hottest summer day could be about 37.7°C. At 4°C temperature, this could rise to 43°C (Figure 9). Since 1990, there have been 5 days above 25°C per month on average in Wokingham but if global temperatures rise by 2°C, this figure could reach 10 days and at 4°C, it could be 19 days.[87]

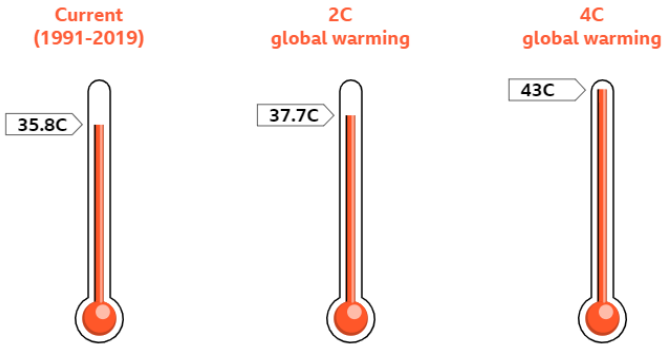


Figure 9: Summer temperature projections for Wokingham under 2°C and 4°C projections

[87] Met Office and BBC, 2021. "What will climate change look like near me?"

Winter

Winter temperatures are also changing in Wokingham. Over the past 30 years, the warmest winter day in Wokingham was 19.2°C. However, projections suggest that if global average temperatures increase 2°C, this could be about 19.6°C and with rises of 4°C, it could rise to about 20.9°C.[88]

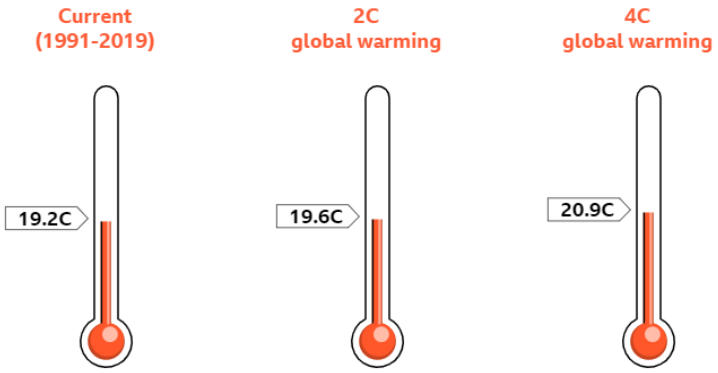


Figure 10: Winter temperature projections for Wokingham under 2°C and 4°C projections

4.4.4.2 Precipitation

Precipitation can be measured as average annual/seasonal precipitation or extreme rainfall days, which can lead to secondary events such as flooding (fluvial, surface, groundwater sewerage).

It is the risk of flooding rather than precipitation directly which poses a risk, with flooding resulting from a combination of factors including land and river management, rainfall, high wind events, and geology amongst others.

Probabilistic projections

Considering probabilistic projections for rainfall, UKCP observations show a high level of variability in precipitation from year to year, with a slight overall increase in UK winter precipitation in recent decades. The projections show a clear shift to higher probability levels of dry summers, but they also suggest that the likelihood of individual wet summers reduces only slightly. Projections also show a pattern of larger increases in winter precipitation over southern and central England towards the end of the century (Figure 11 and Figure 12) with summer rainfall reductions likely to be largest in the south of England.[89] [90]

[88] Met Office and BBC, 2021. "What will climate change look like near me?"

[89] Met Office, 2019. UKCP Factsheet Precipitation. [Online] Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-factsheet-precipitation.pdf

[90] Met Office, 2018. UKCP18 Overview Report. [Online] Available at: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf

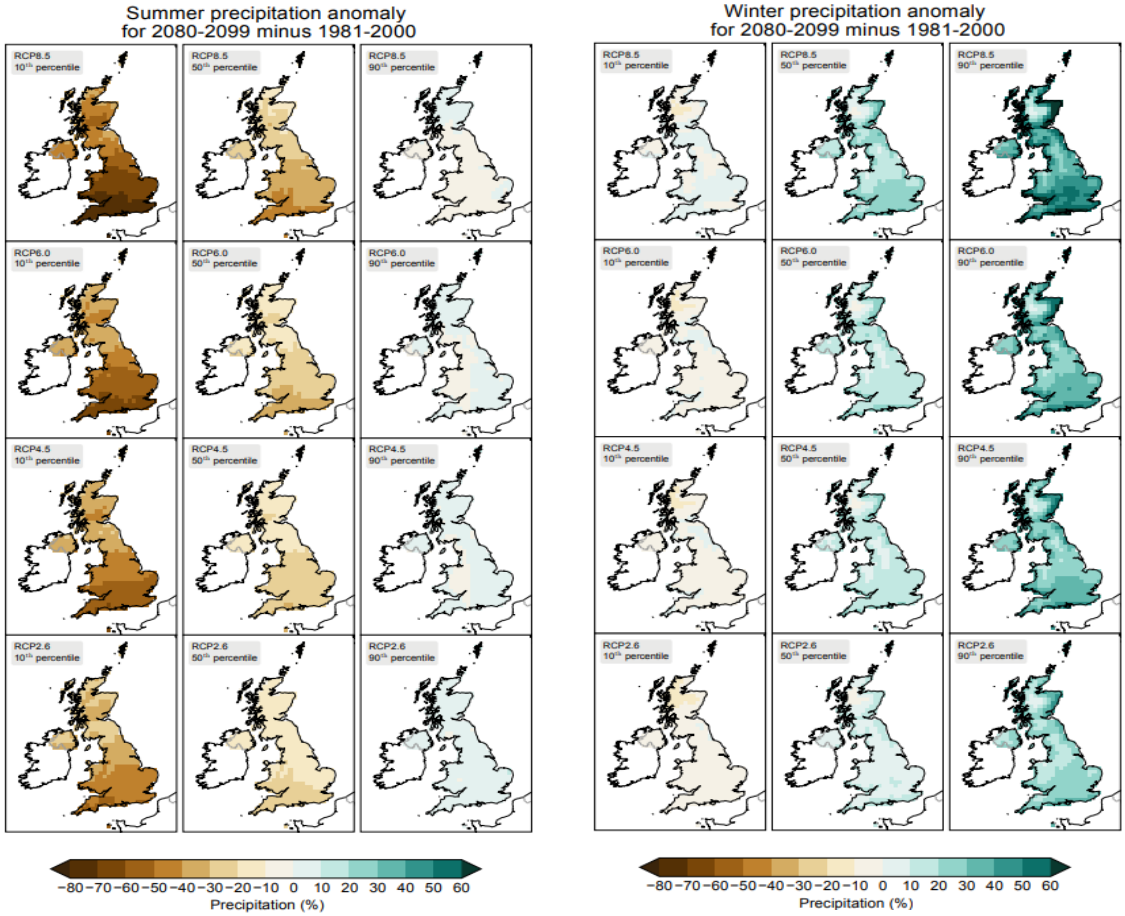


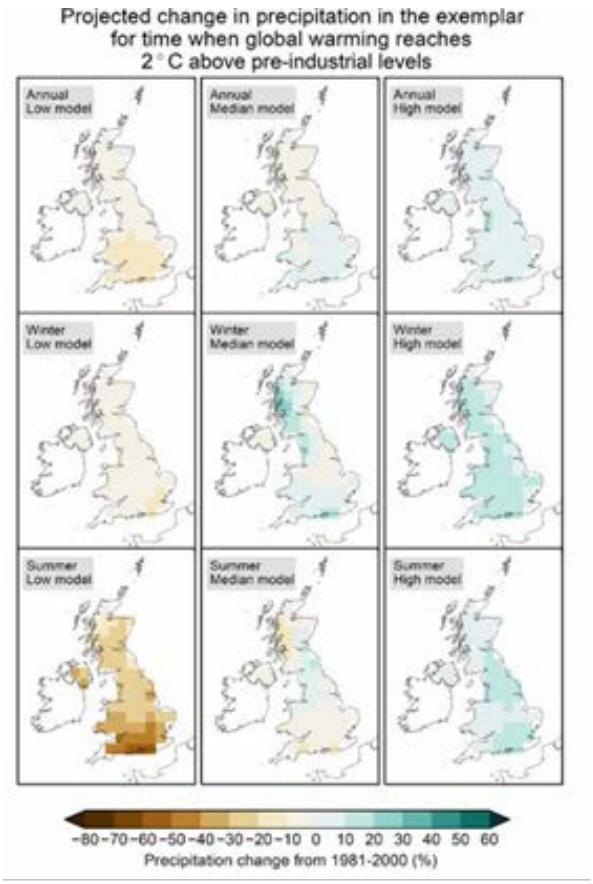
Figure 11 (left): Projected changes in summer mean precipitation for the UK for 2080-2099 compared to 1981-2000 using the probabilistic projections.

Figure 12 (right): Projected changes in winter mean precipitation for the UK for 2080-2099 compared to 1981-2000 using the probabilistic projections.

Derived projections for 2°C and 4°C

On the basis of the derived projection data, UKCP projections suggest that at 2°C of global mean warming, changes in rainfall are uncertain, but slightly wetter winters and drier summers are expected, with summer drying more in the south (Figure 13). At 4°C of global warming, median winter precipitation across the UK is expected to increase by up to 20% across most of the country, while median summer precipitation is expected to decrease in most in the south. In the summer, dry summer days are expected to decrease in mean precipitation levels by up to 50% across much of Southern Wales and England (Figure 14).[91]

[91] Met Office, 2019. UKCP Fact Sheet Derived Projections. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-derived-projections.pdf



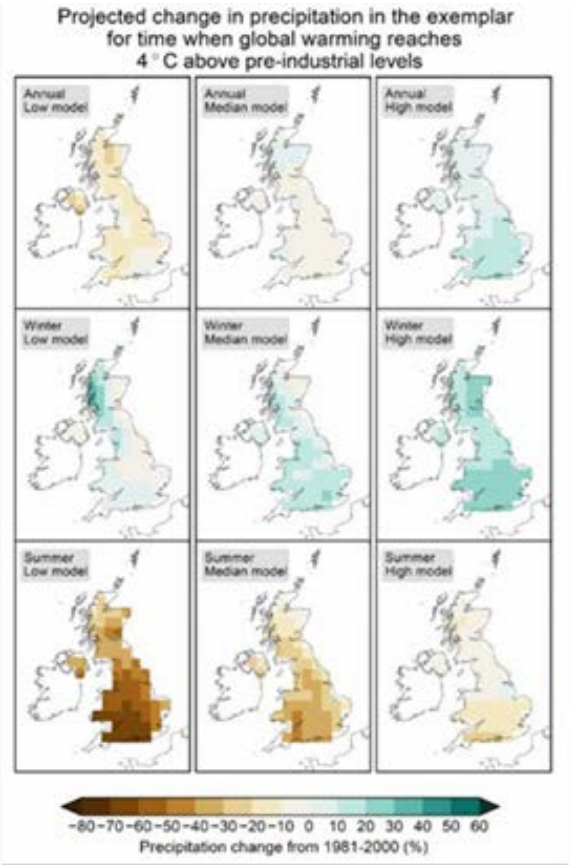


Figure 13 (left): Projected changes in UK precipitation at a global mean warming of 2°C (GWL2) above pre-industrial (1850-1900). Changes are shown relative to present day (1981-2000). Rows show annual (top), winter (December-February; middle) and summer (June-August; bottom) changes.

Figure 14 (right): Projected changes in UK precipitation at a global mean warming of 4°C (GWL4) above pre-industrial (1850-1900). Changes are shown relative to present day (1981-2000). Rows show annual (top), winter (December-February; middle) and summer (June-August; bottom) changes.

Summer

Since 1990 there have been 8 rainy days on average per month in summer in Wokingham. Projections show that if average temperatures rise by 2°C, this could be around 7 days per month while at 4°C rise it could reduce to 5 days.[92]

Across the UK, summer precipitation is likely to be less frequent but more intense. Under a high emissions scenario, rainfall could reduce by 47% by 2070. [93,94]. About 25% of UK currently experiences more than 20 days without rain each summer month. However, if global temperatures rise by 4°C, this could double to about 50% of the country.

Long term total average rainfall in the month of June in the South/South-East region of the UK is 53mm.[95] Over the last 30 years, about 44mm fell in Wokingham on the wettest summer day. Under a future scenario with 2°C rise, this could be about 54mm and at a 4°C rise, it could be about 50mm i.e., the near equivalent of a summer month's worth of rainfall in a single day.

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[92] Met Office and BBC, 2021. "What will climate change look like near me?" [Online] Available at: https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138

[93] Met Office and BBC, 2021. "What will climate change look like near me?" [Online] Available at: https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138

[94] UK Met Office, 2019. UK Climate Projections: Headline Findings. [Online] Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf

[95] Southern Water, 2021. Regional rainfall. [Online] Available at: https://www.southernwater.co.uk/water-for-life/regional-rainfall

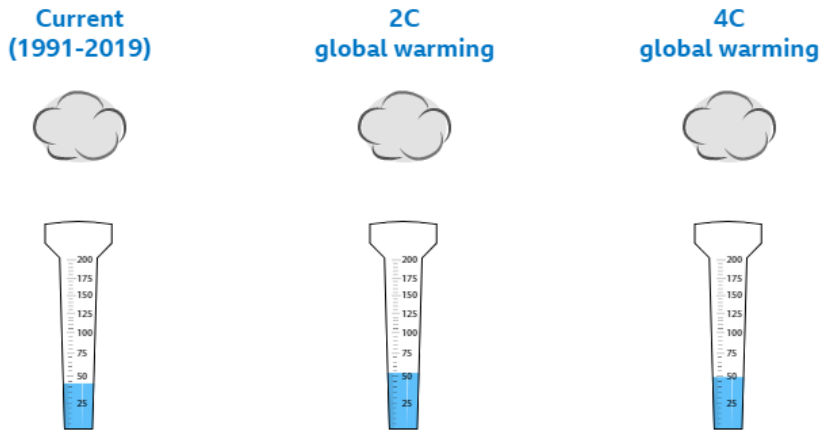


Figure 15 Summer rainfall projections for Wokingham under 2°C and 4°C projections

Winter

In the UK, warmer and wetter winters are expected, with heavy downpours likely to become more frequent and more intense.

Long term total average rainfall in the month of January in the South/South-East region of the UK is 80.1mm, with this figure expected to rise in England by 22% under RCP 2.6, and 33% under RCP scenario 6.0 – 8.5. The exact amount of change in rainfall at 2°C of global warming will vary across the country but in Wokingham the daily peak precipitation could increase by 18% more than that experienced today.[96]

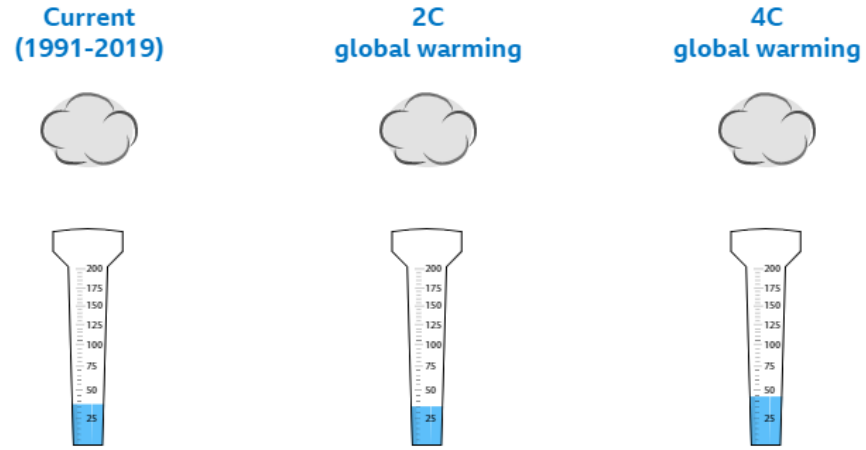


Figure 16 Winter rainfall projections for Wokingham under 2°C and 4°C projections

4.4.4.3 Flooding

Fluvial flooding is caused by high flows in a river which can be as the result of continuous rainfall over a period of weeks above the capacity of the river to offtake its excess volume, or due a period of extreme precipitation greater than the river capacity. Surface water flooding more typically arises from periods of extreme precipitation, where water pools on the surface and is not able to sufficiently drain to prevent flooding.

The potential future risks from flooding for Wokingham have been summarised in depth in the Strategic Flood Risk Assessment. In addition, The Environment Agency Flood Risk Assessments: Climate Change Allowances provides estimated peak river flow allowances changes over the next century under a H++ scenario (extreme climate change) which should be referred to.[97] Within this Flood Risk Assessment, in

[96] Met Office and BBC, 2021. "What will climate change look like near me?" [Online] Available at: https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138

[97] Environment Agency, 2021. Flood risk assessments: climate change allowances.

accordance with the revised peak river flow climate change allowances, River Loddon and its tributaries will expect to see an increase in river peak flows of up to 23% within the 2020's epoch (2015 – 2039), 25% within the 2050's epoch (2040 – 2069) and 46% within the 2080's epoch (2070 – 2125). [98]

It is expected that with this increasing risk there will be increasing disparity between those protected and non-protected areas. With periods of extreme rainfall which will lead to localised periods of surface water flooding and therefore greater action to protect individual properties through better urban design will be required.

Equally infrastructure systems such as transport networks, communication services and businesses will need to be designed to reduce the risk of flooding, particularly considering their interdependencies.[99]

4.4.4.4 Drought

There is a high risk of shortages in public water supply i.e. drought needed for agriculture, energy generation, household demands and industry in the future.

By the 2050s under an RCP 6.0 – 8.5 scenario and high population growth, demand for water could be 150% more than available water resources. There is particular concern for the South East region where more than 25% abstraction of today's value will lead to ecological damage.[100]

Although water companies are required to develop plans relating to adapting to the risks of future water scarcity, it will also be important the general public also reduce their individual water use significantly. This can be supported by design improvements such as low flow fixtures, in-house monitoring and leak prevention.[101]

4.5 Wokingham's Emissions Profile

This section of the report presents Wokingham's current baseline emissions building on the data previously presented in CEAP and progress report, and the business-as-usual pathway based on the UK's existing policies.

This business-as-usual pathway demonstrates the potential trajectory for emissions that Wokingham can expect to observe if no further action is taken, including addressing emissions from new development. This trajectory does show that emissions will fall, but only slightly (<12% by 2050 on a 2019 baseline), as a result of grid decarbonisation activities and societal shifts.

Section 4.5.3 then anticipates the impact that net zero development could have against the BAU. BEIS data is broken down by sector and doesn't easily correlate to "development", however, an estimation of the contribution per house type across scope 1 and 2 emissions has been estimated for 2038 (considering the decarbonisation of the grid) and then scaled for the estimated growth in housing. This does not include the additional emissions that would arise from supporting infrastructure. Such infrastructure may include additional schools, offices, transport assets e.g. railway stations. Research by the International Union of Railways looked at global quantifications for the carbon footprint of a suburban railway corridor for example and estimated that this may contribute between 1.7 and 3.7 $ktCO_2e$ per year.[102]

PAS 2080, is the carbon management in infrastructure verification standard, which would enable specific estimations of carbon contribution from proposed infrastructure.

[98] Wokingham Borough Council, 2020. Strategic Flood Risk Assessment.

[99] UKCCC: Adaptation Committee. UK Climate Change Risk Assessment 2017. Synthesis report: priorities for the next five years.

[100] UKCCC: Adaptation Committee. UK Climate Change Risk Assessment 2017. Synthesis report: priorities for the next five years.

[101] UKCCC: Adaptation Committee, 2019. Progress in preparing for climate change: 2019 Report to Parliament.

[102] International Union of Railways, 2016. Carbon Footprint of Railway Infrastructure. [Online] Available at: https://uic.org/IMG/pdf/carbon_footprint_of_railway_infrastructure.pdf

Note on baseline and business-as-usual (BAU) emissions methodology

There are various methodologies available to estimate local authority baseline emissions data and develop business-as-usual emissions trajectories. The approach within this report uses BEIS UK local authority and regional carbon dioxide emissions national statistics for Wokingham's baseline emissions and BEIS Updated Energy and Emissions Projections to estimate business-as-usual projections. It is recognised that the CEAP instead uses the SCATTER tool, that defines baseline emissions in a slightly different way to the BEIS data (i.e. uses the GHG Protocol for Cities categories that for instance include Waste emissions, unlike BEIS data). The SCATTER tool is also used to plot BAU emissions trajectories, which relies on an alternative BEIS dataset for electricity grid decarbonisation. Both BEIS and SCATTER approaches scale down national decarbonisation projections to Wokingham.

Whilst there are some methodological differences between the BEIS and SCATTER approach, both are robust methodologies based on reputable data sources, and equally provide sufficient context and justification for a greater level of action to address Wokingham's carbon emissions through the Local Plan.

4.5.1 Baseline emissions data

The Department for Business, Energy and Industrial Strategy produces annual CO_2 emissions profiles for regions within the UK at the granularity of second tier authorities.[103]

This emissions data is issued in the two years subsequent, thus, the latest published data is from 2019. The emissions data published is just for CO_2 rather than CO_2e which summarises all GHG emissions in equivalent CO_2e, and therefore would be higher – the data has been scaled accordingly.[104]

The total emissions for Wokingham in 2019 were 726 $ktCO_2$, with a per capita figure of 4.2 tCO_2/capita i.e. the CO_2 emissions emitted for every resident. In the 2020 progress report the 2017 borough wide carbon footprint was presented, although this figure did not include emissions from sources beyond WBC's scope of influence e.g. major transport links and diesel rail transport. If these sectors were similarly removed again Wokingham's total emissions would be 557 $ktCO_2$ compared to the 726 $ktCO_2$ figure reported in 2019.

Taking account of the additional GHG emissions then Wokingham's total carbon footprint in 2019 was 772 $ktCO_2e$[105].

The biggest contributor to Wokingham's emissions in 2019 was transport, making up 45% of the total, followed by domestic emissions at 34%, commercial at 10%, industry at 8% and finally public sector emissions at 2%. Land use, land use change and forestry (LULUCF) offset 15.9 $ktCO_2e$ in 2019, equivalent to 2% of the total.

Wokingham's emissions have reduced by 34% since 2005, which is in line with the percentage reduction seen in UK greenhouse gas emissions within this period.[106] The biggest decline in emissions for Wokingham has been observed in the public sector at 57% (albeit from by far the lowest baseline), followed by the commercial sector with a 54% drop, a 47% decrease in industrial emissions, 35% in the domestic sector which can largely be attributed to decarbonisation of the grid, and 18% within transport.

Wokingham's sectoral emissions between 2005 and 2019 are shown in Figure 17 below.

[103] BEIS, 2021. UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2019. [online] Available at: https://www.gov.uk/Government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2019

[104] BEIS, 2020. 2018 UK Greenhouse Gas Emissions, final figures. [online] Available at: https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/862887/2018_Final_greenhouse_gas_emissions_statistical_release.pdf

[105] BEIS, 2020. Final Greenhouse Gas Emissions Statistical Release.

[106] BEIS, 2021. 2019 UK Greenhouse Gas Emissions, Final Figures. Available at: https://data.gov.uk/dataset/9568363e-57e5-4c33-9e00-31dc528fcc5a/final-uk-greenhouse-gas-emissions-national-statistics

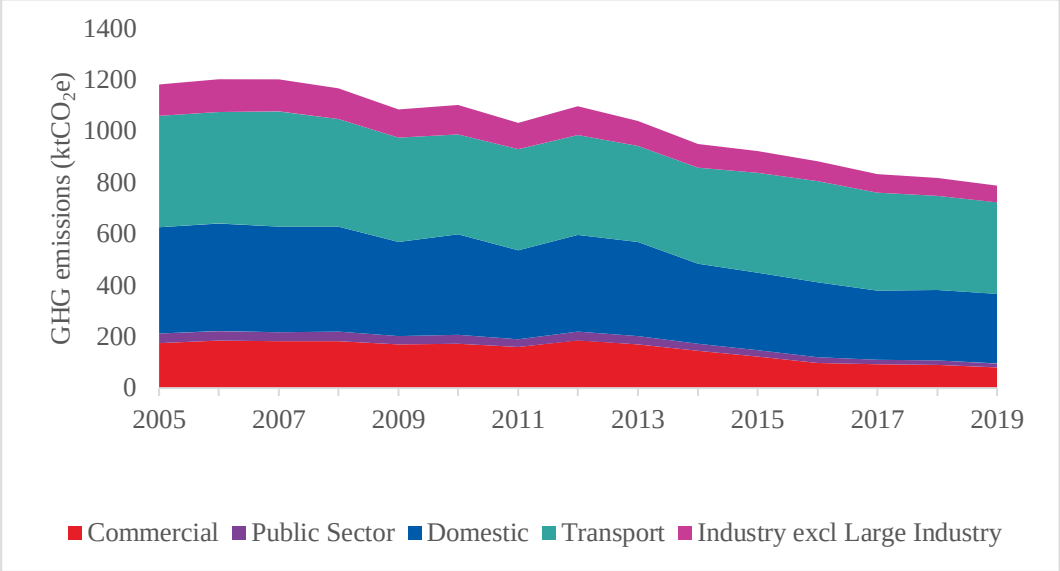


Figure 17 Wokingham's total emissions (ktCO$_2$e) from 2005 to 2019

The performance of each of the sectors over the last 14-year period against the national performance has been shown in Figure 18. It can be seen that the general trends observed are consistent, and lower than average across all sectors for Wokingham.

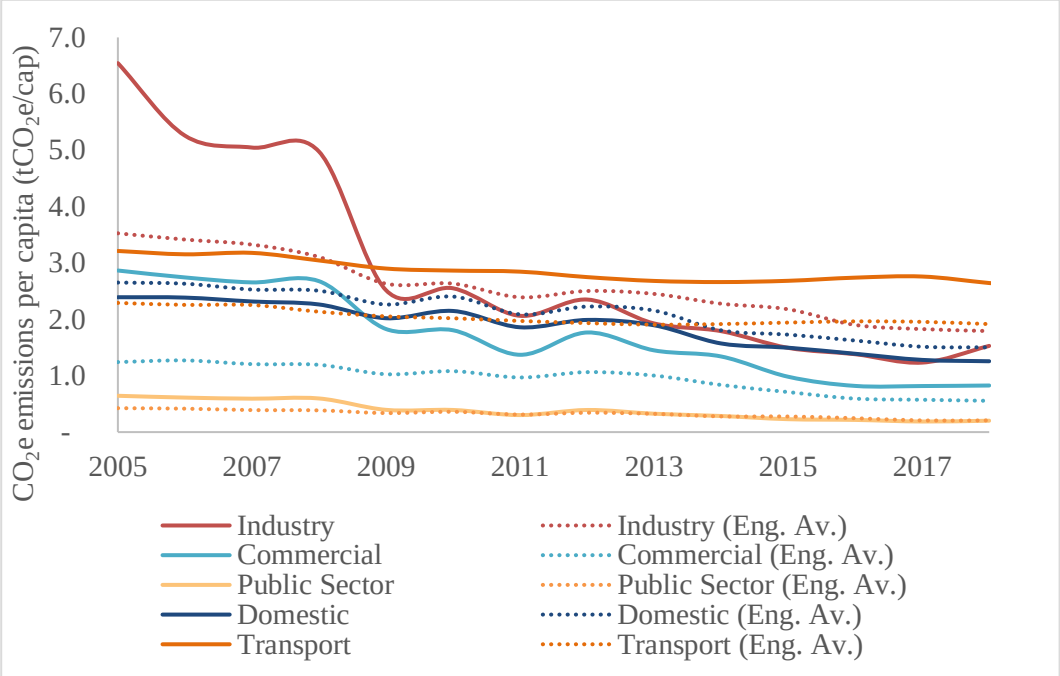


Figure 18 Trends in emissions across the key sectors for Wokingham against the England averages

4.5.2 Business as usual emissions pathway 2038

Applying and downscaling the BEIS 2019 Energy and Emissions projections for the UK to Wokingham provides a business-as-usual pathway i.e., assuming that Wokingham or the national Government were to take no further action to reduce GHG emissions.

In a business-as-usual (BAU) scenario it is anticipated that annual emissions from across the borough would fall by 13% by 2038, against the 2019 baseline, to 669 kt CO_2e, see Figure 19.

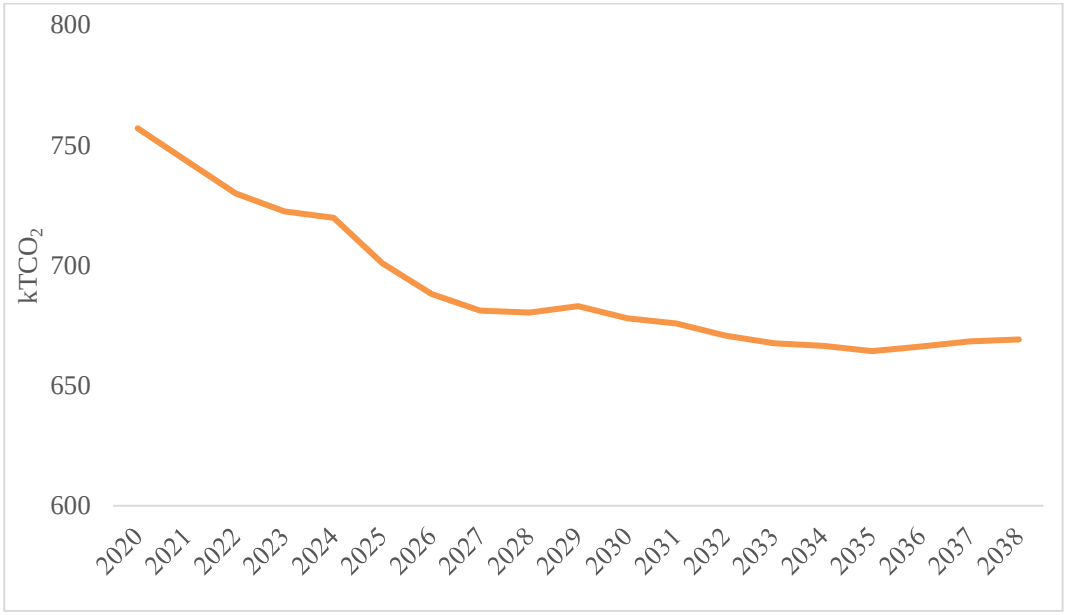


Figure 19 Business as usual GHG emissions pathway Wokingham borough

It is believed that the biggest contributor to emissions reductions will arise from policies relating to the Electricity Supply Industry (ESI)[107], such as UK Carbon Price Support, Feed-in-Tariffs, Renewables Obligation and Contracts for Difference.

Other key policies that are likely to have an impact on non-traded emissions include:

- Resources and Waste Strategy
- Vehicle Efficiency Policies
- English agricultural policies relating to soil management

These policies will help to reduce the emissions associated with electricity use within domestic homes, business and other forms of infrastructure, but will not tackle non-electricity energy use e.g., natural gas for heating, and embodied emissions e.g. construction machinery use, procurement of materials and disposal etc.

Therefore, without significant action to minimise emissions associated with the whole life cycle of development this business-as-usual pathway is unlikely to reduce in line with Wokingham's net zero pathway.

As an illustration of the scale of challenge and necessity for rapid action that Wokingham needs to take, the net zero pathway has been plotted against the UK's national carbon budget ambition and the net zero pathway recommended by the Tyndall Centre, as previously referenced in CEAP progress report, see Section 4.5.[108]

Note that the Climate Emergency Pathway indicates the level of ambition required to achieve net zero carbon emissions by 2030. However, there is currently a significant gap between the emissions reductions that would be achieved from the current level of action set out in the CEAP and the carbon reductions required for this pathway, implying the need for the increased scale and ambition of climate actions.

[107] BEIS, 2020. Updated Energy and Emissions Projections 2019. © Crown Copyright 2020.

[108] Wokingham Borough Council, 2020. Climate Emergency Action Plan Progress Report.

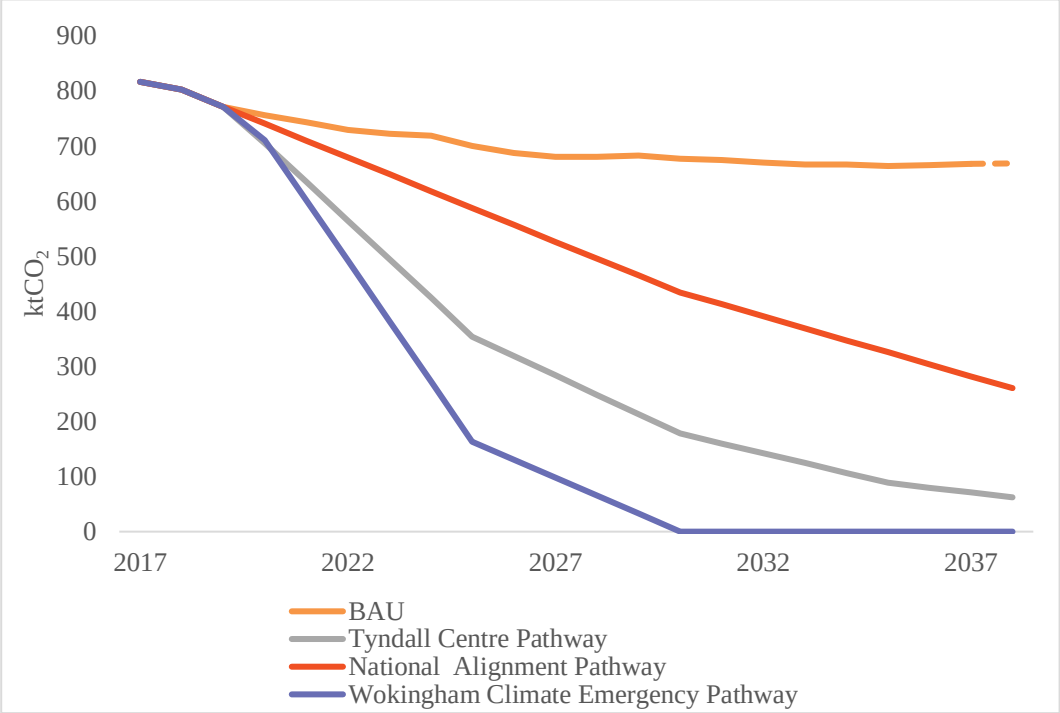


Figure 20 Wokingham's Climate Emergency Action Plan (CEAP) net zero pathway against its BAU and other modelled net zero pathways

4.5.3 Emission hotspots

The National Atmospheric Emissions Inventory enables the identification of point sources of emissions and average emissions levels within local boundaries for the most recent year.

Within Wokingham carbon dioxide pollutant as carbon is concentrated, as would be expected, along major roadways but also in and around Wokingham town centre because of the higher concentration of vehicles. There are also higher concentrations of populations within such urban settings which will be exposed to this and other pollutants such as PM 2.5, PM 10 etc.

The presence of carbon is not directly tied to vehicular traffic it is also linked to combustion as part of agriculture and other commercial processes. In Figure 21 below, we show the concentrations of carbon and PM 2.5 across the borough.

Figure 21 (top) shows that there are several carbon emissions hotspots (red areas) within Wokingham, in particular Wokingham town centre, and tracing the M4 and A329 road network. Identifying these sources is important to put into place specific measures to reduce their impact and prevent the further expansion of such services. Policies within the LPU that seek to reduce emissions (for example those relating to active travel and electric vehicles, green infrastructure and district heating) will help to mitigate emissions from these hotspots. WBC should further consider measures to directly address sources of air pollution in their Air Quality Action Plan.

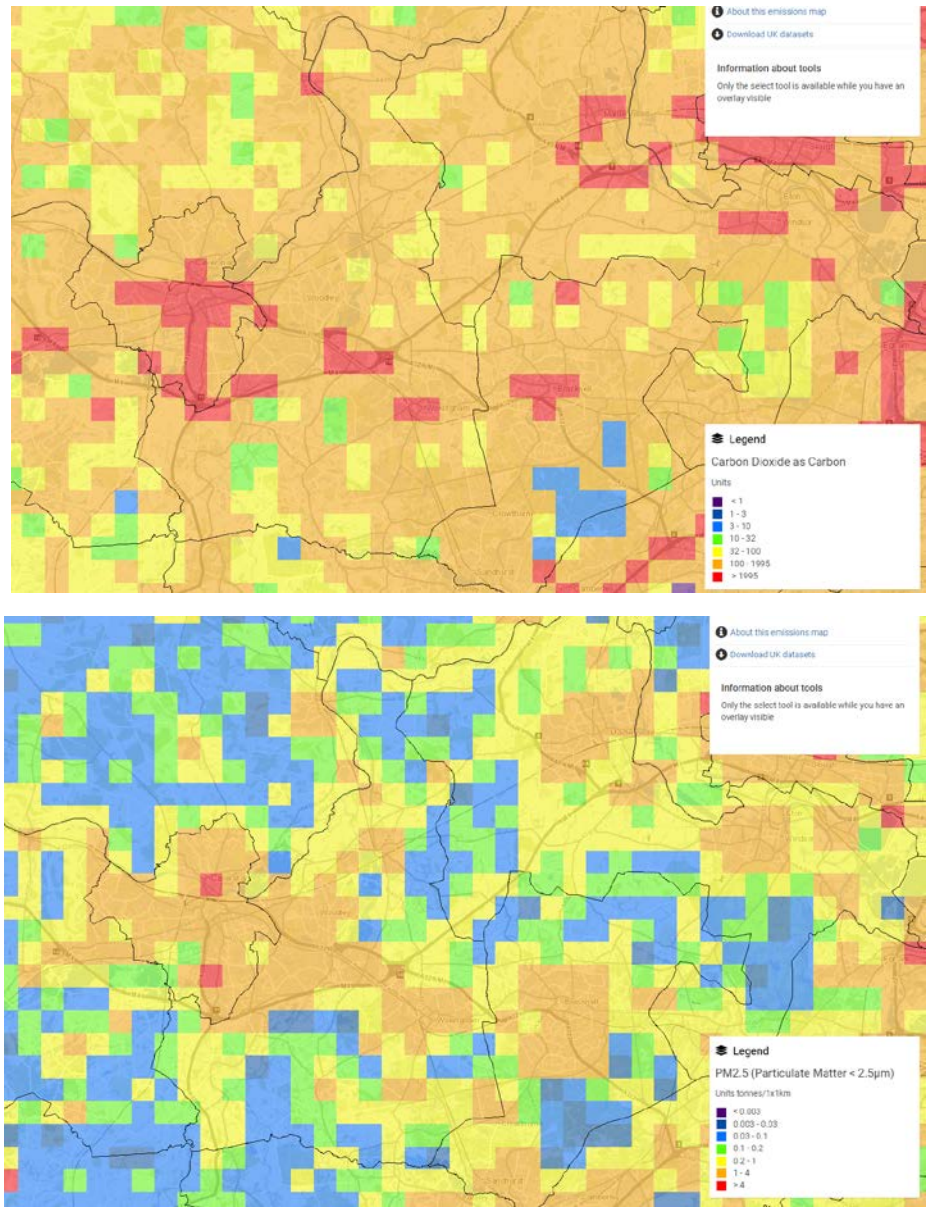
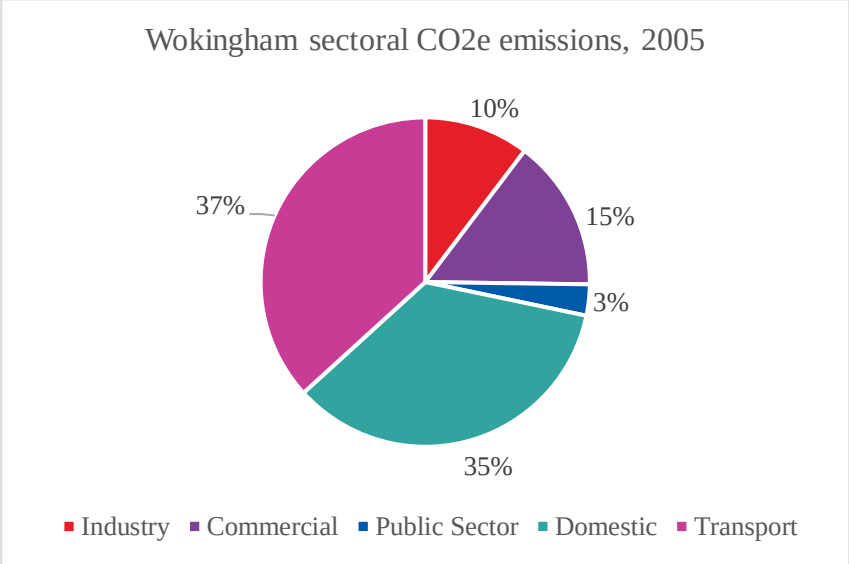


Figure 21 [Top] Carbon dioxide as carbon concentrations in Wokingham; [Bottom] PM 2.5 concentrations in Wokingham © Crown copyright and database rights 2022 licenced under BEIS's Public Sector Mapping Agreement with Ordnance Survey (licence No. 100037028) and Defra's Public Sector Mapping Agreement with Ordnance Survey (licence No. 100022861). Contains OS data © Crown copyright and database right 2020 | Ordnance Survey (GB) data © Crown Copyright and database right 2022 | ONS UK

4.5.4 Future growth and net zero development

The Climate Change Literature Review document explores the role that a local plan can play in addressing emissions associated with new development and encouraging or requiring retrofitting on existing properties. Currently, domestic gas use i.e. gas use in residential homes makes up 25% of Wokingham's emissions, whilst electricity only 8%.[103] Failure to tackle transport emissions sufficiently both at a national and local scale has led to a relative increase in their share of emissions when compared with other sectors, see Section 4.5.



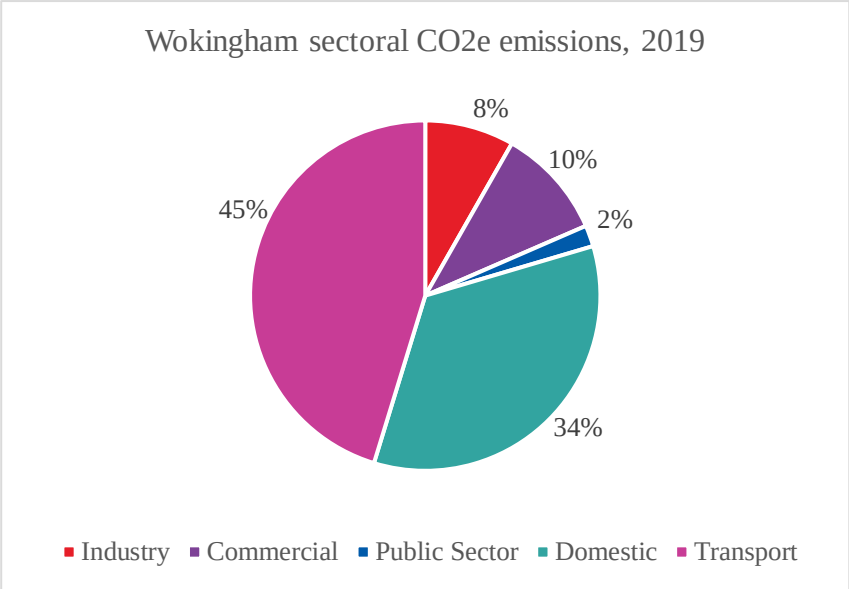


Figure 22 Comparison of the share of Wokingham's CO2 emissions across key sectors [Source: *Arup adapted © BEIS, 2021]*

The construction of new domestic buildings utilising the same footprint or approach of existing domestic buildings will add additional emissions or at least limit efficiency savings e.g. from decarbonisation of the grid.

Wokingham is currently and will continue to be in a period of growth over the next fifteen years, with the Government committed to delivering 300,000 new homes a year across England, to which Wokingham is expected to contribute roughly 800 homes per year[109].

A whole life-cycle carbon assessment more accurately reflects the complete carbon impact of a building by accounting for regulated, unregulated, and embodied emissions over the lifecycle of a building i.e. from raw material extraction through to end of life (see Figure 23).

[109] Wokingham Borough Council (2021) Right Homes, Right Places – Revised Growth Strategy, Revised Growth Strategy consultation - Wokingham Borough Council, accessed 12/05/22

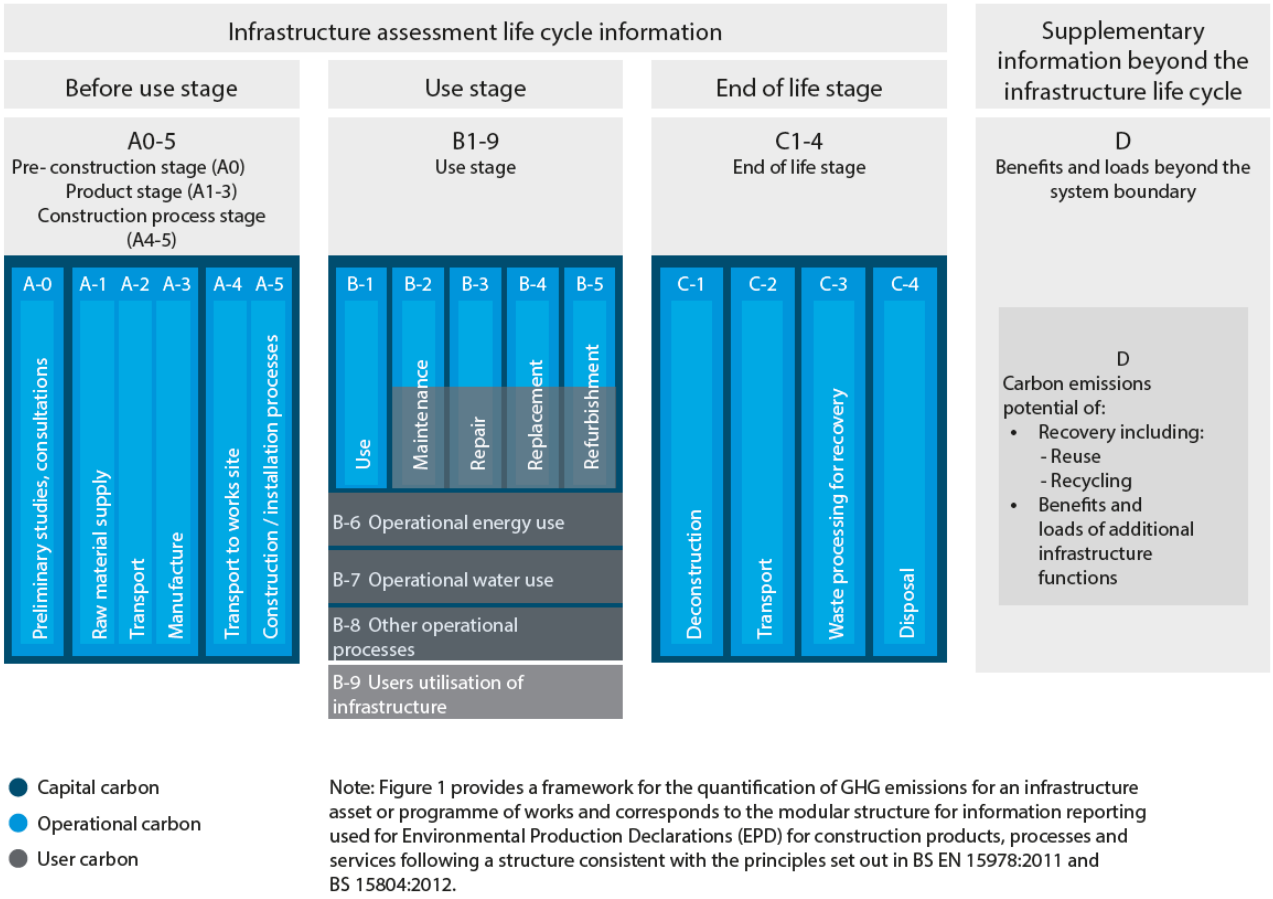


Figure 23 Asset life cycle stages used for carbon accounting. Source: PAS2080:2016 Carbon Management in Infrastructure, BSI, 2016

Currently embodied carbon accounts for between 22-34% of total annual built environment emissions in the UK - expected to rise to 40% by 2050.

Utilising the proposed approach to assessing new domestic construction emissions across its lifecycle, current estimations of emissions across each of the lifecycle stages per household are explored below.

Embodied emissions

Embodied emissions in a whole life-cycle carbon (WLC) assessment calculate the emissions arising from the extraction, manufacture and assembly of materials plus maintenance and end of life disposal.

These emissions account for 25% to 50% of the overall carbon footprint of new buildings.[110] If we consider the current lifetime footprint of a residential building to be 3.5 tCO_2e/m^2,[111] and the average UK home size is $96m^2$,[112] then the embodied emissions of one home could be up to 168 tCO_2e over 60 years. While this calculation is indicative only, it suggests that across 15,500 homes, embodied emissions could be as much as 2.6 $MtCO_2e$.

This report is considering the emissions profile in Wokingham over the 17-year period to 2038 and has calculated the operational emissions for this period below. The embodied emissions do not increase over

[110] UKCCC, 2019. UK Housing: Fit for the Future? [Online] Available at: https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf

[111] Schwartz, Y., et al. The Life Cycle Carbon Footprint of Refurbished and New Buildings – A Systematic Review of Case Studies

[112] Department for Levelling Up, Housing and Communities , 2021. English Housing Survey 2020 to 2021: headline report. Available: https://www.gov.uk/government/statistics/english-housing-survey-2020-to-2021-headline-report

time like operational emissions but are produced at discrete points e.g. resource extraction, end-of-life disposal.

Some of these emissions will not contribute to Wokingham's carbon footprint as they will be produced outside the boundary of the borough, but it is important to consider the full impact that new housing can create.

By way of illustration, modelling undertaken for the UK Climate Change Committee in their 'Biomass in a low carbon economy report' found that switching materials and construction method to timber frame construction can reduce embodied emissions by up to around 3 tCO_2e per home.[113]

Operational emissions

Ofgem estimates that Typical Domestic Consumption Values (TDCV) at medium levels in UK households is 12,000 kWh gas and 2,900 kWh electricity per year.[114,115] Assuming no changes in efficiency or reduction in use, applying the existing carbon factor for gas and the average carbon factor of the UK electricity grid between now and 2038, the emissions of a residential household built today by 2038 would be 45.6 tCO_2e, as shown in Table 2.

Table 2 Estimation of operational emissions produced by new development in Wokingham

ftablef	Electricity	Gas
Average Annual Consumption (kWh)[116]	2,900	12,000
Grid factor (kgCO2e/kWh)	0.0815[117]	0.20374[118]
Total emissions over 17 years 2021 – 2038 (tCO_2e)	4.0	41.6
Sum use emissions over lifetime (tCO_2e)	45.6	

Note that this does include unregulated emissions which is challenging for local authorities to target through local plan policies but is illustrative of the scale of emissions that could be tackled.

Therefore for 15,500 homes there could be up to 707 ktCO2e of emissions over the 17-year period. Wokingham borough's cumulative emissions under a BAU scenario between 2021 and 2038 are 12.4 $MtCO_2e$, and therefore reducing just in use emissions could reduce this by 6%.

This demand is also likely to be increasing due to the trend towards single person households in the last twenty years[119]. In this the absolute increase in energy and gas consumption may not be as much as anticipated with a new build due to the reduction in energy consumption from another household.

All homes will need to make a contribution towards achieving net zero through their energy usage and efficiency. The retrofitting of domestic properties to a net zero standard is far more expensive than ensuring

[113] UKCCC, 2019. UK Housing: Fit for the Future? [Online] Available at: https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf

[114] Based on an Electricity: Profile Class 1, the most common type of metering system within UK homes.

[115] Ofgem, 2020. Typical Domestic Consumption Values. [Online] Available at: https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values

[116] Ofgem, 2020. Typical Domestic Consumption Values. [Online] Available at: https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values

[117] Average calculation. BEIS, 2020. Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. [Online] Available at: https://www.gov.uk/Government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[118] Net CV carbon factor. BEIS, 2020. Greenhouse gas reporting: conversion 2020. [Online] Available at: https://www.gov.uk/Government/publications/greenhouse-gas-reporting-conversion-factors-2020

[119] ONS, 2011. General Lifestyle Survey: 2011.

that as a new build it already meets this standard, see Table 3. Thus, building net zero homes is a more cost-effective measure per tonne saved.

Table 3 Summary of the cost of different climate change mitigation and adaptation measures in new and existing house buildings

Measure	Cost (£) – new build	Cost (£) – retrofit (equivalent outcome)
Air source heat pump and ultra-high fabric efficiency[a]	£4,800	£26,300
Passive cooling[a,b]	£2,300	£9,200
Water efficiency measures[b]	£300	£3,300

Sources:
[a] Currie & Brown and Aecom, 2019, for the CCC. The costs and benefits of tighter standards for new buildings
[b] Wood PLC, 2018 for the CCC

This analysis was focused on the carbon impact of homes themselves, however, locating new homes within towns and cities can also reduce the demand for travel, as employment opportunities, retail and leisure activities, and public services are already located nearby, and therefore the need for additional infrastructure. A similar principle sits behind planned strategic developments, where infrastructure and active travel opportunities can be planned in at the outset, reducing the need to travel by private car.

4.6 Wokingham's Climate Change Future

In summary, Wokingham, as with the rest of the UK, is likely to face significant changes in climate over the following fifteen years. Notably for the region this includes prolonged periods of extreme heat and cooling degree days, and reduced precipitation during summer months. Conversely, in the winter it is likely that precipitation levels will increase and coupled with greater development, this could compound the potential for surface and fluvial flooding.

Wokingham's GHG emissions are concentrated in the domestic and transport sector, with domestic emissions becoming increasingly difficult to reduce due to the high reliance on gas usage in the home. Embodied emissions are rarely considered when assessing the impact of the built environment but have been shown to contribute up to 50% of a new building's emissions and therefore have the potential to prevent the achievement of net zero in Wokingham and in the UK. In line with the national ambition to be net zero then all buildings whether existing or new will need to transition to a low carbon blueprint. Ensuring that homes are built to this standard as soon as possible reduce the long-term costs for residents through the need to retrofit.

5. Embedding Climate Change in Local Plan-Making

The aim of this section is to identify examples of how climate change actions, both in respect of mitigation and adaptation, might be effectively incorporated into planning policy. This section looks at:

Climate change mitigation - the aim is to identify exemplary local plan interventions to reduce emissions.

Climate change adaptation - the aim is to identify exemplary local plan interventions to reduce vulnerability to climate risks.

This section draws on Arup's previous project experience, the literature review of key legislation, planning policy and guidance outlined in Section 3 and an initial screening of best practice seen elsewhere.

As acknowledged by Government, effective spatial planning is an important part of a successful response to climate change, as it can heavily influence greenhouse gas emissions.[120] Planning can contribute to increasing resilience to climate change impacts through the location, mix and design of development. However, local plans do not have the power to influence all sources of emissions within their boundary. The following discussion is focused on change that can be enacted through planning policy and as such avoids discussing in any detail policy options that are not within the remit of the local plan, e.g. in respect of the existing building stock.

The discussion looks at where local authorities have successfully embedded climate change into their planning policies based on a review of best practice. The review divides possible actions into mitigation and adaptation interventions that might feasibly be taken forward through the LPU, and then structured according to key policy themes. As the motivation for identifying climate change interventions enacted through planning is to inform a position statement on the role of local plans in delivering net zero (and resilient) development, the limits of local plans in this regard must also be established. All interventions would be subject to viability testing before being included in a Local Plan.

5.1 Mitigation

The policy theme headings that structure the list of exemplary interventions are based on our extensive experience of reviewing sustainable development, energy and climate change policies in Local Plans that "contribute to radical reductions in greenhouse gas emissions" (NPPF para 152). The key policy themes for mitigation are:

- sustainable building design;
- renewable energy;
- heat networks; and
- low carbon transport.

5.1.1 Sustainable Building Design - Operational Emissions

Operational emissions are those emissions which result from all activities related to the use of a building over its lifespan. Building Regulations[121] set minimum standards for the performance of buildings, with Part L specifically regulating the conservation of fuel and power. The designed carbon emission rate of a new build must not exceed the Target Emission Rate (TER) for a notional building of a similar type, size and

[120] Department for Levelling Up, Housing and Communities (2019) Climate Change, https://www.gov.uk/guidance/climate-change#why-is-it-important-for-planning-to-consider-climate-change, accessed 11/05/21

[121] Building Regulations (2013) Conservation of fuel and power: Approved Document L, https://www.gov.uk/Government/publications/conservation-of-fuel-and-power-approveddocument-l, accessed 06/05/21

shape. The TER is what will be decreased by 31% from the end of 2021 (and approximately 75% from 2025) because of the Future Homes Standard[122].

Local plans can mandate specific percentage reductions against the TER. The percentage is typically lower for minor developments compared to major developments. The London Plan (2021) requires through Policy Sustainable Infrastructure 2 - Minimising Greenhouse Gas Emissions:

"Major development should be net-zero carbon[123]…"

"A minimum on-site reduction of at least 35 per cent beyond Building Regulations… for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures."

For major developments, which must aim to be net zero carbon, this policy means that they must achieve a minimum on-site carbon reduction of a 35% improvement over Part L Building Regulations (e.g. through fabric efficiencies and renewable energy generation), after which point developers can utilise offsetting measures to reach 'net zero'.

The carbon emission rate of a building is typically reduced through energy efficiency measures, such as triple glazing or a waste-water heat recovery system. Other sustainable design practices that reduce building energy use include:

- maximisation of passive features (daylighting, heating, cooling and ventilation),
- building orientation,
- thermal mass and shape, and
- landscaping.

Milton Keynes' Local Plan (2019)[124], for example, requires developments to prioritise fabric first, passive design and landscaping measures to minimise energy demand for heating, lighting and cooling.

The installation of low-carbon heating and/or renewables, such as solar photovoltaic panels, is also an appropriate means to reduce carbon emission rates, as mandated in Oxford's Local Plan[125], which requires a 40% reduction in carbon emissions, of which 25% must be achieved through on-site renewable energy and other low carbon technologies.

Another mechanism used by local plans to reduce operational emissions is to require the application of building sustainability assessment methods, such as Building Research Establishment Environmental Assessment Method (BREEAM) or Leadership in Energy and Environmental Design (LEED). These assessment standards are typically used with the objective of minimising energy consumption, minimising the use of non-renewable materials and water, and reducing the production of emissions, wastes and pollutants, among other factors. The level of standard required by local plans varies, including across different scales/types of development. Reading Borough Council's Local Plan[126] (2019) states that:

"All major non-residential developments or conversation to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible; [and] all minor non-residential developments or

[122] Department for Levelling Up, Housing and Communities (2021) The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings, https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf, accessed 28/04/21

[123] Zero carbon is defined as an activity that causes no net release of carbon dioxide and other greenhouse gas emissions into the atmosphere.

[124] Milton Keynes Council (2019) Plan:MK https://www.milton-keynes.gov.uk/planning-and-building/plan-mk, accessed 05/05/21

[125] Oxford City Council (2020) Oxford Local Plan 2036, https://www.oxford.gov.uk/downloads/file/7380/adopted_oxford_local_plan_2036, accessed 06/05/21

[126] Reading Borough Council (2019) Reading Borough Local Plan, https://images.reading.gov.uk/2019/12/Local_Plan_Adopted_November_2019.pdf, accessed 06/05/21

conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum."

Developer contributions are a tool utilised by Reading Borough Council to compensate for any shortfalls in carbon reductions in developments. The Reading Local Plan requires developer contributions when it can be clearly demonstrated that zero-carbon targets for major development cannot be fully achieved on-site. Offsets should be seen as a last resort (illustrated in Figure 24), and the charges paid into the Council's carbon offset fund. A similar scheme is included in the London Plan. The London Plan adopts a carbon offset price of £95 per tonne carbon - a level considered sufficiently high to encourage a greater level of on-site carbon reduction (beyond the 35% minimum required), as opposed to widespread use of offsetting.

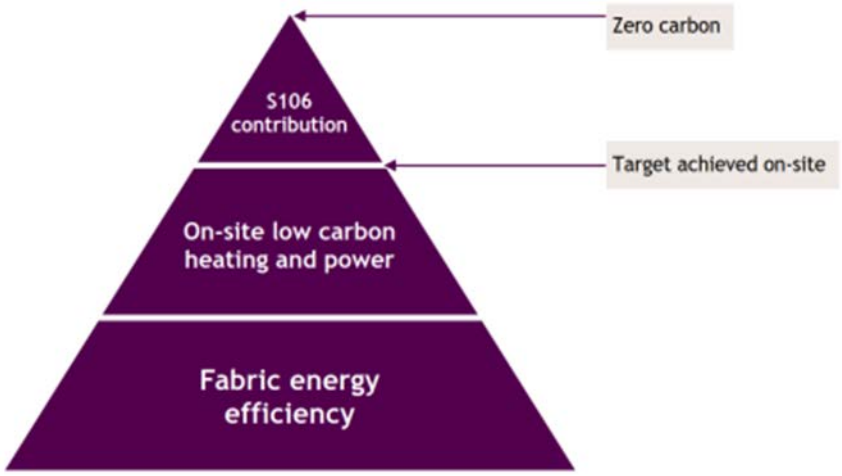


Figure 24: Reading Borough Council's approach to net zero developments

5.1.1.1 Summary of possible policy interventions: Building Design – Operational Emissions

- Building Regulations – Target Emissions Rate achieved through energy efficient measures such as glazing, waste-water heat recovery systems, and landscaping;
- Low-carbon heating and renewables such as solar photovoltaic panels;
- Requiring building sustainability standards such as BREEAM or LEED;
- Developer contribution to compensate for any shortfalls in carbon reductions in developments.

5.1.2 Sustainable Building Design - Embodied Emissions

Between 30-70% of emissions associated with buildings are associated with pre-occupancy stages[127] (from product/material, design and construction related emissions). This figure will increase as the energy efficiency of buildings increases unless we simultaneously decrease embodied emissions, reducing the percentage of lifetime emissions that arise from operation/use of a building or asset. To fully capture a development's carbon impact, a whole life-cycle approach to building design is required. This captures the pre-occupancy stages already mentioned, in addition to a building's unregulated emissions (i.e. those associated with cooking and small appliances), its embodied emissions, and finally emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. The Climate Change Committee recommends that "Government should work towards introducing a mandatory minimum whole-life carbon standard for both buildings and infrastructure." [128]

[127] The Crown Estate and UK Green Building Council (2014) Tackling embodied carbon in buildings, https://www.ukgbc.org/sites/default/files/Tackling%20embodied%20carbon%20in%20buildings.pdf, accessed 05/05/21

[128] Climate Change Committee (2020) Policies for the Sixth Carbon Budget and Net Zero, https://www.theccc.org.uk/publication/sixth-carbon-budget/, accessed 05/05/21

The London Plan[129] (2021) exemplifies recent policy ambition on embodied carbon through Policy Sustainable Infrastructure 2 - Minimising Greenhouse Gas Emissions Part F:

"Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions."

The Mayor of London has published accompanying draft guidance to support the preparation of whole life-cycle (WLC) assessments, with the objective of minimising a development's WLC carbon emissions. The principles set out in the guidance document[130] include:

- the re-use of existing materials and the retrofit and retention of existing structures and fabric over new construction;
- the use of recycled materials and designing for future reuse and recycling, so reducing waste and supporting the circular economy;
- a 'fabric first' approach to promote natural ventilation;
- considering operational and embodied emissions simultaneously;
- sourcing materials locally and through short supply chains; and
- designing for durability and flexibility, increasing building longevity, and avoiding emissions associated with demolition and new construction.

5.1.2.1 Summary of possible policy interventions – Embodied Emissions

Require the submission of a whole life cycle assessment to accompany major planning applications. Applicants would need to demonstrate steps taken to reduce emissions at each stage of a building's life cycle. Calculate a whole lifecycle carbon standard for buildings and infrastructure including the re-use of existing materials and designing for building durability and flexibility.

5.1.3 Renewable Energy

Local plans, such as Oxford City Council's[125], can mandate a percentage of renewable energy to be generated on-site to partly meet the energy demand of new development of a given size. Such policy can include, as in Milton Keynes' Local Plan[131] (2019), strong encouragement for schemes to be community-led.

A less prescriptive approach is seen in local plans which stipulate that developments which incorporate renewable energy sources are more likely to be supported. Rather than mandating renewable energy for certain scales of development, this type of policy would be less specific and require development to have some regard to meeting part of the predicted energy demand through on-site renewable energy generation.

Policy might incorporate a requirement for proposals to provide an Energy Statement, demonstrating compliance with an energy hierarchy that typically follows the structure below:

- Reduce initial energy demand;
- Employ energy efficiency measures within development;
- Utilise renewable energy sources to meet demand;
- Utilise low carbon energy sources; and
- Meet energy demand through conventional energy resources.

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[129] Mayor of London (2021) The London Plan, https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf, accessed 05/05/21

[130] Mayor of London (2020) Whole Life-Cycle Carbon Assessment Guidance Consultation Draft, https://www.london.gov.uk/sites/default/files/wlc_guidance_consultation_version_oct_2020.pdf, accessed 05/05/21

[131] Milton Keynes Council (2019) Plan:MK https://www.milton-keynes.gov.uk/planning-and-building/plan-mk, accessed 05/05/21

Local plans can support standalone renewable energy projects by identifying land suitable for this type of development on their policies map. For on-shore wind to gain approval, for example, it has been a requirement of national policy since 2015 that the land be allocated clearly in a local plan or neighbourhood development plan, unless the project is community-led[132].

5.1.3.1 Summary of possible policy interventions for renewable energy

Mandate a percentage of renewable energy to be generated on-site;

Require development to incorporate renewable energy sources into design;

Energy Statement to be submitted with the planning application;

Local plans to allocate land for renewable energy projects

5.1.4 Heat Networks

Heat networks, also known as 'district heating' schemes, supply heat from a central source to consumer, via a network of underground pipes carrying hot water. Heat networks can cover a large geographical area or be fairly local supplying a group of buildings. Networks can be supplied by a diverse range of sources, including energy from waste facilities, industrial processes, biomass boilers, heat pumps, geothermal sources and gas-fired combined heat and power units. Heat networks are one of the most cost-effective ways to reduce carbon emissions from heating - and their efficiency and carbon-saving potential increases as they expand and connect to each other[133]. From 2025, when the Future Homes Standard[122] comes into force, heat networks are likely to become ever-more present across towns and cities, forming an important part of the Government's heat decarbonisation plan.

Local plans can effectively support heat networks through:

Site selection: locating development in proximity to an existing heat network, to a strategic heat source or to a source of heat demand, enables development to connect to or contribute to existing and new heat networks.

Spatial strategy: co-locating growth to achieve densities of heat demand to sufficiently allow the delivery of commercially viable heat networks.

Specific policy: requiring development to connect to an existing network or be built to be 'connection ready' for new/expanded heat networks.

In several local plans reviewed, policy required development that met a certain threshold to include decentralised energy provision, unless it could be demonstrated that this was not suitable, feasible or viable. In Reading's Local Plan, this threshold was set at any development of more than 20 dwellings and/or non-residential development of over 1,000 sq m. Where an existing network was in place, the number of dwellings was reduced to 10 to consider the feasibility of connecting to the network.

By way of another example, Heat Network Priority Areas[134] have been mapped by the Mayor of London and included in the London Plan. These areas identify where in London the heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers. The London Plan states that major development proposals within Heat Network Priority Areas should:

"have a communal low-temperature heating system:

the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

- *connect to local existing or planned heat networks*

[132] House of Commons (2015) Wind Energy Written Statement, https://www.parliament.uk/globalassets/documents/commons-vote-office/June-2015/18-June/1-DCLG-Planning.pdf, accessed 23/04/21

[133] Royal Town Planning Institute (2019) Planning for a Smart Energy Future, https://www.rtpi.org.uk/media/1435/planning-for-a-smart-energy-future.pdf, accessed 07/05/21

[134] Mayor of London (n.d.) Heat Map, https://maps.london.gov.uk/heatmap, accessed 07/05/21

- *use zero-emission or local secondary heat sources (in conjunction with heat pumps, if required)*
- *use low-emissions or combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)*
- *use ultra-low NOx gas boilers*

….where a heat network is planned but not yet in existence, the development should be designed to allow for the cost-effective connection at a later date".

5.1.4.1 Summary of possible policy interventions: heat networks

Locate development in proximity to existing heat sources;

Co-locating growth to achieve densities of heat demand to sufficiently allow the delivery of commercially viable heat networks;

Require development to connect to an existing network or be built to be 'connection ready' for new heat networks;

Larger developments to include decentralised energy provision; and

Achieving a heat density sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers.

5.1.5 Low Carbon Transport

Locating the right development in the right place to reduce car use and encourage modal shift can be supported by local plans through the setting of an appropriate spatial strategy. The concept of '20-minute neighbourhoods' is gaining increasing traction[135] and indeed WBC's current strategic development approach to managing development takes a similar approach. Sustainable Transport Corridors, as adopted in the Harlow and Gilston Garden Town[136] are designed to ensure residents, workers and visitors can get around by a choice of transport modes, promoting active travel modes, while also reducing the need to travel.

Oxford's Local Plan seeks to prioritise walking, cycling and public transport above private cars. It states that:

"Planning permission will only be granted for development that minimises the need to travel and is laid out and designed in a way that prioritises access by walking, cycling and public transport."

Oxford City Council has utilised its local plan to ensure that development contributes to improving both pedestrian and cycling infrastructure for the city:

"Development [will] provide for connected, high quality, convenient and safe (segregated where possible) cycle routes within developments and the wider networks that are permeable and can accommodate the anticipated increase in cycling."

To encourage and accompany increases in cycling, policies can require that secure cycle parking is created through new development. The London Plan (2021) contains minimum standards for secure, well-located cycle parking spaces. Relatedly, Plans can restrict car parking provision to nudge residents and visitors towards sustainable modes of transport. They can also require the provision of electric vehicle charge points as part of any new development likely to result in trips by car.

5.1.5.1 Summary of possible policy interventions: Low Carbon Transport

Reduce the need to travel through the spatial strategy;

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[135] Royal Town Planning Institute (2021) Implementing 20 Minute Neighbourhoods in Planning Policy and Practice, https://www.rtpi.org.uk/research/2021/march/20-minute-neighbourhoods/, accessed 06/05/21

[136] Epping Forest District Council (2019) Harlow and Gilston Garden Town Sustainable Transport Corridors Strategy and Delivery Plan, https://www.efdclocalplan.org/wp-content/uploads/2019/02/EB1407A-Harlow-and-Gilston-Garden-Town-Sustainable-Transport-Corridor-Study-Summary-Report-Jan-2019.pdf, accessed 13/05/21

Promote and prioritise sustainable and active travel modes;

Require developments to integrate sufficient active travel infrastructure;

Design-in electric vehicle charging points.

5.2 Adaptation

The review of adaptation interventions identifies actions which "minimise vulnerability and improve resilience" (NPPF para 152), taking into account "… the long-term implications for flood risk, …, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures…" (NPPF para 153). Interventions are structured according to the following policy themes:

- reduced risk of overheating;
- reduced flood risk;
- green infrastructure; and
- reducing water demand.

5.2.1 Reduced Risk of Overheating

Local plans can specify that building design take account of the need to minimise summer over-heating, both inside buildings and in the outside surrounds. Intelligent building orientation to reduce heat and the incorporation of natural ventilation, for example, also provides climate mitigation benefits through reducing the need for air conditioning. The London Plan (2021) specifies that:

"Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure…

Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1. *Reduce the amount of heat entering a building through orientation, shading, high albedo materials[137], fenestration[138], insulation and the provision of green infrastructure*
2. *Minimise internal heat generation through energy efficient design*
3. *Manage the heat within the building through exposed internal thermal mass and high ceilings*
4. *Provide passive ventilation*
5. *Provide mechanical ventilation*
6. *Provide active cooling systems."*

5.2.2 Reduced Flood Risk

The NPPF states that 'inappropriate' development should not be located on sites vulnerable to flooding, as evidenced through a flood risk assessment. In setting a spatial strategy and selecting sites, a local plan can avoid development in flood risk zones and, where unavoidable, mandate the incorporation of flood resistant design.

Milton Keynes' Local Plan (2019)[131] contains the following Flood Risk Policy:

"Development within areas of flood risk from any source of flooding will only be acceptable if it is clearly demonstrated that it is appropriate at that location, and that there are no suitable available alternative sites at a lower flood risk."

The policy sets out various requirements for development proposed in flood risk areas, ensuring all opportunities are utilised to improve existing flood risk. Notably, the policy requires that:

[137] High albedo materials are materials which reflect a high level of thermal energy back into the atmosphere, rather than absorbing it.

[138] Fenestration is the arrangement, proportioning and design of windows and doors in a building.

"…a site's design and any flood mitigation measures implemented [must be] designed with an allowance for climate change and the potential impact it may have over the lifetime of the proposed development"

Developers are directed towards the Environment Agency's guidance[139] on the use of climate change allowances in flood risk assessment.

The NPPF (Para 169) states that major development - of 10 dwellings or more - should incorporate sustainable drainage systems (SuDS) to manage water run-off, unless there is clear evidence that this would be inappropriate. The same policy applies to equivalent non-residential or mixed development.

Milton Keynes' Local Plan requires new development to incorporate SuDS. It adds that:

"Flood risk management and SuDS will be provided at a strategic scale and in an integrated manner, wherever possible;

Space will be specifically set aside for SuDS and fluvial flood risk reduction features and used to inform the overall layout of development sites;

This policy recognises the potential for multifunctional SuDS, which create additional social and environmental co-benefits:

…SuDS will be designed as multi-purpose green infrastructure and open space, to maximise additional environmental, biodiversity, social and amenity value, wherever possible."

5.2.3 Green Infrastructure

Green infrastructure provides some of the most effective ways to adapt environments, in particular urban environments, to future climate change, as evidenced by the inclusion of green infrastructure in both overheating and flood risk policy examples above. This role is in addition to the carbon sequestration service it provides, meaning that green infrastructure could equally be included as a policy heading in the mitigation section.

Local plans can allocate and safeguard land for green (and blue) infrastructure. They can also require development to compensate for any loss of green infrastructure, and/or incorporate new planting or biodiversity net gain. Reading's Local Plan (2019) includes a requirement for:

"New development [to] make provision for tree retention and planting within the application site, particularly on the street frontage, or off-site in appropriate situations, to improve the level of tree coverage within the Borough, to provide for biodiversity and to contribute to measures to reduce carbon and adapt to climate change."

Reading's Local Plan contains a requirement for development to provide biodiversity net gain, wherever possible. With the implementation of Schedule 14 of the Environment Act (2021) in November 2023, the vast majority of development (with specific exemptions) will be required to demonstrate a minimum 10% biodiversity net gain, preferably on-site.

5.2.4 Reducing Water Demand

Reducing amounts of rainfall in summer months is a risk posed by climate change which local plan policy can help to alleviate. Development management policies can encourage or specify the inclusion of rainwater harvesting systems and measures to reduce household water demand and use through the installation of water efficiency measures. The London Plan (2021) includes such a water infrastructure policy, stating that:

"Development proposals should:

1) Through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

[139] Environment Agency (2016) Flood Risk Assessments: Climate Change Allowances, https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances, accessed 06/05/21

2) Achieve at least the BREEAM ‘Excellent’ standard for the ‘Wat01’ water category160 or equivalent (commercial development)
3) Incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.”

5.2.4.1 Summary of possible policy interventions for adaptation measures:

Ensure building design to minimise summer over-heating. Energy Strategy to be submitted as part of the planning application to demonstrate how the development will reduce the potential for internal overheating;

Avoid planning development in high risk flood area. Mandate flood resistant design into proposals;

New development to incorporate SuDS;

Allocate and safeguard land for green and blue infrastructure; ensure it is designed in as part of development proposals.

Specify the inclusion of rainwater harvesting systems to reduce household water demand and use through the installation of water efficiency measures.

6. The Limit of Local Plans in Addressing Climate Change

Addressing climate change is one of the core land use planning principles which is expected to underpin plan-making and the delivery of sustainable development. Local plans are able to set out a framework for the future development setting planning policies which guide what kind of development can happen and in which places it can go. A local plan creates the foundations for a multitude of interventions, including those that promote climate change mitigation and adaptation.

However, the role and remit of local plans are clearly established by national legislation and policy. A local plan can only go so far in addressing climate change, as already identified in WBC's Climate Emergency Action Plan. To achieve a net zero Wokingham, multiple actors will need to work together - including WBC, residents, businesses, neighbouring authorities and central Government.

The following sets out the areas where the planning policy is particularly limited in its ability to achieve emissions reductions.

6.1 The Existing Building Stock

Ultimately, planning deals with new development proposal in an area, and has little influence over development that already exists. But with 80% of today's buildings expected to still be occupied in 2050[140], decarbonising our existing building stock needs to be a major priority. In Wokingham, domestic buildings are responsible for 43% of emissions[141]. Speaking just of domestic properties, the Climate Change Committee stated that almost all of the UK's 29 million existing homes would need to be retrofitted to be made low carbon, low-energy and resilient to a changing climate[142]. A range of local authority departments, together with central Government, have a critical role to play in supporting, leading or funding building retrofit. However, there is limited potential to support retrofitting through planning policy, recognising that many measures will not require planning permission. Where planning permission is required, planning policy can seek to support improvements, balancing this against matters, and encourage/require retrofit improvements.

6.2 National Grid Decarbonisation

While local plans can allocate land for renewable energy generation and specify on-site generation in developments, national policy is required to end the burning of fossil fuels nation-wide and to encourage the growth of the renewables industry. The decarbonisation of the National Grid is essential to mitigating climate change, especially with the increasing electrification of power and heating. Beyond the remit of the Local Plan, and likely in partnership with central Government, as well as private investors, WBC can take direct and indirect steps to drive investment in low and zero carbon heat and power generation locally.

6.3 Sustainable Modes of Transport

Transport emissions account for 32% of carbon dioxide emissions in Wokingham. Reducing these emissions is a high priority in the journey towards net zero. However, shifting motorists away from internal-combustion engine (ICE) vehicles and towards electric vehicles, active modes of travel or public transport can be supported, but not wholly achieved, through planning policy. Utilising the LPU to deliver public transport-oriented development, active travel infrastructure and electric vehicle chargepoints in new builds is essential. However, achieving resident behavioural change will demand additional action, both from WBC

[140] UK Green Building Council (n.d.) Climate Change, https://www.ukgbc.org/climate-change/#:~:text=Newly%20constructed%20buildings%20are%20more,is%20decarbonising%20our%20existing%20stock.&text=Heating%20alone%20results%20in%2010,other%20building%20types%20put%20together, accessed 07/05/21

[141] Wokingham Borough Council (2020) Climate Emergency Action Plan, https://www.wokingham.gov.uk/council-and-meetings/open-data/climate-emergency/, accessed 10/05/21

[142] UK Climate Change Committee (2019) UK housing: Fit for the future? - Climate Change Committee (theccc.org.uk), accessed 04/05/21

and central Government. Nudging residents and visitors towards sustainable modes of transport could require fiscal incentives, as well as targeted communications campaigns. WBC will also need to coordinate with private investors, perhaps via the Thames Valley Berkshire LEP, to introduce measures such as financing the provision of on-street and off-street electric vehicle charging points in existing settlements.

6.4 Greening the Economy

A green economy is "low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services."[143] 'Greening' the UK economy is a national priority, as indicated by a suite of national policy and strategy documents[144]. Local plans have no direct influence over the existing business types or practices. WBC can encourage the proliferation of sustainable businesses through procurement policies that demand green practices, as well as offering grants and training for local businesses wishing to reduce their environmental impact. The Local Enterprise Partnership is a key collaborator in greening Wokingham's economy. While local plan allocations can encourage new businesses and industries into the area, they cannot specifically control or influence the commercial decisions of businesses, and planning use classes do not distinguish between the carbon footprint of an applicant's business. Therefore, the planning system has limited ability to green the economy of an area.

6.5 Sequestering Carbon

Carbon sequestration is the process of capturing and storing carbon dioxide, Forestry and other natural land use (FOLU) currently sequester approximately 2% of the Borough's carbon footprint[145]. WBC expects the amount of kilotonnes of greenhouse gas emissions in CO2 equivalent (ktCO2e) to be sequestered in the Borough to double by 2030.

The UK Government is putting in place funding mechanisms to support the deployment and use of carbon capture, usage and storage (CCUS) technologies on industrial sites nationally. However, with Government aiming to be able to deploy CCUS at scale during the 2030s (subject to costs coming down sufficiently)[146], artificial carbon sequestration technologies are unlikely to aid Wokingham in the early part of the plan period or in meeting the 2030 net zero target. It is our natural environment, then, that will sequester and store carbon in its soils, sediments and vegetation.

Planning policy can safeguard natural habitats, designating locally important areas as protected areas within which only limited development types can take place. However, as is the case with the existing building stock, planning policy has only limited ability to improve the existing condition, or the carbon sequestration potential, of designated sites. This will change once Schedule 14 of the Environment Act (2021) enters into force and mandatory biodiversity net gain requirements apply to most developments across England (expected in November 2023)[147]. In recognition of the carbon sequestration role of the natural environment, Councils across the UK (including WBC) are adopting tree planting targets and/or land management decisions to improve carbon sequestration rates. The local plan policies map will identify areas, such as Biodiversity Opportunity Areas, where tree planting or restoration might be considered suitable. However, beyond the local plan, the funding mechanism for tree planting or land improvement schemes needs to be identified. WBC may also seek to engage with local landowners to identify further suitable sites to bolster carbon sequestration rates.

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[143] United Nations Environment Programme (n.d.) Green Economy, https://www.unep.org/regions/asia-and-pacific/regional-initiatives/supporting-resource-efficiency/green-economy, accessed 10/05/21

[144] Clean Growth Strategy (2017), Ten Point Plan for a Green Industrial Revolution (2020), Industrial Decarbonisation Strategy (2021)

[145] Wokingham Borough Council (2020) Climate Emergency Action Plan, https://www.wokingham.gov.uk/council-and-meetings/open-data/climate-emergency/, accessed 26/04/21

[146] UK Government (2017) Clean Growth Strategy, https://www.gov.uk/Government/publications/clean-growth-strategy, accessed 10/05/21

[147] The Environment Bill will make biodiversity net gain an integral part of planning consent. Planning permission will be subject to a condition that the development may not begin unless the local planning authority approves a biodiversity plan for at least 10% net gain.

7. Position Statement

The previous section has clearly presented the existing drivers for change and the policy and legislative framework that demands action against climate change at a local level. An early review of best practice demonstrates that effective local and strategic plans can deliver a range of key interventions to address climate change issues, while also helping to support communities, contribute to economic growth, and protect the wider environment. There is both a clear scope and a necessity for local planning authorities to make action on climate change an integral part of plan-making. This position statement synthesises the findings from the preceding review to set out the framework for action on climate change and WBC's critical role in contributing to this.

International drivers of change demanding action: Climate change has become a defining issue of our times. Significant action needs to be taken now, at scale and pace, to address the causes and effects of climate change and shape how it will impact on people, the economy and the environment into the future.
National legal commitment to address climate: The UK has legally committed to addressing climate change. The Climate Change Act (2008, 2019) requires the UK to reduce its greenhouse gas emissions by 100% (or net zero) relative to 1990 levels by 2050. This national target is reflected in planning legislation through the Planning Act (2008) and the amended Planning and Compulsory Purchase Act (2004), which place a legal duty on local plans to address climate change.
National legislation and policy outline the principles on action that local authorities must adopt: The National Panning Policy Framework (NPPF) is the key guiding document in local authority plan-making and development management. It requires strategic planning policies to take a proactive approach to climate change mitigation and adaptation, in line with the objectives and provision of the Climate Change Act.
Local action required to meet national and international targets: Meeting the UK's ambitious net zero target requires action at all levels of Government, and beyond. WBC has declared a climate emergency and published a Climate Emergency Action Plan[148] to guide both WBC as an organisation and the borough as a whole towards achieving carbon neutrality by 2030. The Climate Emergency Action Plan explicitly identifies the positive role planning policy can play in reducing emissions.
WBC, as the Local Planning Authority, needs to play its role in protecting the local and global environment in its period of growth: Wokingham borough is required to plan for growth in line with the expectations of national planning policy. WBC has already recognised that this growth will increase greenhouse gas emissions and thereby increase the challenge of reaching net zero.
Effective spatial planning as a powerful response to climate change: WBC acknowledges that the planning system is one critical tool available to local authorities to tackle climate change. If planned for appropriately, new development across Wokingham can make a significant contribution to adapting to and mitigating the effects of climate change.
Establishing a vision for Wokingham's future: Sustainability is one of the three pillars underpinning the vision for the LPU[149]. WBC ambition is to set a spatial strategy for the LPU that places growth in the right places to minimise unnecessary travel and balances new growth with encouraging decarbonisation and adaptation. WBC are looking to utilise the LPU as an opportunity to include ambitious sustainable design and renewable energy policies to ensure that the emissions arising from new development are minimised wherever possible. All major applications will need to comply with ambitious sustainability standards.
Utilising planning where it has the most influence: Local plans and the planning system regulate how our built environment looks and is constructed. They can guide future growth to be low carbon and resilient to climate change. Recognising that some interventions to achieve this sit outside of the local plan's sphere of influence, key planning policy areas to consider are: energy and resource efficient buildings, renewable energy, heat networks, transport, risk reduction, and green infrastructure.
Signpost, connect and support other areas where action can be taken: WBC is committed to playing as full a role as possible - leading by example as well as through encouragement - in achieving a carbon neutral

[148] Wokingham Borough Council (2020) Climate Emergency Action Plan, https://www.wokingham.gov.uk/council-and-meetings/open-data/climate-emergency/, accessed 05/05/21

[149] Wokingham Borough Council (2020) Right Homes, Right Places Draft Local Plan Public Consultation, https://www.wokingham.gov.uk/planning-policy/planning-policy-information/local-plan-update/, accessed 05/05/21

borough. WBC is taking a leadership role in respect of decarbonising its own operations. However, achieving a net zero Wokingham is not something that can be achieved through a local plan alone and the LPU is just one of the eight priority areas WBC is focussing on to reduce greenhouse gas emissions[148]. WBC will also use its sphere of influence over residents and businesses to drive behaviour change, encourage sustainable modes of transport, retrofit the existing building stock, green the environment and reduce waste sent to landfill.

Working in collaboration and partnerships to achieve shared goals: In addition to seeking resident buy-in, WBC will work in partnership with other organisations and actors to prevent future emissions. Key to this will be local businesses, parish councils, neighbouring authorities, Thames Valley Berkshire LEP and central Government. Together, we will shape a borough that will be "sustainable for generations to come".

8. Net Zero Definitions

A central aim of the LPU is to craft policies that make the fullest contribution possible to the mitigation of, and adaptation to, climate change and the transition to a low-carbon economy. This is achieved by requiring the highest possible sustainability standards from the new development. This section assesses differing definitions of 'net zero [emissions]' in order to recommend the most appropriate definition to be adopted.

There is no universal definition of 'net zero' for any sector, company, area or organisation. Whilst many Governments, local authorities and companies have declared a commitment to a 'net zero' target, the emissions, scope and boundaries which such commitments include is varied. In recommending the most suitable definition of net zero to be adopted by the LPU, there are three key questions to consider:

1. What is the boundary of the definition? Should different definitions be applied at the borough level and the individual asset (building) level?
2. Should the definition focus solely on carbon dioxide emissions, or include all greenhouse gases?
3. What does the 'net' in net zero mean? To what extent should positive offsetting of emissions be allowed to reach 'net' zero emissions?

The following discussion will address each of these questions in turn, identifying the definitional implications and making recommendations. These recommendations will be discussed with key stakeholders before a final recommendation is made.

8.1 What is the boundary of the definition? Should different definitions be applied at the borough level and the individual asset (building) level?

Scoping the boundary of a net zero definition refers to identifying what categories of emissions should or should not be included in the definition. The most common definition of emissions from the Greenhouse Gas Protocol[150] divides emissions into three categories, or scopes:

Scope 1 – Direct emissions that arise from the burning of fossil fuels from sources controlled by and within the boundary of the reporting entity.

Scope 2 – Indirect emissions[151] occurring as a result of the use of grid-supplied electricity, within the boundary of the study.

Scope 3 – Indirect emissions that occur outside the boundary of the study as a result of the activities or service demands within the study boundary, for example, the emissions associated with food produced outside of the area but consumed by residents within the area.

Scope emissions can be applied to different scales from borough to organisation and asset (building, infrastructure) level.

When considering the borough level, the GHG Protocol for Cities provide a globally recognised and robust accounting standard and framework for measuring and reporting CO2e emissions associated with a city or local authority. Figure 25 shows how scope emissions are defined across the different common activities occurring within a local authority. When local authorities refer to borough-wide emissions reduction targets, this target typically includes Scopes 1 and 2. In the emissions baseline for Wokingham set by WBC in their Climate Emergency Action Plan, aspects of Scope 1 (in-boundary transportation) are excluded for being beyond the council's scope of influence.

[150] Greenhouse Gas Protocol (2014) Global Protocol for Community-Scale Greenhouse Gas Emission Inventories, https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf, accessed 13/05/21

[151] Emissions that result as a consequence of the activities of reporting entity but occur at sources owned or controlled by another entity.

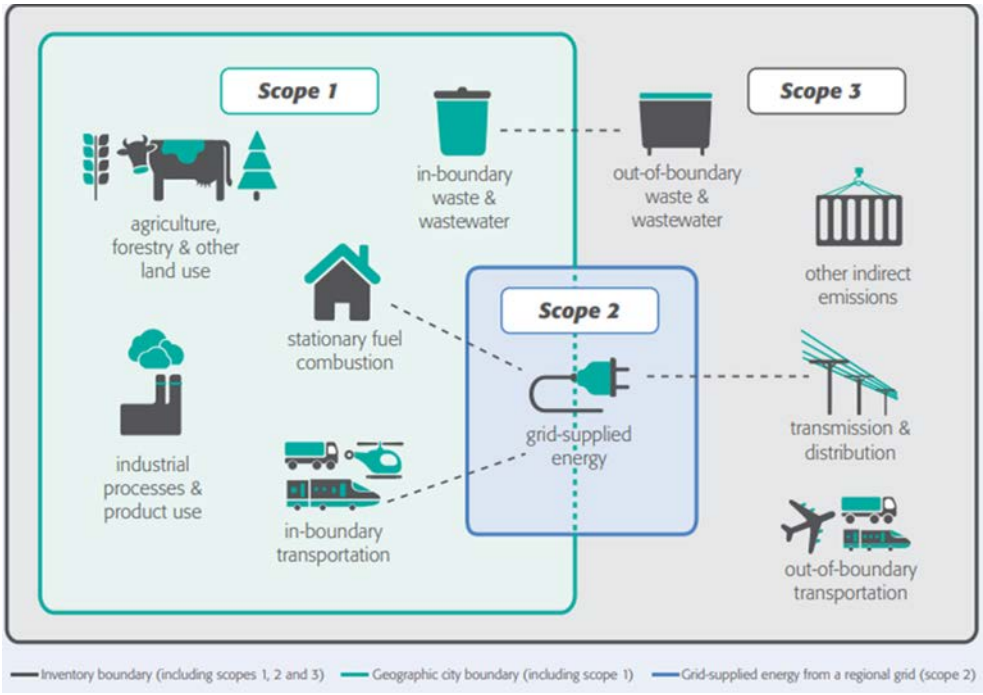

Figure 25: Categorisation of emissions scopes across different common local authority activities (Source: GPC)

While Scopes 1-3 are an effective way to conceptualise and calculate emissions arising across a geographical area, e.g. for Wokingham, there are alternative frameworks for assessing emissions at the asset level. At the asset (building) or infrastructure level, different scope emissions are categorised across **construction**[152] and **operational** emissions. The UK Green Building Council (UKGBC)[153] has defined what net zero means across these two categories of emissions:

9. **Construction**. For new buildings and major renovations - "When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy." Construction emissions typically include elements of Scope 1, 2 and 3 emissions.
10. **Operational Energy**. For all buildings in operation - "When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset." Operational emissions are Scope 1 and 2 energy related emissions. It is important to note that Part L Building Regulations[154], only regulate particular emissions arising from operational energy use. Some buildings can have unregulated energy accounting for 50% of total energy use[155]. This point is returned to on the following page.

A **whole life cycle framework approach** goes one step further than accounting for construction and operational emissions alone. It considers all life cycle stages of a building, extending the definition of

[152] Construction emissions are sometimes referred to elsewhere as 'embodied emissions'. For clarity, this study distinguishes between the two. Construction emissions are a sub-set of embodied emissions. Embodied emissions include maintenance and 'end of life' emissions, whereas construction emissions stop at practical completion of a building.

[153] UKGBC (2019) Net Zero Carbon Buildings Framework, https://www.ukgbc.org/wp-content/uploads/2019/04/Net-Zero-Carbon-Buildings-A-framework-definition.pdf, accessed 11/05/21

[154] Building Regulations (2013) Conservation of fuel and power: Approved Document L, https://www.gov.uk/Government/publications/conservation-of-fuel-and-power-approveddocument-l, accessed 06/05/21

[155] Dougherty, K. (2018) Unregulated Energy - Why We Should Care, https://www.cibsejournal.com/opinion/unregulated-energy-why-we-should-care/, accessed 13/05/21

‘embodied emissions’ to also include the maintenance, replacement, deconstruction, disposal and end of life emissions of an asset, see Figure 26.

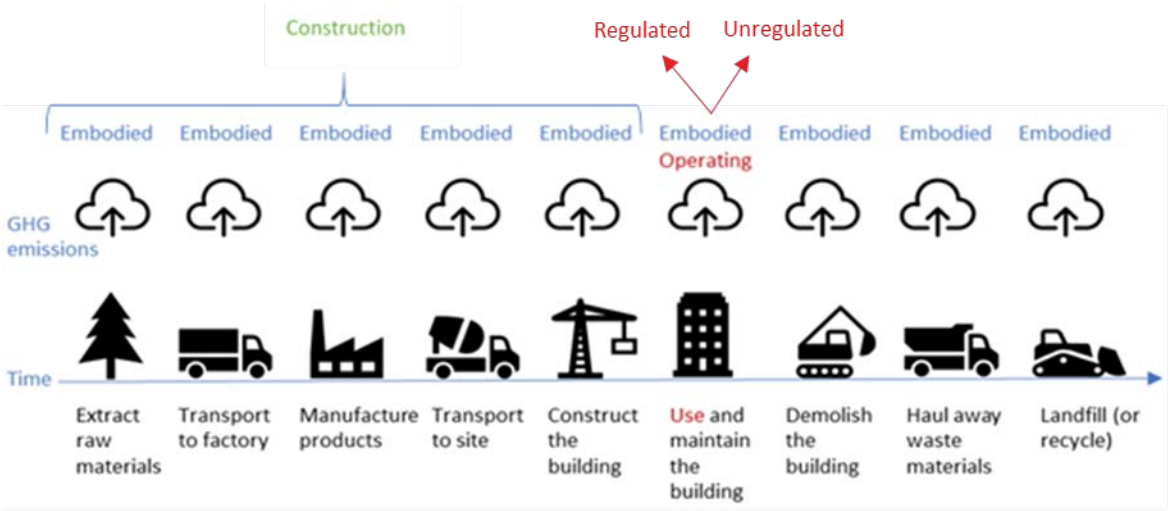

Figure 26: Type of emissions across different building lifestyle stages (Source: adapted from C40 Cities)

Finally, **consumption-based emissions** arise from the materials, manufacture, distribution, retail and disposal of goods and services. The consumption-based approach captures these direct and whole life cycle emissions and attributes them to the final consumers of those goods and services, rather than to the original producers[156].

Figure 27 summarises the types of emissions which exist at the building level (whether domestic or non-domestic). **The key takeaway here is that different definitions of net zero refer to reducing different types, or combinations of types, of emissions**. **Moreover, the definition most appropriate for adoption in planning policy may differ from that best suited for inclusion in the Climate Emergency Action Plan.** Any definition must clarify exactly what types of emissions it applies to.

[156] C40 Cities (2018) Consumption-Based GHG Emissions of C40 Cities, https://www.c40.org/researches/consumption-based-emissions, accessed 13/05/21

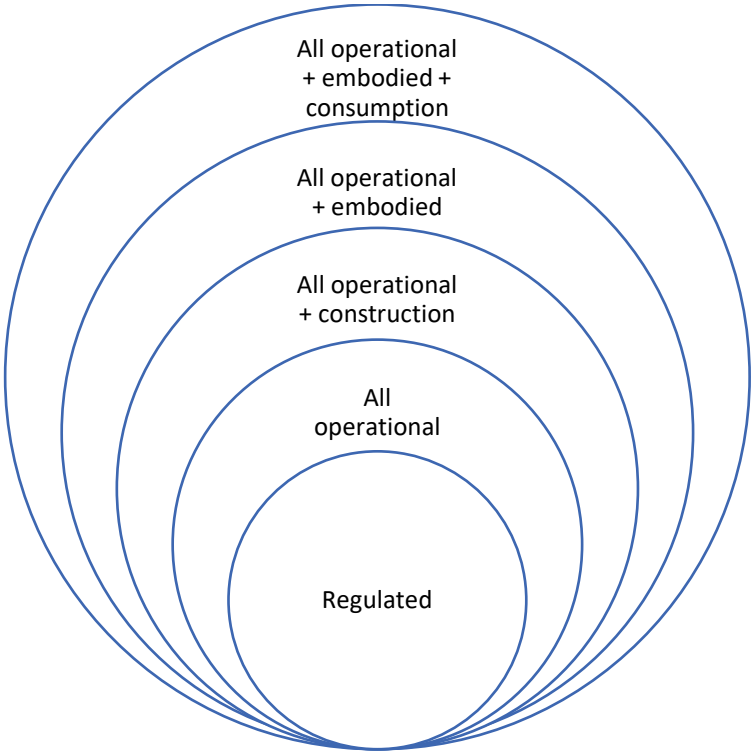

Figure 27: Asset level emission types

Regulated emissions - regulated emissions arise from the use of energy sources regulated by the Part L of the Building Regulations. These sources are fixed building services and fittings, including space heating and cooling, hot water, ventilation and lighting.
All operational emissions - all operational emissions refer to regulated emissions plus emissions that arise from the use of unregulated energy sources (i.e., those which the Building Regulations do not impose a requirement upon). Unregulated energy sources are cooking and plug-in electrical appliances.
Construction emissions - emissions associated with a building's product and construction stages up to practical completion, including extraction of materials, manufacture/processing, transportation and assembly of every product in the building. While some organisations refer to construction emissions as embodied emissions, a distinction is made between the two here for clarity. Construction emissions are a sub-set of embodied emissions.
Embodied emissions - construction emissions plus those emissions associated with the maintenance, replacement, deconstruction, disposal and end of life of a building.
Consumption emissions - these emissions arise from the consumption of goods and services within a development. In large developments, this might include transport, as well as other goods and services like food and waste.

10.1.1 Implications for Local Plan Update definition

An all-encompassing definition of net zero would require the calculation, monitoring and minimisation of emissions across types 1 to 5 of the asset level emission types in Figure 27 (i.e., regulated, operational, construction, embodied, and consumption emission types). **However, the ability of planning policy to influence each of these different types varies, as does the influence of developers.** The following paragraphs explain the influence of planning policy over each of the emissions types.

In terms of **regulated emissions,** planning policy can be used to set energy efficiency standards that exceed the target emission rates of the Part L Building Regulations. As in the London Plan (2021), WBC could require new developments to be net zero, specifying a minimum percentage of this net zero target to be achieved through emissions reductions above Building Regulations and through on-site renewable energy. Carbon offsets can be used to make up the shortfall. When setting energy or carbon standards, WBC must be cognisant of the potential energy performance gap between design and as-built buildings. Often the modelled

building energy performance[157] does not equate to actual in-use performance, undermining the objective of setting standards. Any requirement for buildings to comply with specific emissions reduction targets should be accompanied by a requirement for post-construction measuring and reporting on in-use energy, as in the BREEAM New Construction (2018) standard for non-domestic buildings, with the developer encouraged to address any gaps through additional measures.

In terms of **unregulated emissions**, planning policy has only limited opportunities for influence. It cannot set targets on unregulated energy and, at present, there is no standard or national calculation methodology for modelling unregulated energy demands in a building. What the LPU can do, however, is require that expected unregulated energy emissions are reported in an energy assessment, to be submitted alongside a planning application. While this requirement would not necessarily lead to any emissions reductions in this area, it would ensure that unregulated emissions are not simply overlooked and that developers have a quantified baseline against which they can take voluntary measures to offset unregulated emissions over the lifetime of a project. In addition, the LPU could indirectly mitigate the emissions arising from unregulated energy by allocating sites for and encouraging the provision of renewable energy projects that feed into the national grid, thereby aiding its overall decarbonisation and reducing the emissions associated with the electricity generated to power appliances. It is worth noting that BREEAM (2018) awards two credits out of nine in the energy element of the assessment for demonstrating a meaningful reduction in the total unregulated energy demand of the building by using energy efficient equipment and/or through meeting a proportion of unregulated energy demand through low carbon sources on-site or near-site[158].

As building standards impose more ambitious requirements and technical solutions resulting in higher on-site carbon savings become cheaper, the **emissions resulting from construction and materials** will make up a greater proportion of new development's emissions in the future. Modern methods of construction (MMC) offer a way to build to higher environmental standards - on carbon dioxide emissions, energy efficiency, and waste - compared with 'traditional' building methods. MMC is an umbrella term but broadly it involves anything that differs significantly from standard building methods and it includes a wide range of alternative off-site manufacturing and on-site techniques. Design related planning policies and/or site-specific planning documents can support the use of MMC, require developers to demonstrate how they have considered MMC in proposals, and set clear parameters for its use on site. Local plans can also include specific policies around circular economic design approaches that facilitate longer building lifetimes and greater flexibility for buildings to adapt to new uses, reducing the need for future construction and associated emissions.

In terms of **embodied emissions**, whole life-cycle carbon (WLC) assessments calculate the emissions arising from the construction and the use of a building over its entire life, including its demolition and disposal. The assessment includes calculating all operational emissions, both from regulated and unregulated energy use. No local plan to date has required certain scales of development to demonstrate net zero across *embodied* emissions. Such a policy would be subject to significant challenge at Examination. However, precedent is set by the London Plan (2021) to require WLC assessments – in London, this applies to applications referrable to the Mayor, yet the plan encourages London Boroughs to set the same requirement for major applications. Applications must demonstrate how embodied emissions can be reduced as part of the WLC assessment, but there is no requirement for specific reductions and this policy is separate to that requiring major development to be net zero (applicable only to regulated emissions). minimum whole-life carbon standard for both buildings and infrastructure."

With regards to **consumption emissions**, the role of the planning policy is more complex. Its role here is mainly to encourage behaviour change through shaping places which align with low-carbon lifestyles. This can be done through site selection and encouraging mixed developments, which should minimise the need for private vehicular travel. Policies can require the provision of cycle parking, electric vehicle charge points, and a safe and attractive public realm. Additionally, planning policy could require holistic sustainability standards, such as BREEAM (2018), which has credits for the provision of and improved access to sustainable means of transport and local amenities through new development. It also contains credits related

[157] Lewry, A. (2015) Bridging the performance gap: Understanding predicted and actual energy use of buildings, https://hstalks.com/article/2352/bridging-the-performance-gap-understanding-predict/, accessed 13/05/21

[158] BREEAM (2018) New Construction Standard, https://www.breeam.com/NC2018/content/resources/output/10_pdf/a4_pdf/print/nc_uk_a4_print_mono/nc_uk_a4_print_mono.pdf, accessed 13/05/21

to minimising water consumption and promoting water efficiency. This standard applies only to non-domestic buildings. However, influencing consumer choices is a power largely beyond that of local plans. Regardless, the role of effective place-making, which can nudge residents and visitors towards particular choices over others, should not be overlooked.

10.1.2 Recommendations for Wokingham Borough Council's Local Plan Update

Policy DH9 in the LPU Draft Plan Consultation (2020) states that "Major residential development will…be expected to be designed to achieve carbon neutral homes." It is recommended that 'net zero' is used in place of 'carbon neutral'. While the two terms are widely used synonymously, they can indicate potentially different approaches to balancing emissions. 'Carbon neutrality' can be achieved wholly through offsetting emissions, whereas 'net zero' is better achieved through a focus in the first instance on reducing emissions, with offsetting used as a last resort.

Subject to viability testing, WBC could require whole life-cycle carbon (WLC) assessments for major developments. In line with Part 1 of the Town and County Planning (Development Management Procedure) (England) Order 2015, major developments are generally:

Development of dwellings where 10 or more dwellings are to be provided, or the site is 0.5 hectares or more;

Development of other uses, where the floor space is 1,000 sq m or more, or the site area is 1 hectare or more.

In undertaking a WLC assessment, the true carbon impact of a building is accounted for in the design process, including regulated, unregulated, and embodied emissions over the lifetime of a building. WBC should incorporate a requirement for applications for major development to include a WLC assessment. The assessment must evidence steps taken to reduce embodied emissions. The WLC assessment will be a material factor taken into account by planning officers when determining applications: ambitious efforts to reduce embodied emissions will be weighed positively in the planning balance.

While no quantified threshold of emissions reductions would be included in LPU policy, wording to this effect demonstrates WBC's commitment to tackling emissions across the life cycle of new development.

Figure 28 illustrates the differing policy treatment of regulated operational emissions and all other emission types, as per the preceding recommendation.

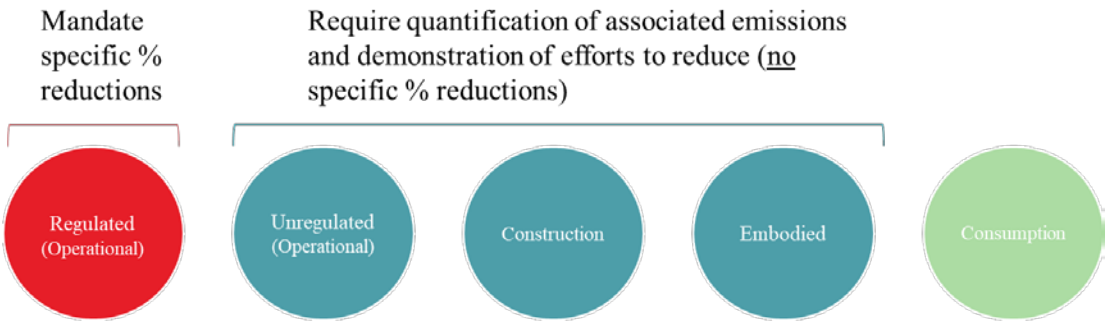

Figure 28: Proposed Approach to Emissions through LPU Policy

It is worth noting that, in addition to including unregulated emissions in a WLC assessment, the LPU can address unregulated emissions arising from the use of appliances *indirectly* by supporting the decarbonisation of the National Grid. As the grid decarbonises, the emissions associated with appliance use will fall over time. In line with the NPPF (Para 155), WBC should look favourably upon renewable energy planning applications, subject to the suitability of the site and minimisation of negative impacts. This will contribute to the overall decarbonisation of the grid and reduction of unregulated emissions.

10.2 Should the definition focus solely on carbon dioxide emissions, or include all greenhouse gases?

Carbon dioxide emissions (CO2) are typically the focus of climate change interventions because CO2 is the most abundant greenhouse gas (GHG) arising from human activity e.g. burning fossil fuels, industrial production and land use changes. However, CO2 is only one of the GHGs driving climate change, other common examples include methane and nitrous oxide. Each greenhouse gas has a different warming effect (known as its 'radiative efficiency') and remains in the atmosphere for differing periods of time (its 'lifetime'), lengthening or shortening the time in which each gas contributes to climate change. A Global Warming Potential (GWP) is a warming metric assigned to each GHG based on its heat absorption and duration in the atmosphere. GWP indicates the amount of warming a gas causes over a given period of time - conventionally, 100 years (**GWP100**), see Table 4.

Table 4: Summary of common greenhouse gases and their global warming potential

Greenhouse Gas	GWP100	Source activities	UK annual emission Mt (CO2e)
Carbon dioxide	1	Burning fossil fuels	365.1
Methane	28 - 36	Agriculture, industry, land use changes	54.0
Nitrous oxide	265 - 298	Agriculture, land use changes	22.2

The metric CO2e (carbon dioxide equivalent, CO2 equivalent or CO2eq) is used to compare emissions from GHGs on the basis of their GWP by converting amounts of other gases to the equivalent amount of CO2. While CO2 accounts only for carbon dioxide therefore, CO2e accounts for carbon dioxide and all other GHG emissions.

The UK Climate Change Act[159], which introduced the statutory target for the UK to reduce GHG emissions by 80% by 2050 - since amended in June 2019 to require a 100% reduction (or net zero) by 2050[160], - does not focus on the reduction of carbon dioxide emissions alone, but rather includes six major GHGs in its reduction target (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride). **While the fluorinated gases have significantly higher GWP100 figures, they have low concentrations in the atmosphere: the total impact of all fluorinated gases is estimated at 3% of all GHG emissions[161]**. Calculating emissions baselines and reductions on the basis of carbon dioxide only excludes the impact of other GHGs, providing an inaccurate indication of the scale of action needed to keep global temperature increases below 2ºC above pre-industrial levels, in line with the Paris Agreement.

10.2.1 Implications for Local Plan Update definition

WBC's emissions target is seeking to align to the international and national narrative of keeping temperatures below 1.5°C. Non-CO2 GHG emissions currently contribute 20% additional CO2e emissions to the UK's overall emission levels and therefore failure to account for their impact could have significant negative repercussions for mitigating the most significant impacts of climate change and meeting the 1.5° target. Furthermore, the emissions factors in Building Regulations which are used to calculate the carbon impact of a building are given as CO2e. Deviating from these standard calculations would, in practical terms, be onerous and challenging.

[159] UK Government (2008) The Climate Act, https://www.legislation.gov.uk/ukpga/2008/27/contents, accessed 23/04/21

[160] UK Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019, https://www.legislation.gov.uk/ukpga/2008/27/contents, accessed 23/04/21

[161] Olivier, J.G.J and Peters, J.A.H.W (2020) Trends in Global CO2 and Total Greenhouse Gas Emissions, Trends in global CO2 and total greenhouse gas emissions: 2020 Report (pbl.nl), accessed 12/05/22

10.2.2 Recommendation

WBC should set a 'net zero' target that incorporates all GHG emissions in terms of CO2e.

10.3 What does the 'net' in net zero mean? To what extent should positive offsetting of emissions be allowed to reach 'net' zero emissions?

Net zero refers to achieving a balance between the amount of anthropogenic GHG emissions produced and the amount removed from the atmosphere. There are therefore two complementary different means to achieving net zero: first, reducing the quantity of emissions emitted into the atmosphere, presently and in the future; and secondly, actively removing greenhouse gases from the atmosphere for an extended period, or permanently.

A gross-zero target would mean reducing all emissions to absolute zero with no removal of GHG emissions to offset the impact of continuing emissions contribution. This currently is not a realistic target due to the continuing difficult to treat areas of our economy e.g. industrial processes that do not currently have zero carbon alternatives. Rather, the net zero target recognises that there will be a small amount of GHG emissions that continue to be produced but that these need to be fully offset – currently being predominantly achieved through natural carbon sinks such as forests. The UK Government is also investing in carbon capture and utilisation technologies – i.e. artificial carbon sinks – to increase the rate of carbon removal. While increasing carbon sequestration will play a role in helping the UK to meet its net zero 2050 target, reducing emissions in the first instance must remain the priority. Developers can offset net zero emission shortfalls in developments by funding projects which avoid future emissions, such as low-carbon district heating networks or retrofitting of existing homes.

10.3.1 Implications for Local Plan Update definition

Considering the current technological, social and economic barriers to achieving absolute zero emissions, it would be unrealistic to set such a target. Additionally, WBC should be as consistent as possible with the UK Climate Change Act target definition, which is for net zero status by 2050 and allows for limited offsetting. Offsetting projects should be done within Wokingham to contribute to the borough-wide net zero target.

However, offsetting (or removing GHG emissions from the atmosphere to counter the impact of continuing to emit GHGs) should be seen as a 'last resort' option. Previous changes in the Earth's climate have indicated that the current observable impacts of global warming are not equivalent to where we have seen similar levels of GHGs in the atmosphere, and in fact we are approaching a 'tipping point' where the impacts could accelerate and there will be an irreversible change in the climate system[162] . Therefore, to the extent possible, WBC should seek to reduce its GHG emissions to zero and use offsetting where further reductions are considered to be practically impossible.

10.3.2 Recommendation

The LPU should adopt a net zero target where the emitted anthropogenic GHG emissions are equivalent to that removed from the atmosphere, but offsetting or active removals are used as a last resort option where further reductions are practically impossible.

10.4 How can developments achieve 'carbon positive' status?

In response to a specific inquiry by WBC, the possibility of development's achieving 'carbon positive' status is considered next. While net zero carbon buildings are today's benchmark of best practice, some organisations, such as the C40 Cities Climate Leadership Group, are already looking ahead to 'climate positive' - or net carbon negative - developments. There are few instances globally of developments which are on the path to going beyond net zero - including the Stockholm Royal Seaport in Sweden[163] and the regeneration of the Heygate Estate in London[164]. Importantly, the existing examples focus on achieving net-negative operational greenhouse gas emissions across the development site, including across energy, waste

[162] Lenton, T. et al. (2019) Climate tipping points – too risky to bet against. Nature, https://www.nature.com/articles/d41586-019-03595-0

[163] http://www.stockholmroyalseaport.com/

[164] http://c40-production-images.s3.amazonaws.com/other_uploads/images/499_Elephant___Castle_Roadmap_Summary.original.pdf?1453225537

and transportation. There is also an assumption that these sites will still need to offset remaining emissions by sequestering emissions on-site and/or reducing emissions off-site through funding energy retrofits, for example. In focussing on operational and wider consumption emissions, these examples demonstrate commendable ambition. However, embodied emissions are not included as part of the calculation of emission impacts of the developments, meaning that all those emissions arising through construction, maintenance and end of life processes are unaccounted for. With embodied carbon accounting for between 22-34% of total annual built environment emissions in the UK - and expected to rise to 40% by 2050 - it is recommended that efforts remain focussed on reducing the whole life-cycle emissions of development, rather than seeking to achieve carbon positive status for a limited scope of emissions.

10.5 Recommendations for 'net zero' policy

In answering the three questions set out at the beginning of this section, recommendations have been made for what definition of 'net zero' could be adopted in the LPU. In line with WBC's desire to be ambitious in its response to climate change, the recommendations have sought to include the widest possible scope of emissions, while recognising where the limits of planning lie.

It is recommended that:

- WBC recognise in their LPU that the emissions associated with a new development are both **operational** and **embodied**.
- WBC clarify in their LPU that there is no precedent in local planning policy to include embodied emissions in a net zero requirement (i.e. net zero across embodied and operational). While there is no explicit prohibition of the possibility in the national planning framework, such a requirement would likely be met with significant challenge and be removed during Examination. Therefore, the LPU defines 'net zero' as reducing regulated (operational) emissions to as close to zero as possible, with carbon offsets used as a last resort.
- WBC introduce a requirement for whole life cycle carbon assessments to be submitted as part of the Sustainability Statement. The threshold at which this requirement applies would be determined by the outcome of whole plan viability testing.

11. Energy Standards for residential and non-residential development

11.1 What's Possible and Review of Best Practice

This review of best practice highlights various approaches to embedding climate change and renewable energy considerations into planning policy. The review is divided into two parts: Best Practice Standards and Guidance and Best Practice Review of Local Authority Policies. The review of local authority policies is ordered by theme, recognising that different local authorities are showing leadership in different areas to address climate change, for example sustainable building design, low carbon transport and renewable energy.

Best practice with regards to renewable energy specifically has informed policy recommendations in Section 13 Future Renewable Energy Capacity, looking at opportunities for the LPU to achieve greater ambition on policy approaches to renewable and low carbon energy. Similarly, best practice with regards to sustainable building design has informed the assessment of any potential for planning policy to require higher sustainability standards of differing development typologies (discussed in Section 12).

11.2 Best Practice Standards and Guidance

The review considers information from/on the following organisations and topics:

Centre for Sustainable Energy (CSE)

Energy hierarchy

Royal Town Planning Institute (RTPI)

Town and Country Planning Association (TCPA)

UK Green Building Council (UKGBC)

Building Research Institute (BRE) Group guidance & standards

Passivhaus Accreditation Framework

Department for Levelling Up, Housing and Communities Viability Guidance (now the Department for Levelling Up, Communities and Housing)

Key messages have been drawn out on the following topics: energy demand reduction; performance assurance; retrofit; local area energy planning; heating and ventilation; and viability.

Energy demand reduction

As outlined in the national policy context, local planning authorities can set energy performance standards for new housing or the adaption of buildings to provide dwellings that are higher than the building regulations (Part L), *but only as long as they are in accordance with national policy and guidance.* Most recently, national policy has been interpreted by a number of local planning authorities as being the equivalent of Level 4 of the withdrawn Code for Sustainable Homes.

Guidance from UKGBC (2020)[165] recommends that setting a 19% reduction on the Dwelling Emission Rate (DER) against the Target Emission Rate (TER) is equivalent to the energy performance requirements in Code for Sustainable Homes Level 4. With the Future Homes Standard entering into effect from the start of 2022, requiring first a 31% reduction then a 75-80% reduction in emissions, this would be the new minimum level of energy performance required of homes.

[165] UK Green Building Council (2020) The Policy Playbook: Driving sustainability in new homes - a resource for local authorities VERSION 1.5. https://www.ukgbc.org/wp-content/uploads/2020/03/The-Policy-Playbook-v.1.5-March-2020.pdf, accessed 28/06/21

Guidance from UKGBC (2020) also recommends that local authorities the world-over enact planning policy, other regulation and incentives to ensure that all new buildings operate at net zero carbon by 2030.

Performance assurance

Best practice guidance advocates an approach to 'leapfrog' Energy Performance Certificate baseline requirements and aim for higher standards as this will minimise the likely cost of future retrofit. This includes a focus on long term goals, such as bringing targets in alignment with BREEAM schemes.

The UKGBC (2020)[165] report suggests that local authorities signal a commitment to introducing a system of in-use testing and reporting. This would require a proportion of homes in a new development to be tested to gather in-use data and provide a performance report on key factors including but not limited to energy performance, indoor air quality and thermal comfort for a set period of time after occupation. Energy performance standards, including Home Quality Mark and BREEAM, require post-occupancy evaluation.

Retrofit

Best practice guidance expresses the importance of outlining policies about retrofit of existing housing stock, *where these require planning permission.* An exemplar policy is found in Milton Keynes' Plan:MK, which states that "significant weight" will be attributed to proposals which would result in "considerable improvements to the energy efficiency and/or general suitability, condition and longevity of existing buildings".

Retrofitting properties include methods such as insulation, fitting new windows and doors, introducing smart technologies. Guidance from the Centre for Sustainable Energy[166] outlines the opportunity to design policies that can tackle both fuel poverty and carbon emissions. This would allow for more targeted interventions for housing where there is additional need and consideration should be taken about including policy to require an assessment of fuel poverty to be undertaken to inform policy making.

The Passivhaus standard EnerPHit is specifically focused on retrofitting. It is acknowledged that older buildings are much more difficult to bring up to Passivhaus standards, however they often have scope for the largest improvements in energy efficiency. Therefore, to achieve Passivhaus standard, EnerPHit requirements are slightly relaxed[167].

Local area energy planning

Guidance[168] published by the CSE in conjunction with the Energy System Catapult emphasises the beneficial role that local area energy planning (LAEP) can play in planning for the net zero transition. LAEPs are comparable to masterplans, which are prepared to establish a long-term view of how a local area should be developed, providing a clear and robust framework for change, without stipulating exactly what is going to be built where and when at the micro level. LAEPs take a similar, spatial planning approach to planning the type and interaction of an area's energy networks and building energy systems.

The LAEP guidance suggests that LAEP spatial boundaries should align with spatial planning authority coverage and that LAEP could be added as an additional dimension to underpin plan-making from an energy perspective. When undertaking the site selection process, LAEPs will provide real support by revealing the connectivity (real or potential) of proposed sites for low-carbon energy networks.

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[166] Centre for Sustainable Energy (2018) Tackling fuel poverty, reducing carbon emissions and keeping household bills down: tensions and synergies, https://www.cse.org.uk/downloads/reports-and-publications/fuel-poverty/policy/insulation-and-heating/policy-tensions-and- synergies-CFP-mainreport-may-2018.pdf, accessed 28/06/21

[167] Passivbuildings (2014) EnerPHit, http://www.passivbuildings.com/retrofit/enerphit/#:~:text=EnerPHit%20is%20the%20standard%20issued%20by%20the%20Passivhaus,%28new%20buildings%29%20for%20the%20refurbishment%20of%20old%20buildings, accessed 05/07/21

[168] Energy Systems Catapult and Centre for Sustainable Energy (2020) Local Area Energy Planning: Guidance for local authorities and energy providers. https://esc-non-prod.s3.eu-west-2.amazonaws.com/2018/12/Local-Area-Energy-Planning-Guidance-for-local-authorities-and-energy-providers.pdf, accessed 19/07/21

Heating and ventilation

Another key factor highlighted in the guidance review is heating and ventilation within housing, linked to energy demand reduction and retrofit. This could be considered for a policy in its own right or the use of BRE[169] or Passivhaus standards[170] could also be utilised to achieve this.

UKGBC (2020)[165] guidance outlines that new and existing buildings have become priority concerns for policy makers and related fiscal measures targeting the energy and carbon performance and that local planning authorities should develop an overheating risk framework which includes mitigation for overheating. This will ensure that developments should follow the cooling hierarchy, utilise an early screening assessment to be used by developers/ the LPA to provide a simple, time-efficient assessment of the risk of over-heating, and adopt a detailed appraisal system when early screening flags a potential issue. This could be guided in supplementary planning guidance and utilised as evidence supporting an application for use by decision makers.

Cooling hierarchy:

1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2. minimise internal heat generation through energy efficient design
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. provide passive ventilation
5. provide mechanical ventilation

Figure 29: Cooling Hierarchy (London Plan, 2021)

In the UK, Passivhaus Standard is a certification which relates specifically to heating and cooling performance of buildings. As such, it is recommended in guidance that local authorities take consideration of Passivhaus standards when considering policies for heating and ventilation.

Viability

Local authorities are required to prepare full plan viability assessments as a means of demonstrating that policy requirements of planning policies will not undermine deliverability of the plan. Viability assessments have to take into account all relevant policies including any planning obligations to provide or support the delivery of infrastructure, and local and national standards.

Best practice review has evaluated guidance on how to consider viability alongside delivering ambitious policy to address climate change. National guidance from the Department for Levelling Up, Housing and Communities suggests that policies must be clear as to who will pay for the implications of the policies, who is to gain, and why the decisions have been made. For example, if the local authority will be utilising S106/CIL funding, this should be set out[171].

In 2018, the BRE Group released a report considering the viability of achieving higher BREEAM ratings in non-residential development, using office developments as a case study. The study concluded that while achieving higher BREEAM ratings does incur some additional upfront capital costs, this is less than 1% and can be paid back within 5 years or less. This study found that "where properly implemented, sustainability strategies and solutions add little to the capital costs of new buildings, and that where there is an additional capital cost for a sustainable solution, these solutions quickly payback through their *operational savings*.

[169] Building Research Establishment (2020) BREEAM technical standards. https://www.breeam.com/discover/technical-standards/breeam- in-use/, accessed 29/06/21

[170] 44 Passivhaus Trust (2019) What is Passivhaus? https://www.passivhaustrust.org.uk/what_is_passivhaus.php#2, accessed 29/06/21

[171] MHCLG (2019) Viability https://www.gov.uk/guidance/viability, accessed 05/07/21

This demonstrates the importance of considering life cycle as well as capital costs when procuring and investing in new buildings." [172] The Briefing Paper concludes that:

For both 'Very Good' scenarios, the BREEAM related capital cost uplifts over the baseline building's overall construction costs are less than 0.25%.

For the two 'Excellent' scenarios, the capital cost uplifts are less than 0.75%.

The updated requirements in BREEAM UK New Construction 2018 have had very little impact on the additional capital costs of achieving 'Very Good' or 'Excellent' ratings.

The savings from the energy efficiency improvement measures required to achieve 'Excellent' ratings quickly payback the additional capital investment.

Figure 30 shows estimated increase in costs to achieve different BREEAM standards.

Increase in capital costs for different building types and certification levels

Rating	School	Industrial	Retail	Office	Mixed Use
Very Good	0.2%	0.1%	0.2%	0.2%	0.15
Excellent	0.7%	0.4%	1.8%	0.8%	1.5%
Outstanding	5.8%	4.8%	10.1%	9.8%	4.8%

Source: Tata Steel, British Constructional Steelwork Association Limited, AECOM, Cyril Sweett, The Steel Construction Institute, Development Securities PLC, 2012.

Figure 30: BRE Group (2016) The value of BREEAM: A review of latest thinking in the commercial building sector

Viability assessments have also been reviewed briefly within the local authority best practice review. This highlighted that there is little information available on the viability of reducing carbon emissions within development and noted that these discussions are typically held on a site-by-site basis with developers. Furthermore, viability assessments are often focused on the requirement to provide affordable housing.

Regardless, the Milton Keynes Whole Plan Viability Study[173] did explore the impact of Policy SC1 – Sustainable Construction, which requires a 19% carbon reduction improvement upon the requirements within Building Regulations Approved Document Part L 2013 and financial contributions to the Council's carbon offset fund for development proposals of 11 or more dwellings and non-residential development with a floor space of 1000 sq. m or more.

The Viability Study assumed professional fees for residential development would amount to 10% of build costs. The study considered these fees to be sufficient to cover the costs incurred by Policy SC1. Carbon offset payments were estimated at an average of £500 per dwelling in Milton Keynes. The study concluded that while the costs of meeting the lower carbon emissions can be substantial, in higher value/central areas there was a significant buffer to accommodate the local plan policy requirements (including affordable housing, flood defences etc.). In brownfield and lower housing value areas the local plan was considered less viable when taken as a whole.

[172] BRE Group (2018) Delivering Sustainable Buildings: Savings and Payback Office Case Study for BREEAM UK New Construction https://files.bregroup.com/breeam/briefingpapers/Delivering-Sustainable-Buildings-Savings-and-Payback-Office-Case-Study-BREEAM-NC- (p.10) 2018_BREEAM_BRE_115359_BriefingPaper.pdfaccessed 28/09/20

[173] Milton Keynes Council (2017) Whole Plan Viability Study https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/viability, accessed 19/07/21

The Viability Study notes that Policy SC3 - Community Energy Networks And Large Scale Renewable Energy Schemes poses an additional cost to developers. There is a lack of evidence base in published costs of district heating schemes in modern estate housing and so could require further research.

11.3 Best Practice Review of Local Authority Policies

This section provides an overview of the planning practice of key UK local authorities from which best practice could be drawn to inform future iterations of planning policy within the LPU.

Eight local authority development plans were reviewed for their approach to sustainable building design, renewable energy, heat networks, low carbon transport, climate change adaptation and reducing water demand. These were:

Reading Borough Local Plan (Adopted, 2019)

The London Plan (Adopted, 2021)

Milton Keynes Plan:MK (Adopted, 2019)

Oxford Local Plan (Adopted, 2019)

Cornwall County Council Draft Climate Emergency Development Plan (Regulation 22, 2021)

Swindon Borough Draft Local Plan Review (Regulation 19, 2021)

West Berkshire Draft Local Plan Review (Regulation 18, 2020)

Flintshire County Draft Local Development Plan (Regulation 22, 2020)

Sustainable Building Design

All development plans reviewed had at least one policy on sustainable building design standards. These have been largely delivered through one, or often a combination of, the methods detailed below:

Energy and/or Climate Statements

Six of the reviewed development plans included a requirement for an Energy (and/or Climate and/or Carbon and/or Sustainability) Statement within applications of a certain size. The scale of development that would trigger this threshold varied, but was generally between 10 and 100 residential units, or 1,000sq.m for non-residential developments.

These Statements required applicants to demonstrate how the proposal has been designed to reduce energy demand and improve efficiency within the framework of the energy hierarchy, including predicted energy demand and CO2 emissions, and the feasibility of connecting to a district or community heating network.

The West Berkshire *Draft* Local Plan Review (which is an emerging plan) does not have a threshold which triggers the submission of a Sustainability Statement to demonstrate alignment with principles of 'responding to climate change' (listed in the policy). Rather, it states that the level of information provided should be proportionate to the scale and nature of the development proposed. This approach is helpful in that it can start a conversation, but may lead to a need for further guidance. At this stage it is untested.

Whole Life-Cycle Carbon Assessments

The London Plan is the only plan reviewed at the time of writing that requires development proposals referable to the Mayor to calculate whole life-cycle carbon emissions and demonstrate actions taken to reduce these emissions in a WLC Assessment. Any major developments that fall under a specific criterion require a referral to the Mayor, including schemes of 150 homes or more. It goes on to encourage non-referable development to undertake WLC Assessments, noting that operational carbon emissions will make up a declining proportion of a development's whole life-cycle carbon emissions as operational carbon targets become more stringent.

Developer Contributions and Carbon Offsetting/Allowable Solutions

Many LPAs across the UK have set up an Offset Fund. Of the plans reviewed for this study, the London Plan uses carbon pricing with the intention of making alignment with low carbon standards the more attractive option than paying into a carbon offset fund. Offset fund payments should not be relied on to make up any shortfall in emissions, although these funds have the potential to unlock carbon savings from the existing building stock. The London Plan requires boroughs to establish and administer a carbon offset fund, for which in-payments must be ring-fenced to implement projects that deliver carbon reductions.

The viability assessment for the London Plan tested a price of £95/tonne of carbon, although boroughs can develop their own carbon price, which is typically done based on evidence from a commissioned study into the cost of carbon reductions within the borough.

Some local authorities have used the Section 106 mechanism to secure these funds, where contributions are typically calculated using a cost of carbon formula (as above). Lambeth Borough Council is an example of a council utilising the s106 mechanism for this.

In the case of the London Plan and Reading Borough Council Sustainable Design SPD, developer contributions are required where it can be clearly demonstrated that zero-carbon targets for major development cannot be fully achieved on-site, in this case funds must be paid into a local authority carbon offset fund.

Section106 and Community Infrastructure Levies were noted as mechanisms to deliver renewable energy infrastructure and climate change mitigation schemes in several local plans.

Allowable solutions are utilised by local authorities where on-site provision of renewable technology was not appropriate. This is often treated as a 'last resort', and developers are encouraged to meet low carbon requirements within the development. Cash payments were used to 'top up' the remaining shortfall between the development and Local Plan stipulated carbon targets.

Meeting Building Assessment Standards

Assessment methodologies such as BREEAM, Homes Quality Mark and Code for Sustainable Homes (now discontinued), and improvements on Part L Building Regulations were utilised in every development plan reviewed.

For major residential development (10 dwellings+), the London Plan, Reading Local Plan and Cornwall Draft DPD expect regulated operational carbon to achieve net-zero. The London and Reading policies go on to state minimum reductions in energy usage beyond Building Regulations Part L that must be achieved on-site as a step towards achieving net zero (35%), whilst the Cornwall Draft DPD requires evidence that total energy use is less than 40kWh/m2/annum. Planning contributions to carbon offset funds can be used to offset remaining carbon to zero in each of the three locations.

Minor residential development must achieve a minimum 10% reduction on-site through energy efficiency measures in London, while a minimum 19% improvement is specified in Reading.

All but one development plan reviewed included BREEAM requirements for certain scales of non-residential development. Best practice is exemplified in almost every plan, with a requirement for non-residential development proposals *of all scales* to achieve BREEAM 'Excellent' as a minimum[174]. Specifying that the BREEAM standard to be met is "the most up-to-date version" future-proofs such policies, allowing performance standards to be increased during the plan period as/when BREEAM standards are increased. Milton Keynes' Plan exempts major non-residential from certain sustainable design obligations (e.g. re-use and recycling of materials, implementing the energy hierarchy, incorporating green roofs) if it achieves BREEAM 'Outstanding', on the understanding that 'Outstanding' design necessarily incorporates various elements of sustainable design and, as current best practice, is expected to deliver best possible quality.

Design Standards

Each local plan included policies requiring development to demonstrate how design has been utilised to maximise passive solar, heating and ventilation opportunities, as well as water conservation techniques.

[174] Reading Borough Local Plan requires minor non-residential development to achieve the most up-to-date BREEAM 'Very Good' as a minimum.

Oxford's Local Plan expands upon the requirements of its Energy Statement for all proposals, requiring evidence to demonstrate compliance with a wide range of sustainable principles, including maximising energy efficiency, using recycled and recyclable materials, minimising waste and being adaptable to future occupier needs.

Several local authorities used supplementary planning documents (SPDs) as a tool to detail sustainable design and construction methods and requirements, including providing easy-to-use 'checklists' for sustainable residential development (as in Reading Borough Council's Sustainable Design SPD).

Renewable Energy

All local plans reviewed included policies related to renewable energy provision. Provision was largely delivered through:

Requiring renewable energy production on site for certain scales of development

Only the West Berkshire Draft Local Plan Review and the Flintshire Draft Local Development Plan set thresholds for development of certain sizes that would have to meet its energy demand through renewable energy production. West Berkshire's draft policy begins by stating that all development should contribute to the borough becoming carbon neutral by 2030, specifying that 10% of future energy use must be met by renewable energy for proposals of 1-9 homes or under 100sq.m commercial floor space and a 20% minimum for proposals of more than 10 homes or 100sq.m commercial floor space.

In Flintshire's Draft Local Development Plan, residential development sites of 100 units or more and non-residential developments with a floorspace of 1000 sqm or more are required to submit an Energy Assessment that determines the feasibility of incorporating low carbon or renewable energy technology or connecting to nearby renewable or low carbon energy sources (and heat networks).

Cornwall's Draft DPD exemplifies greatest ambition, requiring all residential development proposals of whatever size to demonstrate through an Energy and Carbon Statement on-site renewable generation to match the total energy use (with a preference for roof mounted solar PV). Where matching total energy consumption through on-site renewables is shown to be technically infeasible or economically unviable, "renewable energy generation should be maximised as much as possible; and/or [a] connection [should be made] to an existing or proposed district energy network; or where this is not possible the residual carbon offset by a contribution to Cornwall Council's offset fund."

Policies that encourage renewable energy development

The local plans reviewed stipulated that schemes that incorporated renewable energy sources would be supported. Rather than mandating renewable energy for certain scales of development, these policies were less specific and would often only require development to consider or have some regard to meeting part of the predicted energy demand through on site renewable energy. However, they were often complemented by policies requiring all development to demonstrate application of an energy hierarchy.

Encouraging standalone renewable energy proposals

The Draft Flintshire Local Plan included a policy specifying that renewable or low carbon energy generation development may be permitted for large scale solar farms within defined areas in the proposals map, or for small scale/community renewable/low carbon projects where appropriate. The policy review found typical wording relating to standalone energy proposals began by stating express encouragement for such proposals, on the proviso that they will not result in any significant negative social, environmental or economic impacts.

Cornwall County Council's Draft DPD contains a policy to safeguard strategic renewable energy sites, stating that permission for proposals that are not renewable energy installations within areas identified in the policy map as being potentially suited to renewable energy will only be granted in limited circumstances and for a temporary period of time.

Community Energy

The national Planning Practice Guidance on Renewable and Low Carbon Energy acknowledges that community-led renewable energy initiatives are likely to play an increasingly important role and that such schemes should be encouraged to provide positive benefits for local communities.

Cornwall County Council demonstrates support for community energy schemes, including through split ownership, joint venture, equity shares and post-construction community buy-out. It's Renewable Energy Planning Advice[175] states: "The Council believes that this model of renewable energy deployment should receive particular support when considering the merits of renewable energy development at the planning decision stage." This has been translated into their DPD, where draft Policy RE states that proposals for renewable and low carbon energy will be supported as long as they provide community profit sharing or a proportion of community ownership, along with local and social community benefits. The policy continues by saying that "significant weight will be given to community led energy schemes where evidence of community support can be demonstrated, with administrative and financial structures in place to deliver/manage the project and any income from it."

Heat Networks

Those development plans that required Energy Statements to be submitted required developers to evidence the feasibility or infeasibility of connecting the development into or supporting the creation of a decentralised energy network, such as a district heating network or a community heating network. Oxford's Local Plan states that if a development connects to an existing heat network, this will count towards its carbon reduction requirements.

In several development plans, policy required development that exceeded a certain threshold to consider the inclusion of decentralised energy provision, unless it can be demonstrated that this was not suitable, feasible or viable. The scale of development that would trigger this policy differs. In Reading Borough Council, schemes of over 20 residential dwellings or 1,000sq.m non-residential floorspace would be required to demonstrate that they have considered decentralised energy provision. Where an existing network was in place, the number of dwellings was reduced to 10 to consider connection to the energy network. In Milton Keynes, schemes of over 100 homes and non-residential developments of over 1,000sq.m are expected to consider the integration of community energy networks, while *all* new developments in proximity to existing or proposed CHP/local energy networks are expected to connect (unless it can be demonstrated that this is unviable, unjustified or a better alternative for carbon reduction exists).

In the London Plan, Heat Network Priority Areas have been mapped to designate areas where the heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers. Major development proposals within Heat Network Priority Areas are expected to have a communal low-temperature heating system fuelled according to a heating hierarchy that prioritises zero-emission sources.

The London Plan also included a policy requesting developers and boroughs to engage with the local energy company to establish predicted energy requirements and infrastructure resulting from large scale development. Large scale development was also required to develop an Energy Masterplan to determine the most effective energy supply options.

Low Carbon Transport

Setting the Spatial Strategy and Ensuring Connectivity

Each of the development plans reviewed contain strategic policies governing the location of development sites with the objective of maximising accessibility and connectivity via active travel (walking and cycling) routes and public transport. For strategic scale sites, accessibility within site boundaries will be as important as accessibility to other parts of the borough. Policies typically required development proposals to minimise the need to travel, be designed to prioritise or promote opportunities for sustainable transport modes, and to demonstrate good access to key services and facilities. The accessibility and connectivity of a site should, subject to constraints, be reflected in the density of the development.

Transport Assessment Plans

Swindon and West Berkshire's Draft Local Plan Reviews require residential and non-residential development proposals above a threshold to submit a Transport Assessment alongside the planning

[175] Cornwall Council (2016) Cornwall Renewable Energy Planning Advice, https://www.cornwall.gov.uk/media/3ngmulk1/cornwall-renewable-energy-planning-advice-march-2016.pdf, accessed 20/07/21

application. This Assessment will assess and plan mitigation measures for the impact of the proposal on travel, demonstrating the promotion of sustainable travel choices and - in the case of West Berkshire - regard to the Council's Climate Emergency declaration.

Contributing to Strategic Transport Plans or Strategies

Only the Reading Borough Local Plan makes explicit the need for development proposals to contribute to meeting the objectives of the most up-to-date Local Transport Plan (including sub-strategies, such as the Cycling Strategy, specific projects identified and local action plans). Each other development plan clarifies that developments will be expected where appropriate to support the delivery of strategic public transport, cycle and walking routes. This could be done either through designing the development to connect to and extend an existing route, or through developer contributions, or both. Local Cycling and Walking Infrastructure Plans and Active Travel Route Maps are referenced as means to identify walking and cycling infrastructure upgrades for developer contributions.

Car Parking Restrictions and Electric Vehicle Charging Provision

While each development plan promoted the use of sustainable transport modes above private car journeys, typically accompanied with a maximum number of car parking spaces for new developments and a requirement for the provision of bicycle facilities on-site, the London Plan and Oxford Plan go further. Both plans require proposals for sites which are well-connected to deliver car-free development (excluding disabled parking spaces).

In terms of the balance of parking provision between different modes of transport, West Berkshire's Draft Local Plan Review states that this balance must reflect the need for travel activity to minimise carbon emissions and environmental harm. Half of the development plans reviewed included minimum requirements for EV charging provision. The percentage of EV charging spaces differed between authorities but was generally in the range of 10-20% of total spaces. The London Plan demonstrates greatest ambition by requiring all residential car parking spaces to provide infrastructure for EV or Ultra-Low Emission vehicles - a minimum of 20% of spaces should have active charging facilities and crucially the policy is futureproofed by specifying that there should be passive provision[176] for all remaining spaces to allow straightforward future growth of EV spaces.

Green Infrastructure

Multifunctionality

Each development plan emphasises the multifunctional role of green infrastructure in providing resilience to climate change impacts and wider environment and societal benefits. West Berkshire's Draft Local Plan Review (2021) illustrates the multifunctional value ascribed to green infrastructure through their requirement for green infrastructure proposals to "help to mitigate the causes of and address the impacts of climate change…create an attractive and distinctive setting to new development…provide pleasant and safe 'green routes' to commute…contribute to biodiversity net gain." Oxford's Local Plan utilised the Design and Access Statement (DAS) to require all those developments which necessitate a DAS to demonstrate how new or improved green or blue infrastructure features will be incorporated, with reference made to how they will contribute to tackling issues such as climate change mitigation and adaptation.

All reviewed plans made reference to ensuring wherever possible that new green infrastructure is connected to wider, strategic green networks. Reading and Swindon's Local Plans identify opportunities for green corridor expansion on their Policies Maps. West Berkshire's Local Plan Review clarifies that development must be compatible with any Biodiversity Action Plan, Local Nature Recovery Strategy or other conservation plans adopted by the Council.

Biodiversity Net Gain

Seven of the eight development plans require development proposals to first avoid and subsequently mitigate any loss of green infrastructure and demonstrate net gain in biodiversity, tree cover and/or geodiversity.

[176] Passive provision of EV infrastructure means ensuring the network of cables and power supply necessary so that at a future date a socket or equivalent can be added easily to allow vehicle owners to recharge their vehicle.

From November 2023, the Environment Act will require development proposals across England (with certain exceptions) to demonstrate a net gain in biodiversity, supporting the expansion of the country's green network. The minimum percentage net gain is expected to be 10%, which aligns with the most ambitious percentages in reviewed policies. There is precedent in other English local authority planning policy to require a percentage higher than 10%, such as Lichfield District Council, which requires a 20% net gain in its Biodiversity and Development SPD[177]. Other councils are following suit through their emerging planning documents, including Guildford Borough Council's (Regulation 19) Draft Local Plan: Development Management Policies[178].

Futureproofing

In choosing green infrastructure and additional biodiversity for a site, Cornwall County Council emphasise that consideration must be given to the resilience of what is proposed to climate change, with the aim of ensuring the longevity of green elements in the face of a changing climate.

Reduced Risk of Overheating

In comparison with the other policy themes covered (e.g. Sustainable Building Design, Low Carbon Transport etc), managing the risk of overheating was noticeably absent in the majority of local plans reviewed. Where it was referenced, this was typically in reference to the beneficial role of green infrastructure in mitigating the impact of high temperatures.

The London Plan (2021) policy on managing heat risk stands out by setting out a cooling hierarchy for development proposals to demonstrate compliance with. Both Milton Keynes' and Reading Borough's Local Plans require proposals to demonstrate design measures to create comfortable thermal environments for occupants.

Milton Keynes' Plan contains a standout policy under Policy SC1, requiring proposals of more than 11 dwellings and non-residential developments of over 1000sq.m to calculate 'as built' performance for overheating (and air quality) of proposals, with monitoring and reporting to the local planning authority and occupiers required for the first five years of a development's occupancy.

None of the development plans reviewed included a requirement to demonstrate building thermal comfort against medium- or long-term climate change scenarios for temperature, nor against extreme heat events.

While the Passivhaus Standard relates specifically to the heating and cooling performance of buildings, none of the eight Local Plans reviewed called for the use of Passivhaus in alleviating overheating risk. Regardless, there is planning policy precedent in other English local authorities for explicitly supporting the Passivhaus standard. An example of this is in Cambridge Local Plan (2018) Policy 28, which states that "the Council will be supportive of schemes that seek to utilise standards such as…the Passivhaus Standard".

Reduced Flood Risk

Each of the eight local plans reviewed contained very similarly worded policies on flood risk management, drawing on the relevant policies set out in the NPPF.

More specifically, the NPPF sets out the sequential approach to site selection that local plans must take, steering all new development towards areas with the lowest risk of flooding (from all sources) in the first instance. The NPPF adds that in applying the sequential approach, local planning authorities must take account of climate change and the vulnerability of future uses to flood risk. Where exceptional development in areas of flood risk is necessary, the proposal must demonstrate that it is designed not to increase - and, wherever possible, to reduce -flood risk, both on-site and in the surrounding area. To ensure that a site's design and any flood mitigation measures implemented are designed with an allowance for climate change over the proposed development's lifetime, developers should refer to the Environment Agency's guidance on

[177] Lichfield District Council (2016) Biodiversity and Development Supplementary Planning Document, Biodiversity and Development SPD (lichfielddc.gov.uk), accessed 12/05/22

[178] Guildford Borough Council (2022) Draft Guildford Borough Local Plan: Development Management Policies, Reg 19 Guildford LPDMP.pdf, accessed 12/05/22

the use of climate change allowances[179]. West Berkshire's Draft Local Plan Review specifies adaptation consideration based on long-run flood events (i.e., rainfall events up to and including the 1 in 100-year event and the 100-year plus event).

Cornwall's Draft DPD exemplifies best practice, requiring development proposals to demonstrate how the design of buildings and the surrounding environment has been planned to be resilient to the ongoing and predicted impacts of climate change, including the design of road surfaces and drainage systems to cope with more frequent episodes of extreme heat and rain.

Typically, the reviewed local plans required new developments to incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards[180] and, in the case of West Berkshire, in line with their SuDS Supplementary Planning Document. Best practice SuDS should achieve greenfield runoff rates, be designed with an allowance for climate change impacts over the development's lifetime and bring about multiple socio-environmental benefits as an integral part of the development.

Reduced Water Demand and Increased Efficiency

Six of the eight local plans reviewed opted to require the Building Regulations Part G 'optional' requirement of 110 litres per day for new residential development. In Oxford's Local Plan, as in others reviewed, this requirement is supported by a strong high-level policy on sustainable design and construction (Policy RE1) that sets out that planning permission will only be granted when submissions demonstrate, among other sustainability principles, 'conserving water and maximising water efficiency'. Part G does not require actual water usage to be monitored - the provision is in terms of the estimated water usage of a home.

Whereas Building Regulations Part G do not require actual water usage to be monitored, BREEAM 'post-construction stage' assessments serve to confirm a building's 'as-built' performance across criteria, including water consumption. Under the 2018 BREEAM New Construction Scheme an *optional* 'post-occupancy' stage of assessment exists. This stage confirms the process of monitoring, reviewing and reporting on the performance (including in terms of water consumption) of a building once occupied. It is normally carried out between 12 and 24 months following the occupation of the building. While none of the local plans reviewed mandated non-residential buildings to obtain a BREEAM post-occupancy stage certification, this could be included subject to viability considerations.

It is important to note that BREEAM periodically releases updated versions of its New Construction standard (the most recent is 2018, preceded by 2014). Local plans should clearly state which version of BREEAM they are specifying, as more recent versions demand higher performance standards, or alternatively specify that the BREEAM standard to be met is "the most up-to-date version" to future-proof such policies.

Other policies reviewed encouraged or specified the inclusion of rainwater harvesting systems and measures to reduce household water demand and use through the installation of water efficiency measures, sometimes only above a certain threshold or dependent on viability.

With regards to non-residential development, policies required demonstration of how proposals achieve BREEAM status. Most policies required non-residential proposals *of all sizes* to achieve BREEAM 'Excellent' status (whereas Reading's Local Plan specified that minor non-residential must achieve 'Very Good' status'). The London Plan and West Berkshire Draft Local Plan state that 'excellence' must be achieved specifically within the BREEAM water category, requiring (unless technically or viably infeasible) set percentage improvements over the defined water consumption baseline performance of the building.

[179] Environment Agency (2022) Flood Risk Assessments: Climate Change Allowances, Flood risk assessments: climate change allowances - GOV.UK (www.gov.uk), accessed 12/05/22

[180] DEFRA (2015) Sustainable drainage systems non-statutory technical standards https://www.gov.uk/Government/publications/sustainable-drainage-systems-non-statutory-technical-standards, accessed 20/07/21

11.4 Recommendations for Greatest Ambition in Wokingham Borough Council's Policies

Drawing on the previous two sections of this report, in which best practice guidance and planning policies related to climate change are summarised, this section presents opportunities for greatest ambition in WBC planning policy.

Setting energy efficiency standards at Future Homes (and Buildings) Standards and Net Zero

Currently, local authorities can set their own energy efficiency standards beyond Building Regulations Part L because the amendments to the 2008 Planning Act have not yet been enacted. The Government's response to the Future Homes Standard consultation confirmed that local authorities will retain powers to set local energy efficiency standards for new homes, although it adds that the new planning reforms will clarify the longer-term role of local planning authorities in this regard.

WBC LPU Draft Plan (2020) policy DH9 sets out a requirement for all minor developments to achieve 19% improvements in the dwelling emissions rate over the target emissions rate, as defined within Building Regulations Part L. However, with the interim Future Homes Standard entering into effect in June 2022, rising to 75-80% reduction by 2025, WBC should incorporate the full 75-80% reduction in its LPU viability assessment. WBC's intention here should be to pre-emptively adopt the higher standard in its LPU.

WBC should require *all* non-residential development to achieve BREEAM 'Excellent'. Under BREEAM, WBC could specify a minimum number of credits to be achieved under the energy category and look favourably upon (and/or secure through planning conditions) proposals which require a post-occupancy evaluation. Presently, WBC LPU Draft Plan (2020) policy requires minor development to achieve a 'Very Good' BREEAM rating – this falls short of the incoming Future Buildings Standards - as discussed in the next section – and should be amended to 'Excellent'.

Requiring Whole Life-Cycle Carbon Assessments for major development – Require WLC assessments to be submitted alongside planning applications for major schemes. WLC assessments would need to be carried out using a nationally recognised assessment methodology.

Expanding the Sustainability Statement - It is recommended that an overarching requirement for development to submit a Sustainability Statement detailing where energy savings can be made, and how low carbon/renewable technology has been properly considered in the development will encompass many of the policies discussed above. This has the added benefit of consolidating all information related to the energy performance of a scheme for planning officers when considering a development.

Developing Supplementary Planning Documents (SPD) - Supplementary Planning Documents (SPD) allow local plans to expand upon sustainability policy further than the policy explanation text. Following the adoption of the local plan, WBC should look to produce an SPD to provide best practice guidance and explain requirements in becoming net zero, how to comply with sustainability standards and accreditations, and how to submit a WLC assessment.

Outlining how to address residual carbon and Utilising Section 106/CIL -Many local plans include guidance on the use of carbon offsetting to highlight to applicants how residual carbon could be managed in delivering climate targets. WBC should clarify internally and subsequently outline their approach to residual carbon and carbon offsetting. To deter schemes which do not achieve the highest possible carbon standards, guidance must clarify that offsetting is acceptable only if additional carbon standards are demonstrably infeasible and the price of carbon must be set at a sufficiently high level. Section 106/CIL requirements can also be used to contribute to low carbon/renewable energy schemes.

Local Area Energy Planning - LAEPs are comparable to masterplans, which are prepared to establish a long-term view of how a local area should be developed LAEPs identify the most suitable low/zero carbon energy technologies across a spatial area. Section 13.2 undertakes elements of a local area energy plan, where current and future renewable energy capacity is mapped across the borough. The suitability of sites for differing renewable technologies should be embedded in site specific policy wording.

Adaptation scenarios – Planning policy should reflect a requirement for development to be resilient to climate change and extreme weather events as defined in Section 4. Where WBC could show greatest ambition is in specifying that design measures, such as policies for heating and ventilation, are demonstrably

resilient for adaptation considerations based on high emissions scenarios/long run events (e.g. resilient against 1 in 100 year floods or maintaining a specified level of thermal comfort in extreme heat events). Several UK developments that have been built for high thermal performance have been tested for summertime overheating post completion. There is a range of published guidance available on how to reduce overheating in new homes.

Performance assurance mechanisms - Building performance evaluation helps designers to close the performance gap and provides data to local planning authorities to help them understand the performance spectrum of new builds within their borough. Post-occupancy evaluation typically involves the collection of energy and water performance data in-use. The WBC planning policy should mandate the use of building standards, such as BREEAM, which offer optional certifications at the post-occupancy stage. WBC can encourage the use of post-occupancy evaluation on large-scale housing schemes through planning policy wording.

11.5 Testing Policy – Feasibility and Viability

This section reviews and tests some of the recommendations for energy standards above to ensure they are appropriate to be embedded into the WBC LPU. In doing so, it provides evidence in support of planning policies where they are considered appropriate, and where evidence suggests that policy requirements can go beyond those as stated.

The WBC Draft Local Plan (2020) policies on environmental standards read as follows:

Policy DH8: Environmental standards for non-residential development

Major development

d) Major non-residential developments or conversions to non-residential will additionally be required to meet the most up-to-date BREEAM 'Excellent' standards, or any future equivalent.

Minor development

e) Minor non-residential developments or conversions to non-residential will additionally be required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum.

Extensions to existing non-residential premises

f) All extensions to existing non-residential premises of 500sqm floorspace or more are encouraged to achieve 'Very Good' in BREEAM.

Policy DH9: Environmental standards for residential development

Minor developments

b) Minor residential developments will additionally be expected to achieve at least a 19% improvement in the dwelling emission rate over the target emission rate, as defined within Building Regulations Approved Document Part L 2013, or satisfy any higher standard that is required under new national planning policy or Building Regulations.

Major developments

c) Major residential development will additionally be expected to be designed to achieve carbon neutral homes. Conversions to residential and extensions to existing dwellings

d) All conversions to residential and extensions to existing dwellings of 500 sqm of residential floorspace (gross) or more are encouraged to achieve 'Excellent' in BREEAM domestic refurbishment.

To test policies DH8 and DH9, representative developments have been used which are characteristic of schemes likely to come forward across Wokingham. Technical solutions that developers would need to utilise to deliver on the policy ambition on these representative developments, guided by the Energy Hierarchy to reduce demand, use efficiently, supply cleanly are then considered.

The majority of new homes in Wokingham are anticipated to come forward in large strategic sites, covering a mix of uses, consistent with the approach in the current Core Strategy local plan. The task therefore tests a

representative development that covers a range of domestic and non-domestic buildings including options for residential properties, primary schools, secondary school, community centres, healthcare facility, centres for Research and Development, and an Innovation Park. The residential properties are likely to be a mix of flatted development and houses. The representative buildings are used to demonstrate how specific measures could reduce a building's energy demand and environmental impact.

11.5.1 Non-residential representative buildings

The non-domestic sample buildings have been selected from recent Arup projects. The typologies of these buildings represent those proposed in the representative development outlined above. Buildings from three different typologies covering a healthcare and research facility, a primary school and a multi-use university building that have achieved different levels of BREEAM were selected. The table below provides details of each of these representative buildings with a commentary following which details the measures deployed for these buildings to achieve their respective BREEAM ratings.

Table 5: Representative non-residential buildings

Information on representative non-residential buildings
Primary School  Three additional storeys extended over the existing primary school building. The extension contains new classrooms and enables a third entry point to the school. The extension connects to the existing services in the original building. **BREEAM rating achieved: Very Good**
Healthcare and research facility  A new cancer treatment and research facility at an existing hospital campus in south-west London. Six storey concrete frame building providing new outpatient facilities, medical day-care, and collaboration space for clinical researchers to accelerate cancer diagnosis and treatment for patients. Passive design means the building has a curved shape and consists of a full-height atrium, allowing natural light to penetrate into the building. Solar panels on the roof generate on-site electricity. **Floorspace (GIA): 12,450 m^2** **BREEAM rating achieved: Excellent**

Information on representative non-residential buildings

Multi-use university building

A high-profile university building in Central London. Double height ground floor open plan space with four additional storeys and roof terraces. The primary structural concrete comprises 50% ground granulated blast-furnace slag to reduce the building's embodied carbon. The building features a number of low-carbon technologies, including natural cooling using ground-source technology, heat pumps, and a two-season natural ventilation strategy. Efficient sanitary fittings reduce water consumption by more than 50% compared to equivalent buildings, while a biodiverse green sedum roof supports a range of native species and enhance the microclimate. The space comprises hot desking space, library, multi faith rooms and meeting spaces.

Floorspace (GIA): 5,765 m^2

BREEAM rating achieved: Outstanding

11.5.1.1 Non-residential building standards

Building Regulations and Sustainability Assessment Method provide guidance or standards on the performance expected of materials and building work. They are used by LPAs either in development plan policies or as a condition for planning permissions. As previously stated, The Planning and Energy Act (2008) set out powers which enable local planning authorities to set energy efficiency standards in their development plan policies that exceed the energy efficiency requirements of Building Regulations Approved Document L, as long as they are in accordance with national policy and guidance. Below are the non-residential standards that could be utilised in the WBU LPU.

Baseline Scenario: Building Regulations (Approved Document L)

Building Regulations L2 cover the conservation of fuel and power in non-domestic buildings. Non-domestic building regulations largely apply the same criteria as L1 regulations for domestic buildings (discussed further in 11.5.3 below).

Non-domestic scenario: Future Buildings Standard (for non-domestic buildings built from 2022 in the interim and then from 2025)

A 27% reduction in emissions under Building Regulations Part L from June 2022, with a greater reduction expected from 2025.

Non-domestic scenario: BREEAM ratings

BREEAM is a globally recognised assessment framework for certifying buildings. It is an effective tool to compare similar projects against each other and communicate standards of sustainability at a given moment in time. There are schemes suitable for new construction, refurbishment, fit out and bespoke scopes.

Credits are awarded to buildings based on their proposals to minimise operational energy demand, consumption and CO2 emissions. The lowest number of credit (1) sets out the minimum requirement for performance improvements to be progressively better than the relevant national building regulations compliant standard. Credits increase as higher standards are met- BREEAM Excellent requires a minimum

of a 25% reduction from regulated building energy consumption, while BREEAM Outstanding requires 40% reductions, with the highest number of credits (15) awarded to those schemes achieving 100% reduction. BREEAM ratings go beyond setting energy efficiency measures and set a standard for water consumption, waste, materials, ecology and drainage.

Meeting prescribed BREEAM ratings is becoming a common practice by local authorities across UK. WBC already aims within its Draft Local Plan (2020) for non-residential buildings to achieve BREEAM Very Good and Excellent ratings for minor and major development respectively. As such, the next section provides the council with examples of the type of measures that might be required for non-domestic buildings to go beyond existing standards.

11.5.1.2 Technical interventions required to meet various BREEAM ratings

The table below compares the achievements of three representative non-domestic building projects which achieved either Very Good, Excellent or Outstanding level certification.

Table 6: Building interventions required to achieve BREEAM ratings Very Good, Excellent or Outstanding

Representative Development	Primary School	Healthcare and research facility	Multi-use university building
BREEAM rating	Very good	Excellent	Outstanding
Topic	Interventions	Interventions	Interventions
Energy generation & efficiency	A PV array installed on the roof reduced the overall energy demand of the building, resulting in a 5% reduction in associated carbon emissions. This does not meet the Future Buildings Standard	Passive design measures such as a large full height atrium to maximise natural light, brise soleil shading, maximised thermal performance of building fabric, and high efficiency lighting to reduce energy demand. The development will capture heat generated from the existing site-wide heating system serving the hospital which is currently wasted. Plate heat exchangers will be used to transfer this heat from the existing site-wide heating system to a low temperature hot water (LTHW) heating system serving the proposed building. Savings from connecting the development to the existing heat network are estimated at 41 tonnes per annum or 9% compared to Part L 2013. Large PV array on the roof. Overall, a 35% reduction in CO2 emissions compared to Part L 2013 is expected.	'Passive first' approach to design. Enhanced natural daylight, reduced solar gains and a preference for natural ventilation reduced energy demand. Free cooling, heat pumps, open loop ground source borehole system, connection to existing district heating network and 400m2 PV array maximised the renewable energy supply. As a result of these interventions, the building was designed to achieve a 35% reduction in building carbon emissions against Building Regulations requirements Part L 2013 and 40% improvement on Part L 2010.
Water Consumption	Water efficient sanitary fittings resulted in a 40% reduction of water consumption.	Water consumption designed at 110 litres per person per day. This is equivalent to a 40% reduction against the baseline.	The most water efficient sanitary options installed, resulting in a 55% reduction of water consumption.
Waste	Over 95% construction waste diverted from landfill.	95% - 100% construction waste diverted from landfill.	100% construction waste diverted from landfill. Timber waste significantly reduced – 14 tonnes donated to social enterprises, and 2 tonnes saved through reusable formwork and shuttering.
Materials	Materials specified with ISO 14001 certification where appropriate, to demonstrate	Internal materials specified to improve the experience of the patients using the facility.	53% of the total volume of the frame is aggregate, which reduced the carbon footprint

Representative Development	Primary School	Healthcare and research facility	Multi-use university building
	responsible sourcing of major building elements.	Open plan floorplates and reconfigurable spaces to maximise adaptability of the building.	of the frame by half – 913kgCO2e/tonne to 457kgCO2e/tonne.
Ecology	Existing trees on site retained and protected.	Built on a brownfield site. Green roof and external landscaping achieve a net gain in biodiversity.	Biodiverse roof which also provides rainwater attenuation and positive influence on the microclimate. Also carefully designed in line with amenity space, PV array and rooflights.
Drainage	No increase in the impermeable floor area due to the building footprint remaining unchanged.	SuDS drainage systems incorporated in the form of green roof, permeable paving, a vortex separator and an infiltration tank.	Implementation of SuDS to reduce the amount of surface water runoff from the site.

To achieve higher rating level across BREEAM schemes there is sometimes an increase in the capital costs. This is extremely difficult to quantify, but the Building Research Establishment (BRE) have published some average figures[181]. The projected increases to capital costs of a building differs slightly between different building types, but these can be averaged for each BREEAM rating. BRE have published average carbon dioxide emissions savings across different levels of BREEAM rating for different development types (see Table 7).

Table 7: Average costs and carbon savings associated with different BREEAM ratings (BRE, 2016)

BREEAM Rating	Very Good	Excellent	Outstanding
Average capital cost increase	+ 0.17%	+ 1.04%	+ 7.06%
Education (School)	+ 0.2%	+ 0.7%	+ 5.8%
Industrial	+ 0.1%	+ 0.4%	+ 4.8%
Retail	+ 0.2%	+ 1.8%	+ 10.1%
Office	+ 0.2%	+ 0.8%	+ 9.8%
Mixed Use	+ 0.15%	+ 1.5%	+ 4.8%
Average CO_2 emissions savings	- 15%	- 32%	- 66%

11.5.2 Recommendations for non-residential energy standards policy

BREEAM ratings are a commonly used and widely applauded sustainability assessment method (see Section 12.1 for a discussion on different methods), and are already used in WBC Draft Local Plan (2020) policies DH8 and DH9 on environmental standards. However, from June 2022, the interim Future Buildings Standard will introduce a 27% carbon reduction standard based on increased efficiency and fabric improvements. **With BREEAM Very Good rating equalling less than 25% emissions reduction, this standard will not meet the Future Buildings Standard carbon reduction targets. It is therefore recommended that as a minimum WBC either align policy DH8 requiring minor development to meet Future Buildings Standard requiring 27% carbon reductions or upgrade the current requirements from Very Good to Excellent. With BREEAM ratings requiring sustainable design measures across a range of factors (discussed in full in Section 12.1), pursuing BREEAM Excellent as a minimum is preferable**.

Drawing on the representative developments, interventions that assist a building to achieve BREEAM Excellent or Outstanding include:

Passive design measures including maximising natural light, shading, maximised thermal performance of building fabric, and high efficiency lighting to reduce energy demand;

Heat from waste, including using a plate heat exchanger to transfer heat to a low temperature hot water heating system;

Savings from connection development to the existing heat network;

Large PV on roofs; and

Free cooling, heat pumps, and open loop ground source borehole system.

[181] BRE (2016) The value of BREEAM, https://tools.breeam.com/filelibrary/Briefing%20Papers/BREEAM-Briefing-Paper----The-Value-of-BREEAM--November-2016----123864.pdf, accessed 16.09.2021

11.5.3 Residential building standards and future scenarios

As with non-residential buildings, planning policy should identify appropriate standards which ensure that new residential buildings contribute to the reduction in greenhouse gas emissions. As previously set out, The Planning and Energy Act (2008) set out powers which enable local planning authorities to set energy efficiency standards that exceed the energy efficiency requirements of Building Regulations Approved Document L. Below are the different residential standards that could be utilised in the WBC LPU. Each standard covers more of less the same topics, including: floor, wall, and roof insulation, windows and doors, air permeability, heating and hot water vectors, energy control system, lighting, and renewable energy generation.

Baseline Scenario: Building Regulations (Approved Document L)

A standard home is assumed to be used as the representative domestic development.

With regards to the energy performance of buildings (both dwellings and non-dwellings), Building Regulations Approved Document L[182] (conservation of fuel and power) sets the baseline standards which all new development must achieve as a minimum. In essence, Part L regulations ensure that when a new building is constructed or alterations are made to an existing property, heat gain and loss are limited through fabric choices and fixed building services are as energy efficient as possible. Document L is divided into four parts defined by: L1 and L2 (residential and non-residential) and A and B (new and existing buildings).

Both the L1 and L2 regulations are broken down into five criteria. For L2 regulations, the same criteria are generally applied to all types of non-residential buildings, although some buildings are given special consideration. The criteria for residential buildings are as follows:

1. Achieving the target emission rate (TER) [and the target fabric efficiency rate (TFEE)][183].
2. Limits on design flexibility.
3. Limiting the effects of heat gain in summer.
4. Building performance consistent with the dwelling/building emission rate (DER) (BER) [and dwelling fabric efficiency rate (DFEE)][184].
5. Provisions of energy-efficient operation of the dwelling.

Domestic Future Scenario 1: Code for Sustainable Homes Level 4 equivalent

The Planning and Energy Act (2008) set out powers which enable local planning authorities to set energy efficiency standards in planning policies that exceed the energy efficiency requirements of Building Regulations Approved Document L, *as long as they are in accordance with national policy and guidance*. Despite successive announcements by Government that this power would be removed, this has not occurred. Most recently, through its response to the Future Homes Standard consultation, Government announced that local authorities would retain the power to set higher energy efficiency requirements through their local plan. These would need to remain in accordance with national policy and guidance (which will be set at the level of the Future Homes Standard [see below] before the end of 2021).

In 2015, Government created a new approach for setting technical housing standards in order to rationalise the many differing standards that existed. The Code for Sustainable Homes was withdrawn and replaced with new additional, optional Building Regulations regarding, among other things, water use. Plans to increase Building Regulation energy efficiency requirements to an equivalent level of Code for Sustainable Homes Level 4, however, were retired. The Code for Sustainable Homes Level 4 is equivalent to a 19% improvement on the dwelling emission rate in Building Regulations and, while the now-defunct Code for Sustainable Homes itself cannot be required within planning conditions, the 19% improvement is commonly seen in recent local plans.

[182] Department for Levelling Up, Housing and Communities (2013) Conservation of fuel and power: Approved Document L, https://www.gov.uk/Government/publications/conservation-of-fuel-and-power-approved-document-l, accessed 12/07/2021

[183] The TFEE applies only to dwelling buildings.

[184] The DFEE applies only to dwelling buildings.

Building Regulations Approved Document G provides guidance on the supply of water to a property, including water efficiency. The 2015 edition reaffirmed the previous requirement for all new build dwellings to meet a 125 litres-per-person-per-day limit, but added an option for planning authorities to apply a more stringent target of 110 litres-per-person-per-day as part of a planning application. Part G requires that water efficiency is calculated and submitted to the Building Control Authority at design and as-built stages. Some larger sites require a full water reduction strategy as part of the planning process.

Domestic Future Scenario 2: Future Homes Standard

The Future Homes Standard will enter into effect from June 2022. It will update Part L1A Building Regulations for new dwellings, requiring all new homes to be built from 2022 to produce 31% less carbon emissions compared to current Part L (2013) standards. From 2025, this requirement will increase to 75-80% less carbon. These reductions are expected to be achieved through very high fabric standards and low-carbon heating. Additionally, all new homes must be 'zero-carbon ready', meaning that no further energy efficiency retrofit work will be necessary to enable homes to become zero-carbon as the electricity grid decarbonises. It is important to note that the new emissions reduction requirements apply only to the emissions arising from regulated energy, i.e. lighting, ventilation and heating space and water. The Future Homes Standard does not introduce new maximum limits for water usage in homes.

Domestic Future Scenario 4: Passivhaus

Passivhaus Standard is a certification which relates specifically to the heating and cooling performance of buildings. It focuses primarily on reducing energy demand and increasing energy efficiency, thereby reducing the carbon emissions of a given building, whilst also seeking excellent indoor air quality and thermal comfort levels. The Passivhaus Institute defines Passivhaus building as: "a building in which thermal comfort can be achieved solely by post-heating or post-cooling the fresh air flow required for a good indoor air quality, without the need for additional recirculation of air".

Achieving Passivhaus Standard typically involves design modelling, very high insulation levels, extremely high-performance windows with insulated frames, airtight building fabric, thermal bridge free construction[185] and a mechanical ventilation system with highly efficient heat recovery.

Home Quality Mark

In 2015 BRE introduced the national Home Quality Mark for new domestic builds to help to protect the quality of homes against the increasing and urgent demand for more housing. The Home Quality Mark is independently evaluated by a licensed BRE assessor to indicate the quality and performance of the home. This includes

Running costs;

Impact of the building on the occupant's health and wellbeing;

The building's environmental footprint;

The building's resilience to overheating and flooding; and

The digital connectivity and performance of the home.

The intention of the Home Quality Mark was to demonstrate high quality homes and differentiate them in the marketplace whilst also giving occupants assurance that the building is well-designed and built, and cost-effective to run. As this is voluntary, it has not been used as one of the assessment criterion.

The table below sets outs a comparison of the different residential building standards, including the associated energy efficiency measure and the corresponding standard.

[185] Thermal bridge free construction requires a continuous thermal envelope to ensure a robust high-quality building envelope that delivers radical energy efficiency and exceptional comfort.

The 'u-value' is a measure of how effective an insulator is – i.e., how good the thermal performance of a building's fabric is. Its unit of measurement is W/m²K. The better-insulated a structure is, the lower the U-value will be.

Table 8: Comparison of different residential building standards for typical building measures

Scenario	Energy efficiency measure	Standard (what is implemented, what is the impact)
Building Regulations Part L – Base Case	Wall insulation (internal, external & cavity wall)	U= 0.18 W/m²K Example construction: Brick/block cavity wall with 200-300 mineral wool insulation or 100-200mm rigid insulation
	Roof insulation (exposed roof apartments only)	U= 0.13 W/m²K Example construction: Inverted roof with 250mm rigid insulation
	Windows and doors standard	Window areas are typically limited to 25% of the floor area. U= 1.4 W/m²K Example construction: Double glazed Opaque (external) doors= U= 1.4 W/m²K
	Floor insulation (ground floor apartments only)	U= 0.13 W/m²K Example construction: 120mm rigid insulation below concrete slab
	Air permeability	5 m3/hr.m2 @50Pa
	Heating and hot water vector	89.5% efficient gas-fired combi boiler
	Energy control system	None specified
	Lighting	100% 'low energy' fittings
	Renewable Energy Generation	None required

Scenario	Energy efficiency measure	Standard (what is implemented, what is the impact)
Code for Sustainable Homes Level 4 Equivalent (19% emission reduction)	Wall insulation (internal, external & cavity wall)	U= 0.2 W/m²K
	Loft/roof insulation	U= 0.15 W/m²K
	Windows and doors standard	U= 1.1 W/m²K Triple glazing
	Floor insulation	U= 0.15 W/m²K
	Heating and hot water vector	No improvement needed over part L Gas boiler
	Energy control system	None specified
	Lighting	>75% of fitting 'low energy'
	Energy Generation	None specified
Future Homes Standard – interim (31% emission reduction)	Wall insulation (internal, external & cavity wall)	U= 0.16 W/m²K
	Loft/roof insulation	U= 0.13 W/m²K
	Windows and doors standard	U= 1.1 W/m²K Triple glazing
	Floor insulation	U= 0.13 W/m²K
	Air leakage	3.0 m3/h.m2
	Heating and hot water vector	Low carbon heating such as heat pump required to achieve carbon reduction
	Energy control system	N/A
	Lighting	100% 'low energy' fittings

Scenario	Energy efficiency measure	Standard (what is implemented, what is the impact)
	Energy Generation	None specified
Future Homes Standard (75%-80% emission reduction) To come into place in 2025 therefore specifics are suggested but not confirmed	Wall insulation (internal, external & cavity wall)	U=0.15 W/m²K
	Loft/roof insulation	U=0.11 W/m²K
	Windows and doors standard	U (windows) =0.8 W/m²K and U (doors) =1.0 W/m²K
	Floor insulation	U=0.11 W/m²K
	Air leakage	5.0 m3/h.m2
	Heating and hot water vector	New builds can no longer connect to the gas network – low carbon heating (e.g. heat pump)
	Energy control system	None specified
	Lighting	None specified
	Overheating	There will be some form of overheating mitigation regulation for new homes
	Energy Generation	None specified
Passivhaus (80-90 % emission reduction against Building Regulations Part L)	Wall insulation (internal, external & cavity wall)	U=0.1-0.15 W/m²K (external) 300mm fully filled cavity wall or 200-300mm insulation between structure plus additional 100mm insulation externally
	Loft/roof insulation	U=0.1-0.15 W/m²K (external)
	Windows and doors standard	U<0.8 W/m²K, minimum g-value 50% Triple glazing
	Floor insulation	U=0.1-0.15 W/m²K (external)

Scenario	Energy efficiency measure	Standard (what is implemented, what is the impact)
		300-500mm rigid insulation above or below slab
	Air leakage	<0.6ach at 50 Pa
	Heating and hot water vector	Not specified but heating required is lower than typical and therefore suitable for any vector but it must not exceed the energy limit of 120 kWh/m2 Space heating <15kWh/m2.yr Heating distributed via ventilation system
	Energy control system	Not specified
	Lighting	Not specified but total energy limit of 120 kWh/m2
	Energy Generation	Future changes may make solar PV part of the Passivhaus Plus or Premium certification

Zero Carbon

Zero regulated carbon is a 100% emissions reduction against Building Regulation Part L. Achieving zero regulated carbon for a building requires even stricter efficiency standards beyond just energy to include additional sustainable design measures to those laid out in the table above, and is likely to require energy generation from renewable energy technologies, such as air source heat pumps, photovoltaics and waste-water heat recovery (as achieving net zero regulated carbon is impractical through building fabric measures alone).

Cost-carbon saving

Table 9 presents a comparative analysis of the cost and carbon impact of the typical domestic building energy efficiency measures. This is an indicative output to suggest which measures are the most cost-effective at reducing carbon emissions and therefore should be prioritised. Naturally the carbon emissions saving and the cost is unique to each building and would need to be evaluated on a case-by-case basis.

Table 9: Red-Amber-Green analysis to prevent the carbon-cost impact of various domestic building energy efficiency measures

Measure	Carbon saving	Cost
Solid wall insulation	Medium saving	High cost
Cavity wall insulation	Low saving	Low cost
Floor insulation	High saving	Medium cost
Loft/roof insulation	Low saving	Low cost
Triple glazing	High saving	Medium cost
Draught proofing	Medium saving	Low cost
LED lighting	High saving	Low cost

11.5.4 Recommendations for residential development energy standards policies

From 2025, the Future Homes Standard 75-80% reduction on Part L emissions will be mandatory for all new builds. It is recommended that Policy DH9 should be revised to raise the dwelling emissions rate over the current target from the existing 19% which is in-line with Building Regulations Part L 2013, to 75-80% by 2025 as defined in the Future Homes Standard. It should be noted that there is an interim target of 31% less carbon emissions to current Part L standards from 2022, but the testing of a more ambitious target is recommended to future proof the local development plan and achieve emissions reduction as soon as possible. These reductions are expected to be achieved through very high fabric standards and low-carbon heating. The Future Homes Standard energy efficiency measures can be found in full in table 8 and include low carbon heating such as a heat pump, 100% low energy light fittings, and triple glazing.

To limit any further retrofitting or renovation required for future new builds, it is likely to be most cost-effective and future-proof to mandate Future Homes Standard carbon emissions reductions against Part L in conjunction with an overall requirement for net zero. This acknowledges that, over the next few years at least, offsetting will often be used to make up the remaining 20-25% of regulated carbon emissions.

11.5.5 On-site renewable energy generation potential

On-site renewable energy generation and storage should be encouraged. Energy Assessments (formed as part of the Climate and Energy Statement submitted with the application) should explain how the opportunities for producing, storing and using renewable energy on-site will be maximised. This should be regardless of whether the building has met their prescribed regulations and/or ratings.

Energy Assessments should ensure that the suggested on-site renewable energy generation is achievable and compatible with other measures. Often the promotion of energy generation, such as PV, requires the use of roof space, which could hinder the potential of other requirements of interventions such as natural light and potential of green roofs. The overall cost and benefits should therefore be assessed on an individual development application.

Energy generation information for the three representative non-residential buildings used previously is presented in Table 10. This provides an example on how a realistic and feasible size of PV plant was chosen for each of these buildings. It should be noted that although this section focuses on PV outputs, the on-site Energy Assessments should include an assessment of renewable heat sources via waste heat from an energy from waste (EfW) plant, waste heat from industrial purposes, ground source heat pumps, water source heat pumps, sewer source heat pumps, air source heat pumps, etc.

Table 10: Details of on-site renewable generation for the representative non-domestic buildings

Representative Development	Roof area used	Reasoning
Primary School (BREAM: Very Good)	10% - 20%	Constrained given size and location and requirements for plant and access space on the roof.
Healthcare and research facility (BREEAM: Excellent)	10% - 20%	The site consists of a large roof. However, this large roof is used to effectively use natural light in the building. The requirement of natural light constraints the size or PV plant.
Multi-use university building (BREAAM: Outstanding)	40% - 50%	Maximised use of PV energy generation balanced with amenity space and biodiversity provision on the roof area.

Standard home designs are less cumbersome and complicated when compared to non-residential buildings. This makes it easier to consider the potential photovoltaic (PV) outputs per home. Table 11 below provides some information on the indicative electrical output and plant installation size of three roof type scenarios. These roof type scenarios cover a range of roofs and roof sizes that are likely to be present for a range of homes in Wokingham.

Table 11: Potential of PV on domestic roof tops in Wokingham

Type of home roof	Average roof area available for PV installation186	PV kilowatts peak[187] (kWp)	PV Megawatt hour per year[188] (MWh/year)
Flat roof	55m2 – 95m2	7.8 – 13.5	7.6 – 13.2
Pitched roof (400 – 500) - south facing	20m2 – 50m2	2.8 – 7.1	2.6 – 6.7
Pitched roof (400 – 500) - east or west facing	20m2 – 50m2	2.8 – 7.1	2.0 – 5.1

The potential PV outputs from all buildings currently in Wokingham is reported in Section 13.

[186] https://www.fixmyroof.co.uk/videos-and-guides/pitched-roof/roofing-prices/ & https://improvementcosts.com/costs/roofing/home-roofing-cost/

[187] Photovoltaic (PV) kilowatts peak is the peak power of a PV system or panel. Solar panel systems are given a rating in kilowatts peak, which is the rate at which they generate energy at peak performance, such as on a sunny day in the afternoon in the UK.

[188] Megawatt hours per year means the estimated amount of energy that a PV system or panel would generate over the course of a year.

11.5.6 Carbon offset

Carbon offset should be treated as a last resort measure for when on-site carbon savings measures have been maximised.

In London, carbon offset payments are applicable to all new major developments[189]. Based on typical performance of new build development to date, London's carbon offset funds could amount to £30-40 million annually.

The carbon offset fund is reliant on the following factors:

Governance structure that manages the fund and to identify a suitable range of projects that can be funded from the collected fund.

Suitable monitoring and auditing procedures.

Carbon offset price: For example, the recommended carbon offset price by the GLA is £95/tCO_2/year. However, each local authority in the GLA can set their own price. The majority of London authorities use £60/tCO_2/year, while eight authorities use £95/tCO_2/year, Lewisham local authority uses £104/tCO_2/year and Islington local authority uses £920/tCO_2/year. Rates are normally justified on the back of studies commissioned by the borough investigating local opportunities for carbon reduction.

Creation of a zero carbon/other carbon target: The carbon offset payment will depend on the difference between the estimated carbon emission of the development (tCO_2/year) and the zero carbon/other carbon target.

Payment collection point/timeline: Some payments can be collected over several years or at certain points (e.g., commencement on-site or post-construction). The contributions can be secured through Section 106 agreements (as in London).

- The period for which the payment is collected: London charges major developments to pay for 30 years of carbon emissions.

Carbon offset payment formula:

$$\text{Carbon offset payment received} = \text{Carbon offset price} * (\text{Estimated annual carbon emissions} - \text{Annual carbon target}) * \text{Time period (years)}$$

[189] Generally, those developments with 10 or more units or with >1000m2 of non-domestic floorspace

Table 12: Example offset payment formula

Factor	Unit
Assumed development	100 average homes
Assumed carbon offset payment	£60/tCO2/year
Payment period	30 years
Part L emission	1-1.5 tCO2/year[190]
Target set	Future Homes Interim standard (31% reduction in carbon emissions against Part L (2013)).
Emission per average home (post target met)	0.69 – 1.035 tCO2/year; Average: 0.8625 tCO2/year
Average emission for the entire site	0.8625 tCO2/year * 100 = 86.25 tCO2/year

Carbon offset payment for:

*£155,250 = £60/tCO$_2$/year * 86.25 tCO$_2$/year * 30 years*

[190] Estimate based on Arup's experience.

12. Sustainable Design Principles

Local plan policies can promote sustainable design and construction beyond only energy performance and low carbon supply. The section below begins with a review of sustainability methods and goes on to consider some of the main policy interventions relating to energy, water, green infrastructure, transport and so on. Recommended amendments to LPU Draft Plan (2020) policy are set out where appropriate.

12.1 Sustainability Assessment Methods

Sustainability standard certifications are commonly required as part of a local plan, or as a planning condition imposed on developments. They provide an important measure to express the expectation of what developer-led projects should achieve in terms of sustainable design, and ensures they are compliant with locally set policy. If adhered to, designing in accordance with a set standard ensures that developers look to improve design and make effective use of resources, with a focus on sustainable value and efficiency. Most adopted standards require a certified assessor to carry out the assessment of the sustainability of the proposed or developed building.

Table 13 below sets out the leading sustainability assessment methods commonly adopted in the UK, and looks to compare their use, themes, and benefits. While all standards are considered acceptable, BREEAM is the most widely used green building certification in the UK. BREEAM covers all building types, so it can effectively be applied to residential and non-residential properties of all scales. It also covers a broad range of sustainability themes which ensures a robust approach to sustainability measures. Consisting of 40 individual assessment issues, BREEAM spans five core technical categories: governance, land use and ecology, resources and energy, social and economic wellbeing, and transport and movement. The rating benchmarks range from acceptable to pass, good, very good, excellent and outstanding. These benchmarks then enable users to assess and compare the performance of a building with other BREEAM rated buildings of the same type, leading to the easy identification of exemplar buildings to raise the sustainability standards of a stock of future buildings.

BREEAM captures many elements of sustainable design, going beyond building design to promote sustainable land use, habitat protection and creation, and long-term biodiversity for a building's site and surrounding land. Similarly, BREEAM encourages access to sustainable means of transport for building users, specifically with a focus on the accessibility of public and active transport and designing to support a

reduction in car journeys. Efficient use of resources is also an integral part of sustainable design principles captured by BREEAM, for example, encouraging measures to reduce future waste arising from the construction and operation of the building, and encouraging sustainable water use in the operation of the building and its site, including means of reducing potable water consumption over the lifetime of the building and minimising the losses through leakage.

Table 13: Comparison of main sustainability assessment standards used in the UK

	BREEAM	LEED	Home Quality Mark (HQM)	WELL Building Standard
Summary	BREEAM is the most widely used green building certification system in the UK, covers all building types, and uses third party independent assessors.	LEED (Leadership in Energy and Environmental Design) is the most widely used green building rating system internationally. It covers all building types and is assessed using in-house accredited professionals.	The HQM sits within the BREEAM family tailored for new homes, using a simple star rating for the standard of a home's design, construction and sustainability.	The WELL Building Standard combines best practices in design and construction with an assessment of health and wellness, analysing the potential of buildings to support human health, well-being and comfort.
Date introduced	1990	1998	2015	2014
Country of origin	UK	USA	UK	USA
Current version	BREEAM 2018	LEEDv4 (4.1)	HQM ONE	WELLv1 WELLv2
Administrative body	Building Research Establishment (BRE)	US Green Building Council (USGBC)	Building Research Establishment (BRE)	International Wellbeing Institute
Certification body	Building Research Establishment (BRE)	Green Business Certification Institute (GBCI)	Building Research Establishment (BRE)	Green Business Certification Institute (GBCI)
Assessed by	BREEAM Assessor	LEED Accredited Professional	BREEAM Assessor	WELL Accredited Professional (assisting)

	BREEAM	LEED	Home Quality Mark (HQM)	WELL Building Standard
				WELL Assessor (verifying)
Schemes	New construction (including Commercial, Retail, Industrial, Residential, Courts and Prisons) Refurbishment and Fit-Out Homes International Bespoke In-Use Communities Infrastructure	Building Design and Construction Interior Design and Construction Core & Shell Schools Retail Homes Existing buildings: Operation and maintenance Neighbourhood Development	Home Quality Mark	Buildings Interiors Core Offices Retail Education Commercial Kitchens Restaurants Multifamily Residential Custom Health & Safety (COVID-19 related) Community
Sustainability themes	Management Health and Wellbeing Energy Transport Water Materials Waste Land Use and Ecology Pollution Innovation	Integrated Process Location and Transportation Sustainable Sites Water Efficiency Energy and Atmosphere Materials and Resources Indoor Environmental Quality Innovation Regional Priority	Transport and Movement Outdoors Safety and Resilience Comfort Energy Materials Space Water Quality Assurance Construction Impacts Customer Experience	Air Water Nourishment Light Movement Thermal Comfort Sound Materials Mind Community Innovation

	BREEAM	LEED	Home Quality Mark (HQM)	WELL Building Standard
Rating levels	Pass Good Very Good Excellent Outstanding	Certified Silver Gold Platinum	1-5 star overall rating plus three performance indicators representing health and wellbeing, environmental impact and running costs	Bronze (for Core) Silver Gold Platinum
Number of projects certified worldwide (2020)	>500,000	73,000	17,000 homes registered	326
Number of projects certified in the UK (2020)	13,000+	95	11,000+	11
Strengths	WBC's existing SPD on Sustainable Design and Construction already includes the requirement to meet BREEAM standards Comprehensive coverage of environmental sustainability Aligns with UK best practice Widest use in the UK Can be combined with WELL Flexibility to accommodate almost all building types	Includes some additional sustainability aspects such as solar reflectance Can be combined with WELL Includes some lesser-known measures in the UK such as integrated project delivery	This scheme replaces the now obsolete Code for Sustainable Homes Intended to allow renters to differentiate good quality, environmental homes Covers design, construction, handover and in-use, minimising performance gaps between design and operation Holistic scheme, including health and wellbeing, smart technologies and transport	Focuses on the experience of building occupants Flexibility to accommodate almost all building types Accompanies LEED and BREEAM Flexible to UK standards Data is verified with onsite measurements Ongoing performance is monitored and certification renewal is required Aspects of social sustainability such as health are addressed

	BREEAM	LEED	Home Quality Mark (HQM)	WELL Building Standard
Weaknesses	Social / economic considerations are not included Ongoing performance is not monitored	Social/economic considerations are not included Ongoing performance is not monitored Less common in the UK	Only covers new residential properties	Relatively high cost due to requirement for onsite verification of evidence Limited environmental sustainability assessment

12.2 Energy Hierarchy

While standards for energy efficiency have been discussed extensively above, inclusion in policy of an approach to the energy hierarchy should be considered. The energy hierarchy ('the hierarchy') has taken a number of forms since it was first conceived in 2005 by Philip Wolfe; the latest of which was introduced in the 2021 London Plan, shown in Figure 31. The hierarchy is intended to guide the design, construction and operation of new buildings through the application of a prioritised set of decision-making principles. In London's case, these principles are accompanied by specific targets, notably a minimum 35% reduction in on-site carbon emissions beyond the Building Regulations requirements for major developments.

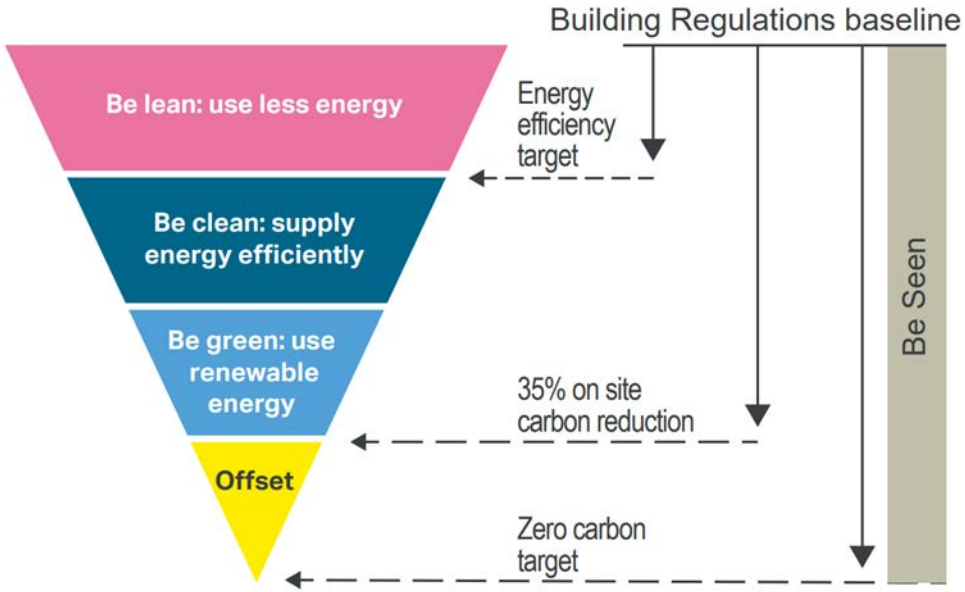


Figure 31: The energy hierarchy and associated targets (Greater London Authority, London Plan 2021)

Following the hierarchy from the actions that should be implemented first, 'Be lean' refers to reducing energy demand, through designing a building's fabric and orientation to maximise daylighting and passive heating and cooling, as well as managing demand during operation.

Secondly, 'Be clean' relates to utilising available local energy sources such as connecting to a local district heat network, and supplying energy efficiently.

'Be green' then encourages the maximisation of on-site renewable energy generation and storage. Once it has been demonstrated that these options have been exhausted and net-zero has not been achieved, residual emissions can be offset through payment to a borough's carbon offset fund (see section 10.5), or a verified local alternative.

The final hierarchy component, 'be seen', requires energy performance to be monitored, verified and reported.

WBC's Draft LPU Policy DH7 'Energy' in its current form adopts the principles of the energy hierarchy. It is supportive of development proposals that are 'lean'

(take a fabric first approach), 'clean' (maximise use of low-carbon local energy sources), and 'green' (reduce on-site energy demands and maximise on-site generation). The policy falls short of requiring development proposals to include an energy strategy setting out how operational performance will be monitored, verified and reported. Subject to viability testing, such a requirement is considered to be proportionate for major residential and non-residential development. An energy monitoring plan would be included in the Sustainability Statement.

12.3 Water Efficiency

The WBC Water Cycle Study Phase 1 Scoping Study (2019)[191] states that Wokingham is classified alongside many local authorities in southern England as an area of serious water stress. There is a risk of shortages in public water supply for example water needed for agriculture, energy generation, household demands and industry in the future. Water extraction also has to be balanced against minimising ecological damage. As a valuable resource, efforts should be made to conserve water and reduce water wastage during the construction and operation of a building. This could be done through improved practices and technologies or by setting minimum standards to reduce water consumption.

Planning policies should encourage adaptations such as the inclusion of rainwater harvesting systems, also captured in circular economy principles, measures to reduce household water demand, and the installation of water efficiency measures, in-house monitoring and leak repair and prevention. BREEAM also contains credits related to minimising water consumption and promoting water efficiency.

The London Plan (2021) includes such a water infrastructure policy, stating that:

> *"Development proposals should:*
>
> 1. *Through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
> 2. *Achieve at least the BREEAM 'Excellent' standard for the 'Wat01' water category160 or equivalent (commercial development)*

[191] https://www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=475412

3. *Incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing."*

The London Plan policy is also corroborated with other local authorities reviews as part of Section 11.3 Best Practice Review of Local Authority Policies. Several Plans reviewed opted to require the Building Regulations Part G 'optional' requirement of 110 litres per day for new residential development, which is made a condition that that requirement must be complied with. As the Best Practice describes, Oxford's Local Plan, as in others reviewed, this requirement is supported by a strong high-level policy on sustainable design and construction (Policy RE1) that sets out that planning permission will only be granted when submissions demonstrate, among other sustainability principles, 'conserving water and maximising water efficiency'.

WBC's Draft LPU Policy DH9 'Environmental Standards for Residential Development' states that development will be supported if it achieves the higher water efficiency standard (110 litres per person, per day). The draft policy as is looks favourably upon developments that intend to achieve this; however, it could adopt a stricter approach and *require* compliance.

WBC should consider requiring non-residential development to achieve BREEAM 'Excellent' (unless technically or viably infeasible). This would impose at least as stringent efficiency requirements as the 110-litre standard in Building Regulations (a 12.5% improvement on baseline regulations, up to a maximum 65% improvement). Achieving 'Excellent' in the BREEAM wat01 category is essential for a building to score 'Excellent' overall.

Under the 2018 BREEAM New Construction Scheme an optional 'post-occupancy' stage of assessment exists. This stage confirms the process of monitoring, reviewing and reporting on the performance (including in terms of water consumption) of a building once occupied. While none of the local plans reviewed mandated non-residential buildings to obtain a BREEAM post-occupancy stage certification, this could be included subject to viability considerations, as is likely to inform the Whole Life Carbon Cycle Assessment.

12.4 Retrofitting Existing Building Stock

Some 80% of today's building are expected to continue to be occupied in 2050. There is therefore an unequivocal need for a widespread retrofit programme to improve the efficiency and decarbonise the energy supply of the existing building stock if Wokingham is to achieve its climate emergency commitment. Whilst intervention to existing buildings largely falls outside the remit of planning, it is important for planning documentation to reflect an appropriately high level of energy efficiency improvement in the context of retrofit planning applications.

WBC's Draft LPU Policy DH9 'Environmental Standards for Residential Development' includes two positive elements with regards to retrofit. First, it "encourages" conversions to residential and extensions requiring planning permission (where floorspace is 500sqm or more) to achieve 'Excellent' in BREEAM domestic refurbishment. Secondly, it is supportive generally of measures that will facilitate a reduction in emissions in existing dwellings. Emphasis could be added by stating that 'significant weight' will be attributed to measures which result in emissions savings, as well as improving the longevity of existing buildings.

Avenues for the funding of local authority led retrofit programmes in the UK are limited in scope and number, however available schemes through central Government are given in Table 14.

Table 14: Government retrofit funding schemes

Retrofit funding opportunity	Description
BEIS Sustainable Warmth competition[192]	The Sustainable Warmth Competition is a £350 million funding opportunity for local authorities to upgrade 'on-gas' and 'off-gas' properties in their regions. The competition brings together the Local Authority Delivery Phase 3 and the Home Upgrade Grant Phase 1 schemes.
BEIS Wave 1 of the Social Housing Decarbonisation Fund[193]	The Social Housing Decarbonisation Fund will upgrade a significant amount of social housing stock to an Energy Performance Certificate rating of C. Applications for the first wave of funding will open in autumn 2021. Registered providers of social housing will be able to apply.

12.5 Wider policy considerations

Support for strategic policy

[192] https://www.gov.uk/Government/publications/apply-for-the-sustainable-warmth-competition

[193] https://www.gov.uk/Government/publications/social-housing-decarbonisation-fund

It is important to integrate climate change into high-level strategic planning policy within the LPU, to add weight to decision making and to provide a hook to tie together the wide range of measures required.

Climate change is already a central theme throughout WBC's Draft LPU (2020), starting from its vision and objectives and cascading down through policy and explanatory text as relevant. Indeed, Objective 1 of the LPU is to "make the fullest contribution possible to the mitigation of, and adaptation to, climate change and the transition to a low-carbon economy". Climate change considerations are incorporated into a wide-ranging set of policies, for example on the spatial strategy, climate change adaptation, green and blue infrastructure, place-making and quality design, energy, and sustainable drainage.

Zero carbon transport

An important topic that should be considered for inclusion in any development plan is sustainable transport and particularly the promotion of walking and cycling. It is likely that this would be integrated within a 'Transport' chapter within the local plan, but it is important to tie this back to the benefits regarding a reduction in GHG emissions and climate change mitigation. This should focus on reducing the number and length of journeys – specifically those taken using private cars – and maximise active travel and public transport opportunities. Additionally, requiring developments to provide electric vehicle charging points supports the transition away from petrol- and diesel-powered cars.

WBC's Draft LPU Policy C1 'Active and Sustainable Transport and Accessibility' seeks to promote these modes of transport and the principle of connectivity within and between developments in the borough. Policy C1 requires proposals to demonstrate their compliance with the objectives and policies of the Local Transport Plan (or any successor strategy), with the two plans intended to reinforce one another. Policy C2 requires, amongst other matters, that developments are designed in accordance with the user hierarchy which first prioritises pedestrian movements, then cycling, public transport, specialist vehicles, and other motor traffic last. Policy C3 'Cycling and Walking' mandates that development proposals promote active transport modes. Policy C4 'Vehicle and Cycle Parking' requires developments to provide appropriate parking arrangements which include cycles and electric vehicle charging facilities. Additionally, Policy C5 'Technology and Innovation in Transport' requires major development proposals to submit an Electric Vehicle Charging Strategy to demonstrate suitable provision of electric vehicle chargepoints.

Green infrastructure and nature-based carbon solutions

Green infrastructure has a notable role to play in both mitigation and adaptation to climate change. The provision of green infrastructure is often linked directly to policies on sustainable building design or flood risk / adaptation.

The draft Greater Manchester Spatial Framework (2019) Policy GM-S 2 promotes increasing carbon sequestration through the restoration of peat-based habitats, woodland management and tree-planting. Policy GM-G 7 states plans to plant a tree for every resident in Greater Manchester over the next 25 years as part of the City of Trees initiative.

Chapter 10 of WBC's Draft LPU 'Natural Environment and Flooding' contains a series of comprehensive policies on green infrastructure (policies NE1 through to NE7 and NE10). Policy makes clear the need for development proposals to align with the objectives and requirements within any adopted Biodiversity Action Plan or conservation plan, as well as spatial designations, such as Biodiversity Opportunity Areas, Sites of Urban Landscape Value or Local Nature Recovery Networks. Whilst policy requires developments to achieve minimum 10% biodiversity net gain, there is precedent for the LPU to require a 20% biodiversity net gain. This would need to be subject to viability testing alongside other policy requirements in the LPU.

Flood risk adaptation

National Planning Policy states that 'inappropriate' development should not be located on sites vulnerable to flooding, as evidenced through a flood risk assessment. In setting a spatial strategy and selecting sites, a local plan can avoid development in flood risk zones and, where unavoidable, mandate the incorporation of flood resistant design. Wokingham sits within the Thames River basin district and several main rivers run through the area including the River Thames and its tributary the Foudry Brook, and the River Loddon and its many feeder watercourses including Emm Brook. The high concentration of river systems has led to periodic flooding and it will be important to tie existing work being undertaken on flood risk with future likely impacts of climate change and policy support for climate change adaptation.

Milton Keynes' Local Plan (2019) contains the following Flood Risk Policy: *"Development within areas of flood risk from any source of flooding will only be acceptable if it is clearly demonstrated that it is appropriate at that location, and that there are no suitable available alternative sites at a lower flood risk."* The policy sets out various requirements for development proposed in flood risk areas, ensuring all opportunities are utilised to improve existing flood risk. Notably, the policy requires that: *"…a site's design and any flood mitigation measures implemented [must be] designed with an allowance for climate change and the potential impact it may have over the lifetime of the proposed development."*

Developers are directed towards the Environment Agency's guidance on the use of climate change allowances in flood risk assessment.

WBC's LPU reflects best practice on flood risk. Policy NE8 reiterates national policy and guidance, stating that proposals must demonstrate the use of Strategic Flood Risk Assessment and apply the sequential approach. The policy clarifies that the sequential approach must take into account the effects of climate change. Policy NE9 adds that major development must incorporate SuDS as "an intrinsic part of the proposal" in areas at risk of flooding. All development on greenfield land must reproduce greenfield runoff rates, while all development on brownfield land must produce runoff rates that are either 40% better than existing or as near to greenfield rates as possible.

13. Renewable Energy Capacity Analysis

The NPPF section 14 sets out policies to meet the challenges of climate change, flooding and coastal change. NPPF paragraph 155 states that to help increase the use and supply of renewable and low carbon energy and heat, plans should identify opportunities for developments to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers. NPPF paragraph 156 goes onto state that local planning authorities should support community-led initiative for renewable and low carbon energy. As such, this section provides an assessment of renewable energy capacity in Wokingham and viable renewable energy sources which could be realised through local and neighbourhood planning processes, in recognition of NPPF and PPG support for community-led renewable energy developments. Applications for commercial scale projects outside these areas are still anticipated, but they must demonstrate that the proposed location meets the criteria used in identifying suitable areas.

13.1 Assessment of Current Renewable Energy Capacity Across the Borough

This section firstly develops a baseline of renewable energy projects that are already installed or are currently in the planning system, drawing on national and local data sets. The section also presents on community energy activity in the borough, as well as pointing to other community energy groups nationally that have been successful in deploying renewable energy over the last decade. The baseline is useful in determining the level of uptake for renewable energy across the borough and the pressures this is placing on existing infrastructure.

13.1.1 Existing renewable energy schemes

The Heat Network Planning Database indicates that, at the time of writing (August 2021), there are no recorded heat networks in Wokingham. However, there are examples of solar photovoltaics, both ground and rooftop mounted, and onshore wind generation project which are operational or in development, as set out in Table 15 below.

Table 15: Existing and planned for renwable energy projects in Wokingham

Site	Type	Capacity (MW)	Status
Sheepbridge Court Farm	Solar Photovoltaics – Ground	5	Operational

Site	Type	Capacity (MW)	Status
Aborfield Solar Park	Solar Photovoltaics – Ground	14	Awaiting Construction
Rectory Road	Solar Photovoltaics – Rooftop	Unknown	Application Submitted
Green Park	Wind Onshore	2	Operational
Rushy Mead (University of Reading)	Wind Onshore	12	Application Refused

In February 2021, WBC announced plans for a new solar farm on Barkham Farm[194]. The proposals would see solar panels installed on 40 hectares of council-owned farmland adjacent to Barkham Ride (High Barn Farm and part of Brook Farm). The solar farm is anticipated to generate around 23 to 32 MWs a year and would be in place for a 40-year period. The application for the Scoping Opinion application to determine the content of the Environmental Impact Assessment for the Installation of a 35 MW (37.98ha) Solar Farm with associated infrastructure, tree planting and landscaping, grid connection and upgrade of Bridleway BARK BR 11 (Ref: 210460) has been determined. The full planning application (Ref: 211081) was submitted in March 2021 and approval was granted in January 2022.

13.1.2 Community energy schemes

In January 2021, WBC launched a new independent Community Action Group called Wokingham Community Energy (WCE)[195]. WCE seeks to encourage sustainable energy projects within Wokingham. It is proposed that profits made by the scheme, through the sale of green energy to customers or back into the national grid, would be used to pay interest to shareholders with the remainder going into a pot to fund green projects and initiatives within the community. The new scheme plans to work closely with Energy4All, the national body established to help implement schemes such as this across the UK, and the local Reading Community Energy Fund (RCEF) which was established in 2016 to implement a similar community energy

[194] https://www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=546054

[195] https://news.wokingham.gov.uk/news/new-community-energy-scheme-for-wokingham-borough/

project in Reading Borough. Planned projects are expected to include investments such as installing solar panels on top of public or large commercial buildings.

There are no identified Community Energy projects already in place in Wokingham yet. However, there are multiple benefits, aside from increased renewable energy generation, to be realised from their delivery. These include increasing resource efficiency by harnessing unused roofs to generate energy and reducing transmission losses by local generation for local use, increased community engagement, advocacy and behaviour changes, and increased energy awareness. Case studies from around the country of successful community energy projects which may come forward under the new WCE initiative include the following:

North Kensington Community Energy – this 140-member group have installed 86.27 kW of rooftop solar on school and community buildings, with plans to install another 150 kW. They are also currently investigating the potential for a micro-anaerobic digestion system.

Brighton and Hove Energy Services Cooperative – this 170-member group have successfully completed 42 community energy projects, ranging from solar PV, battery storage, biomass, heat pumps, heat networks, underfloor heating and energy efficiency projects.

Greater Manchester Community Renewables – this project saw solar arrays built on two school buildings, with close engagement and participation from school students.

Penllergare Trust, Wales - this hydroelectricity project saw 25 kW of low head hydropower installed at an upper lake in the Penllergare Valley Woods. The installation is projected to generate 71,000 kWh per annum.

Balerno Village Trust, Edinburgh – this hydro power project has successfully installed a 95 kW system in Balerno Village, south-west of Edinburgh.

Garth Wind Farm, Shetlands – Garth Wind is a community-led project with five 0.9 MW turbines, totally 4.5 MW in North Yell, Shetland.

13.2 Future Renewable Energy Capacity

13.2.1 Future Renewables Capacity

This section identifies the types of renewable and low carbon technologies that could be deployed in Wokingham, based on the local context and opportunities arising. This includes recognising the planning and environmental constraints (such as Green Belt, flood risk, heritage and SSSIs), technical and physical constraints (such as built-ups areas and grid capacity), and wind speed and solar irradiation. This allows for an assessment of understanding the broad potential for renewable and low carbon energy within the borough, with further consideration of what policy criteria could be introduced to maximise these opportunities.

13.2.2 Small and commercial scale wind

The Renewable and Low-carbon Energy Capacity Methodology[196] stipulates that threshold wind speeds of 4.5 m/s and 5.0 m/s should be used for assessing small and commercial scale wind turbine opportunities respectively. The wind speed data available for Wokingham however indicated that mean wind speeds are lower than this, so the potential for wind turbines was not considered beyond this stage. Three sources of wind speed data were compared before reaching this conclusion, summarised in Table 16.

According to this methodology, Wokingham does not have sufficiently high wind speeds to be suitable for wind generation.

Table 16: Mean wind speed in Wokingham at borough-wide level

Mean wind speed, averaged over year (m/s)	Year of data	Source of data
4.41	2020	CFSR2
3.96	2019	CFSR2
4.49	2020	ERA-5

13.2.3 Solar PV

The availability of roof-based solar PV was calculated using National Land and Property Gazetteer data from WBC to determine the number of eligible buildings to accommodate solar PV. The potential capacity for solar PV was calculated based on the number of buildings in the area, an estimated percentage of those viable for solar PV and an assumed average PV capacity for each building typology. The benchmarks and outcomes are shown in Table 17 and are based off the Renewable and Low-carbon Energy Capacity Methodology for commercial and industrial properties and calculations for domestic properties[197]. For the purposes of this calculation, conservative values from the lower end of the range of capacities were used, assuming all buildings have pitched roofs.

Table 17: Total roof-top solar PV capacity in Wokingham for different building typolgies

[196] SQW Energy (2010) Renewable and Low Carbon Energy Capacity Methodology, Microsoft Word - Renewable and Low-carbon Energy Capacity Methodology - Final 04032010c.doc (publishing.service.gov.uk), accessed 13/05/22

[197] SQW Energy (2010) Renewable and Low Carbon Energy Capacity Methodology, Microsoft Word - Renewable and Low-carbon Energy Capacity Methodology - Final 04032010c.doc (publishing.service.gov.uk), accessed 13/05/22

Building typology	Assumed percentage of buildings viable for rooftop solar PV	Assumed capacity per building (kW)	Total capacity (kW)
Existing domestic	25%	2.8	52,100
New domestic	50%	2.8	10,400
Industrial	80%	5.0	6,700
Commercial	40%	5.0	6,300
Total	-	-	75,500

13.2.4 Ground Solar PV

The area of land available for ground solar is calculated based on the area of open spaces (agricultural, marsh land and heath) in Wokingham. Ground solar PV panels are normally installed to cover the area of each piece of land which is 5-10m away from the perimeter, to avoid shading from any perimeter borders such as trees or hedges and to allow access. Open spaces which fell into the following categories were removed:

- Any areas which are Sites of Special Scientific Interest (SSSI) (including Special Areas of Conservation (SAC) and Special Protection Areas (SPA)) and Areas of Outstanding Natural Beauty (AONB) were considered to be restricted. In the Wokingham Borough Council this affected Sites of Special Scientific Interest.
- Any land with an agricultural grade of 3a or higher (i.e. Best and Most Versatile) according to the post 1988 Agricultural Land Classification (detailed data based on surveys of specific areas) or with an agricultural grade of 1 or 2 according to the pre 1988 Agricultural Land Classification (which has greater coverage than the post 1988 data) was considered to be too high grade to be viable for solar panel installation.
- Any land areas which were less than 3,000m^2 (and therefore unlikely to have a significant area more than 10m away from the perimeter of the land).

The remaining land was presumed to have a solar panel productivity of 0.7 MW/ha, a standard industry assumption. Based on the need for solar panels to be 5-10m away from the perimeter of a piece of land, it was assumed that 90% of the total area could be used. Figure 32 presents a map of the viable areas, Table 18 shows the calculated potential capacity for ground solar PV in Wokingham.

It should be noted that some of the viable land lies in Green Belt and therefore exceptional circumstances would need to be demonstrated to install ground solar PV.

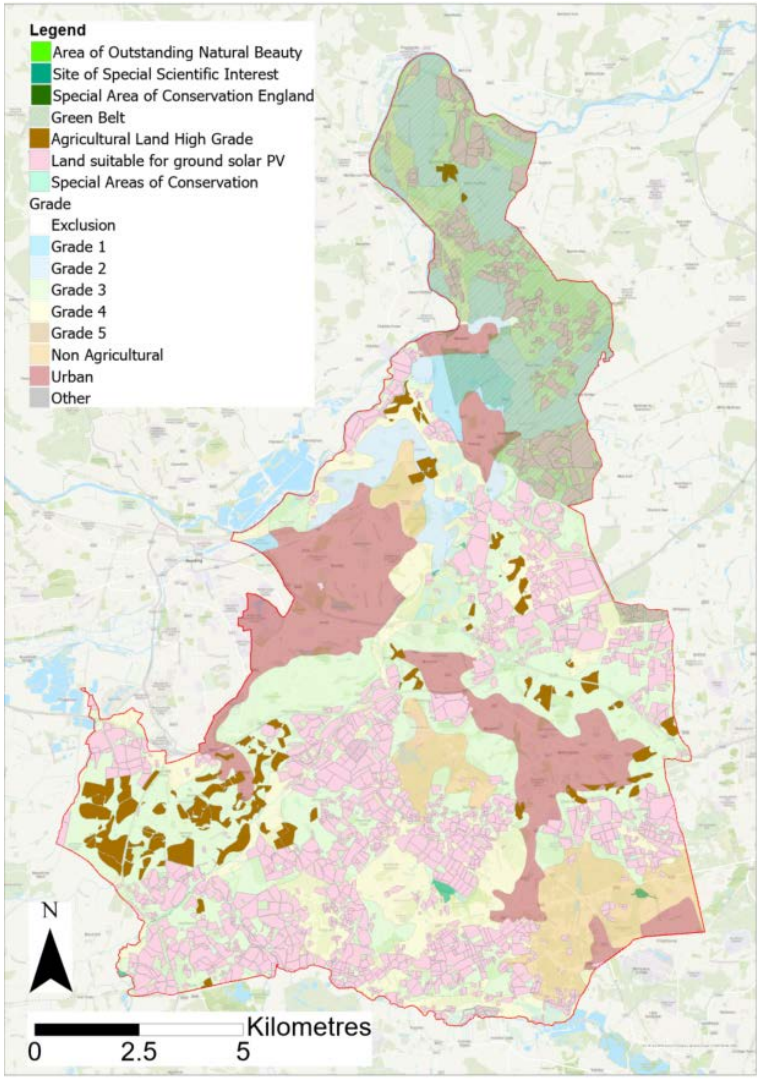


Figure 32: Area of land with viability for ground solar PV in Wokingham

Table 18: Total potential capacity for ground solar PV in Wokingham

Metric	Value
Area of land which is unrestricted for ground solar PV installation (m^2)	47,083,729
Percentage of the area of land covered by PV panels (%)	90%
Total area viable for ground solar PV panels (m^2)	42,375,356
Total potential capacity for ground solar PV in Wokingham (MW)	7,489

13.2.5 District Heating Networks

Building heat demand for Wokingham was mapped to identify any areas with viability for heat networks.

Areas with a minimum threshold of 3,000 kW/km2 were identified to have sufficiently high building heat density for heat network viability. This was estimated using GIS software to calculate the building heat density across Wokingham using a square kilometre raster. Areas with multiple adjacent squares over the threshold were combined as a potential heat network 'zone'. To be considered, each zone had to have more than three buildings which could connect.

A minimum heat demand threshold was applied to the building data prior to this analysis: at least 75,000 kWh/year to be considered for connection. Buildings, particularly residential buildings, below this are normally found to be unfeasible to connect to a heat network due to the infrastructure costs required.

The heat demand of buildings within the identified zones was calculated to understand the total capacity of heat in Wokingham which could be provided by district heating. The identified potential heat network zones are shown in Figure 33 and detailed in Table 19.

Table 19: Areas with potential for a heat network

Potential Heat Network Zones	Number of buildings	Total heat demand (kWh/year)
1	796	149,138,198
2	312	91,640,979

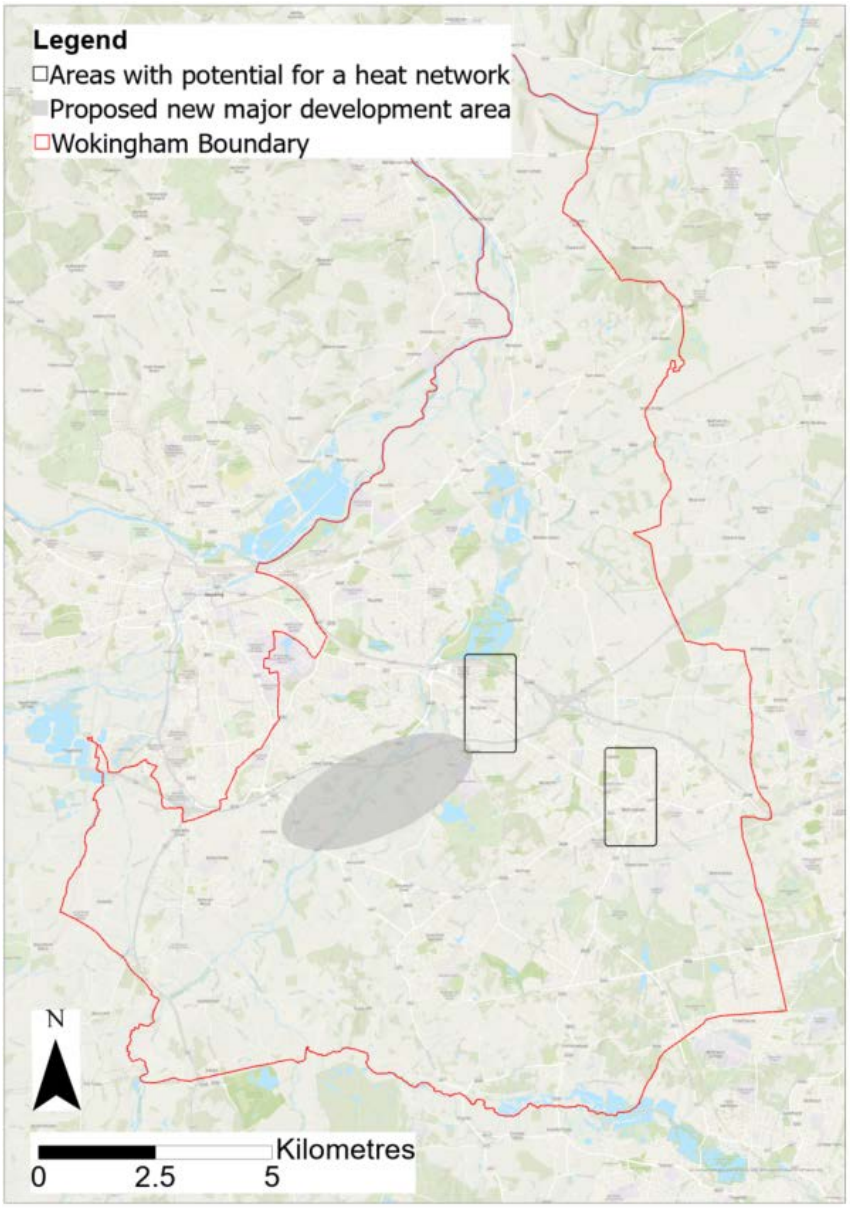


Figure 33: Areas of Wokingham identified as having sufficient heat density for a potential heat network

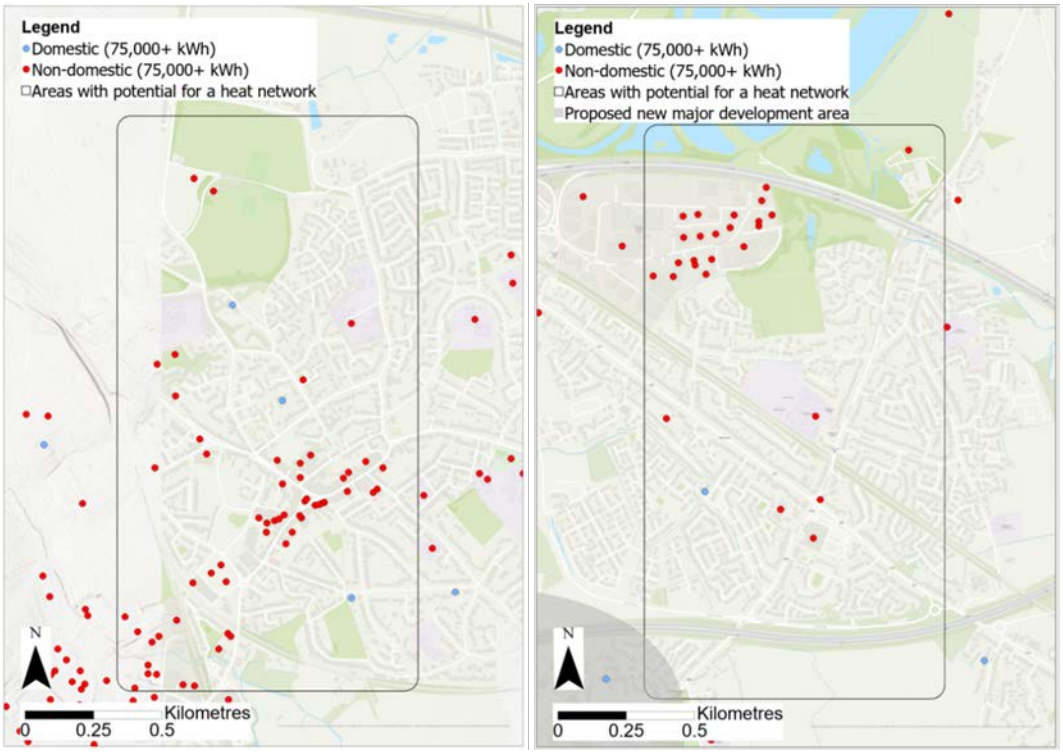


Figure 34: Areas with potential for a heat network in Wokingham, including domestic and non-domestic loads with heat demands of at least 75,000 kWh/year. Zone 1 (left) and Zone 2 (right).

Figure 34 shows a more granular map of the areas identified to have potential for a heat network in Wokingham, including the buildings in each which have a heat demand of more than 75,000 kWh/year. The data has been benchmarked based on building floor areas, so the domestic properties shown in the figure are those with the largest floor areas.

Zone 1 is a 2km^2 area in the centre of Wokingham. It has a high density of non-domestic buildings including: Wokingham Theatre, Glebelands Care Home and numerous buildings along the main central district.

Zone 2 is a 2km^2 area which is bordered by the A329 to the north and the M4 to the south. It includes the Winnersh Triangle business park, which has a large density of non-domestic building heat loads. It also

includes the Sainsburys and Westfield Road Surgery to the south of the area. This zone is dissected by the train line passing to Winnersh station and therefore the feasibility and cost of installing infrastructure to cross this would have to be analysed.

13.2.6 Infrastructure

The primary substations (PSS) and bulk supply points (BSP) in Wokingham were mapped to understand the potential constraints and impact from additional renewable energy sources.

Table 20 presents the location and connection of the PSS' and BSPs and describes their current transmission and distribution status.

Table 20: Current transmission and distribution status of primary sub-stations in Wokingham

Primary Substation	Bulk Supply Point	Transmission Status	Distribution Status
Elms Road	Wokingham	Unconstrained	Constrained
Wokingham	Wokingham	Unconstrained	Constrained
Poole (Hill Street)	Wokingham	Unconstrained	Unconstrained
Arborfield	Wokingham	Unconstrainted	Constrained

13.3 Recommendations for Renewable Energy Policy

The WBC Draft LPU (2020) contains a policy on low carbon and renewable energy generation: policy DH10. As it stands, Policy DH10 is comprehensive and reflective of renewable energy policies reviewed. WBC Draft Local Plan Report on Initial Consultation Outcomes document (2021) notes that few comments were received on policy DH10, but those received stated support from town/parish councils and statutory bodies, notably Natural England, Reading Borough Council and West Berkshire District Council.

Of the comments that were received, some suggested that the policy should consider the impacts of low/zero carbon energy generation on ecology and landscape. Policy DH10 already specifies that such schemes will be supported, provided that they do not cause unacceptable impacts on landscape and biodiversity - a sentence typical of other local authority policies on the matter. LPU Draft Policy NE1 requires a minimum 10% biodiversity net gain for development proposals of all sizes – this would apply to applications for low/zero carbon generation schemes. However, for completeness, **it is recommended that the requirement for biodiversity net gain is repeated in Policy DH10**.

WBC could consider allocating suitable sites for renewable energy generation to safeguard such sites from alternative development types. These sites would be shown on the accompanying Policies Map. An initial step in progressing the allocation of sites would be engagement with key site landowners and commissioning of site selection and feasibility studies, in particular for solar PV sites. WBC could then consider the use of Local Development Orders to provide permitted development rights for solar in locations where harm is not expected to outweigh benefit (as done by Swindon Borough Council).

Paragraph 2 of policy DH10 states that local support for schemes will be attributed significant weight in decision taking. **WBC could promote community involvement and benefit from commercial schemes by specifying that schemes over a certain capacity (such as 5MW in the case of Cornwall) provide an option to local communities to own a proportion of the scheme**.

Finally, the findings of the Renewable Energy Capacity Study suggest that district heat networks are likely to be suitable in two identified heat network zones. Subject to confirmation of their suitability through further feasibility testing, WBC could consider **adopting a policy on district heat networks that is area-specific to the two suitable zones** (akin to the Heat Network Priority Areas identified in the London Plan). Such a policy would either encourage or require new development within those heat network zones to connect or feed into the heat network (unless it can be demonstrated that doing so is not feasible).

14. Circular Economy in the Built Environment

The built environment - comprised of the man-made elements of our surroundings such as buildings and infrastructure – currently represents a major global consumer of natural resources and a significant contributor to global carbon emissions. This is because the built environment we live in today continues to be designed around the linear model, in which materials are sourced, used and then disposed of as waste. Known as the take-make-use-dispose model, this produces negative externalities that include rising carbon emissions, increased pressures on landfill, unsustainable levels of water extraction and widespread ecosystem pollution. It is estimated that between now and 2050, carbon emissions from construction will be responsible for almost half of total new building emissions[198].

Transitioning to a circular model for the built environment, and thereby making radical changes in the way we think about constructing, equipping, using, maintaining, altering and renewing our built environment, presents a powerful opportunity to reduce the carbon emissions and resource consumption associated with buildings.

Circular economy implementation can be considered at many different scales within the built environment, including component, building, city, national and global levels. To realise the full opportunity of a circular built environment, new circular economy approaches will have to be implemented at all scales. However, for this project, the focus is primarily on new developments, exploring examples of how circular economy principles can be embedded into policy and practice.

14.1 Embedding the circular economy in developments

The circular economy model aims to decouple economic growth from resource consumption. In a circular economy, renewable materials are used where possible, energy is provided from renewable sources, natural systems are preserved and enhanced, and waste and negative impacts are designed out. Materials, products and components are managed in repetitive loops, maintaining them at their highest useful purpose as long as feasible, which minimises resource waste.

A circular built environment represents the creation of a more efficient and higher performing built environment, supporting the development of more resilient and sustainable cities.

[198] Architecture 2030, New Buildings: Embodied Carbon, available at: https://architecture2030.org/new-buildings-embodied/, accessed 24/08/2021

A circular approach to new buildings employs three main principles[199]:

Designing out waste and thinking about the way in which materials can be disassembled and reused at the end of their useful life starts with the design of buildings and infrastructure that is flexible and adaptable. This means reusing rather than demolishing where possible, designing products and components so that they can easily be disassembled, and using parts that lend themselves to up-cycling or recycling. Restoring and regenerating natural systems, such as the water system, through design creates healthy and resilient resource flows, benefitting occupants and biodiversity now and into the future.

There are a wide variety of design interventions that promote the circular economy, including:

Designing for longevity: ensuring the long-term durability, utilisation and value of built assets. Designing for maintenance, repair and reuse at all life cycle stages and using durable materials minimises waste generation during construction and deconstruction and helps to ensure assets are used optimally throughout their lifecycles.

Designing flexible building cores: allowing developers to enable buildings to switch use at a later date - from commercial to residential or from commercial to other employment types, for example - reduces the need for resource-intensive demolition and re-construction.

Reducing resource usage: principles such as off-site construction and modular components reduce the amount of waste produced on-site and enable reuse and repurposing. Components and materials can then be

[199] Arup and the Ellen MacArthur Foundation (2018) First Steps Towards a Circular Built Environment, available at: https://www.arup.com/perspectives/publications/research/section/first-steps-towards-a-circular-built-environment, accessed 24/08/2021

reused for the construction of new buildings, repurposed for application in infrastructure or transferred for use in other industrial sectors — eliminating primary material use.

Utilising renewable energy: renewable energy, including excesses arising from free sources of heat such as sewers, lakes, rivers, canals, data centres, Energy from Waste (EfW) and other sources can be harvested to provide heat, cooling and electricity to buildings. Storage can be used to balance supply and demand. This reduces the need for large, centralised fossil fuel energy generation and increases the scope for efficient decentralised systems.

Location: London

Lead architect: Allford Hall Monaghan Morris

White Collar Factory

A mixed-use development designed using exposed services, adaptable floor places and internal fittings to allow for easy subdivision, interactivity and flexibility over time. Adaptable components also prolong the building's lifespan.

Durable materials were chosen for their low-carbon attributes.

Integrated smart services including passive systems that maximise natural daylight and ventilation deliver energy efficiency and maximise comfort levels. Occupation carbon emissions are 25% lower than Building Regulations Part L.

BREEAM Excellent and LEED Platinum compliant.

Sky Believe in Better Building

The commercial headquarters for Sky is a timber construction made using modular, off-site prefabrication techniques.

The building incorporates rooftop PV and connects to a campus-wide biomass combined cooling, heating and power (CCHP) system.

Designed for flexible use with adaptable fittings and partitions that allow spaces to be easily altered for different functions.

Achieved BREEAM Excellent and Passivhaus standards.

Location: London **Lead architect: Arup Associates**	
 **Location: London** **Lead architect: alma-nac**	**Paxton House** Refurbishment and conversion of a derelict 1960s building to a complex of 43 homes with shared communal spaces. Sustainable timber cladding used for its high-performance credentials, which make it both durable and long-lasting. A roof garden and herb garden are shared by the whole building.

14.2 Embedding the circular economy in planning policy

Creating a policy environment that incentivises and facilitates more circular behaviour is essential to the transition away from a linear system. There are significant opportunities to foster a regulatory environment that favours and facilitates the development of circular economy initiatives. For new development, planning policy is a crucial lever in this.

Within planning policy, requirements covering demolition strategies, specification of construction materials, proportions of reused and reusable materials, and mandatory whole life-cycle calculations could all play a part in supporting circular economy adoption. Examples of policy approaches taken by local authorities in the UK are presented below.

It is important to note that while each of the development plan documents presented below contains a specific policy on circular economy, circular economy principles of minimising resource use and waste can and should be embedded in policies throughout a local plan. Policies promoting the harvesting and recycling of rainwater, for example, embody circularity. Similarly, policies promoting the integration of renewable energy technologies or sustainable modes of transport equally embody the principles of circularity.

Location: London

Authority: Greater London Authority

The London Plan (2021)

The new London Plan recognises that the circular economy is essential to achieving 'Good Growth' - growth that is socially and economically inclusive and environmentally sustainable.

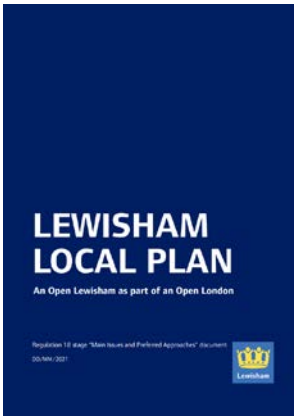
The Plan seeks to be a catalyst for the circular economy by requiring major developments to provide evidence that they are hard-wiring circular economy principles into schemes (Policy SI7).

All referable developments will be required to submit a Circular Economy Statement. Local authorities are encouraged to adopt a similar approach for non-referable schemes, setting their own threshold.

The Circular Economy Statement should demonstrate:

- how all materials arising from demolition and remediation works will be re-used and/or recycled
- how the proposal's design and construction will reduce material demands and enable building materials, components and products to be disassembled and re-used at the end of their useful life
- opportunities for managing as much waste as possible on site
- adequate and easily accessible storage space and collection systems to support recycling and re-use
- how much waste the proposal is expected to generate, and how and where the waste will be managed in accordance with the waste hierarchy
- how performance will be monitored and reported.

The supporting text recognises that incorporating circular economy principles into the design of developments will be crucial, referencing Policy SD3 'Optimising site capacity through the design-led approach', which requires development to "take into account the principles of the circular economy".



Location: Lewisham, London

Authority: Lewisham Council

Lewisham Regulation 18 Draft Local Plan (2021)[200]

In response to the main issues facing the Borough, Lewisham's Draft Local Plan promotes the circular economy, thereby seeking to reduce waste and prioritise the re-use and recycling of materials.

The need for development to incorporate circularity principles in the design and construction stages is referenced throughout the Plan.

Policy SD12 'Design to support the circular economy' states that all development proposals will be expected to apply circular economy principles in order to minimise waste and support the delivery of sustainable development in Lewisham. At the start of the design process, the following principles should be taken into account:

Building in layers, ensuring that different parts of buildings and spaces are accessible and can be maintained and replaced when necessary;

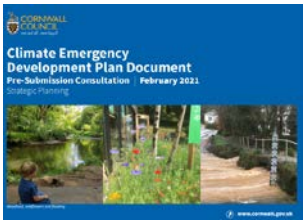
Designing out waste, ensuring that waste reduction is planned from project inception to completion (including consideration of standardised components, modular build and re-use of secondary products and materials);

- Designing for adaptability;
- Designing for disassembly; and
- Using materials that can be re-used and recycled.

Major development proposals should aim to be net zero-waste, as demonstrated through a Circular Economy Statement (submitted as part of a Sustainable Design Statement).

Policy SD12 specifically singles out multi-storey flatted residential development, including mixed-use development, requiring the provision of waste storage and collection systems at each floor.

[200] Lewisham Council (2021) Regulation 18 Draft Local Plan, available at: https://lewisham.gov.uk/myservices/planning/policy/planning/about-the-lewisham-local-plan, accessed 01/09/2021



Location: Cornwall

Authority: Cornwall County Council

Cornwall Council Draft Climate Emergency Development Plan Document (2021)

Policy Sustainable Energy and Construction 1 states that development proposals will be required to demonstrate how they have implemented a series of principles, including minimising the use of materials and promoting the circular economy. Measures to do this include:

- Prioritising the use of previously developed land;
- Reusing and recycling appropriate materials that arise through demolition and refurbishment, including the reuse of non-contaminated excavated soil and hardcore within the site;
- Prioritising the use of locally sourced and/or sustainable materials and construction techniques that have smaller ecological and carbon footprints;
- Using locally distinctive, resilient, low maintenance materials that are appropriate for Cornwall's damp maritime climate (see Design Guide for more detail);
- Considering the lifecycle of the development and surrounding area, including how they can be adapted to meet changing community needs and how materials can be recycled at the end of their lifetime; and
- Providing adequate space to enable and encourage greater levels of recycling across residential and non-residential developments.

Location: Old Oak and Park Royal, London

Authority: Old Oak and Park Royal Development Corporation

Old Oak and Park Royal Regulation 19 Draft Local Plan (2017)[201]

The Old Oak and Park Royal Development Corporation commissioned a Circular and Sharing Economy Study[202] as a key evidence base to underpin the production of their Local Plan. The report identifies specific measures that would support a shift to a more resource and space efficient place and its recommendations are embedded throughout the policies of the Local Plan and in a specific policy on the topic (Policy EU7).

Policy EU7 requires major development proposals to demonstrate through the submission of a Circular and Sharing Economy Statement how the principles of the circular and sharing economy have been incorporated into the design, construction, operational use of and end life disassembly of new development.

Policy EU8 follows on, promoting the use of sustainable materials, assuring support for developments that use materials which are locally sourced, reduce embodied carbon, and are designed to last and wear well over the lifetime. A minimum of 20% of the total material value of new buildings, infrastructure and landscape works should derive from reused or recycled content.

14.3 Circular Economy Statements

Requiring the submission of circular economy statements, either standalone or as part of broader planning document submissions, is becoming more widespread in planning policy. The Greater London Authority published draft guidance on the matter, which explains how to prepare a Circular Economy Statement to accompany planning applications that are referable to the Mayor, or where boroughs have specified a lower threshold (typically for major development). The guidance explains the three steps involved in the production of a Circular Economy Statement, which take place at different stages of the development process (see Table 21). For masterplan-led developments where limited design information is available, the Circular

[201] Old Oak and Park Royal Development Corporation (2017) Old Oak and Park Royal Regulation 19 Draft Local Plan, available at: https://www.london.gov.uk/sites/default/files/opdc_local_plan_revised_draft_for_regulation_19_consultation_0.pdf, accessed on 01/09/2021

[202] Arup (2017) Circular and Sharing Economy Study: Local Plan Supporting Study, available at: https://www.london.gov.uk/sites/default/files/9._circular_and_sharing_economy_study_0.pdf, accessed 01/09/2021

Economy Statement should focus on the work carried out to assess opportunities for re-use of any materials, buildings or resources on site. It should also describe any strategic ways that the masterplan will promote circular economy measures.

Table 21: The stages of developing a Circular Economy Statement (GLA, 2020)

Planning stage:	Prep-App / Outline Planning Application	Full Application / Reserved Matters	Updates/ Completion
Output(s):	Draft Circular Economy Statement	Detailed Circular Economy Statement	Planning updates Post-completion updates
RIBA Stages:	0-2	2-3	4-7
Objectives:	Identify strategic approach(es) to development and any materials on site Agree metrics and targets to report against at detailed stage Identify supporting information or calculations that will be required as evidence	Confirm strategic approach(es) with emphasis on detailed design Confirm metrics and targets to report against, outlining specific commitments, opportunities and plans to achieve these Identify challenges and counter-actions	Produce updates Confirm compliance Report outcomes Report lessons learned
Actions to undertake:	Initial workshop(s) with design team to agree strategic approach Integrate circular economy principles into the project brief	Follow up workshop(s) with design team Calculations, research, data gathering, etc. Engagement with supply chain	Confirm that targets are achieved Monitor outcomes Engage with occupants/tenants as necessary

14.4 Recommendations for Circular Economy Policy

Circular economy principles present a practical means to minimise the negative externalities associated with the built environment, including reducing greenhouse gas emissions, preventing resource degradation and minimising waste.

At present, the draft LPU does not emphasise the importance of circular principles. To ensure that developers incorporate these principles, WBC should:

Consider the addition of a specific policy on the circular economy, emulating the design approach taken by the London Plan and London boroughs;

Recognise either in main or supplementary policy text the link between circular economy and reducing whole life-cycle carbon emissions of a building;

Consider how best to assess the circular economy credentials of proposed developments - this may entail the addition of a circular economy section to the Sustainability Statement as proposed in the Draft LPU;

Continue with the draft intention to specify minimum BREEAM environmental standards for non-residential buildings, as BREEAM certification requires responsible sourcing of materials and efficient resource use;

Review draft policies related to resource use - particularly on minerals and waste, natural environment, and water - in search of opportunities to strengthen circularity principles; and

Continue to pursue ambitious policies on renewable energy and sustainable transport, in recognition of their beneficial impact in reducing greenhouse gas emissions.

15. Summary of Recommendations and Challenges for Further Consideration

15.1 Summary of Policy Recommendations

The Evidence Base provides an extensive discussion on the opportunities, implications and recommendations for WBC's planning policies in responding to climate change. The following table provides a summary of the key recommendations for embedding climate change and renewable energy in local planning policy that emerged through the study.

Table 22: Wokingham Borough Council recommendations for supporting climate change mitigations and renewable energy opportunities in local planning policy

Net Zero Development

Topic	Recommendation
Definition	The LPU should replace 'carbon neutral' in Policy DH9 with 'net zero'. The net zero requirement applies to regulated (operational) emissions only. However, through Policy DH9

Topic	Recommendation
	(or a new policy), the LPU should additionally require the submission of whole lifecycle carbon assessments. The accompanying Sustainable Design and Construction SPD would clarify the framework for the transparent assessment of whole lifecycle emissions. When defining the 'net' in net zero, Wokingham's planning policies should adopt a net zero target where the emitted anthropogenic GHG emissions are equivalent to that removed from the atmosphere, but offsetting or active removals are used as a last resort option where further reductions are practically impossible.
Regulated Emissions – Setting energy efficiency standards that exceed target emission rates of the Part L Building Regulations	Defined as those emissions arising from the use of energy sources regulated by the Part L of the Building Regulations. These sources are fixed building services and fittings, including space heating and cooling, hot water, ventilation and lighting. For regulated emissions, WBC can use their planning policies to set energy efficiency standards that exceed the target emission rates of the Part L Building Regulations. WBC could require new developments to be net zero, specifying a minimum percentage of this net zero target to be achieved through emissions reductions above Building Regulations and through on-site renewable energy. Carbon offsets can be used to make up the shortfall.
Embodied Emissions – Whole Life-Cycle Carbon Assessments	Defined as construction emissions plus those emissions associated with the maintenance, replacement, deconstruction, disposal and end of life of a building WBC should require whole lifecycle carbon assessments (WLC) for major applications. The WLC would quantify the emissions arising through the construction, use and disposal of a building over its entire life (60 years). Planning applications would be expected to demonstrate through their WLC that efforts have been made to reduce all emission types. Guidance on how to undertake WLCs should be provided in the Sustainable Design and Construction SPD. In minimising on-site emissions, renewable energy projects will almost certainly have to be incorporated, which should contribute to reducing unregulated emissions.
Sustainability Statements	Sustainability Statements would be required alongside planning applications to demonstrate how the development is contributing to tackling climate change, including consideration of the energy hierarchy, whole life cycle considerations (for major development) and how monitoring and reporting on performance will be delivered.

Energy Standards for Residential and Non-Residential Development

Topic	Recommendation
Energy Standards: Non-Residential Development	Update Policy DH8 to require minor development to meet Future Buildings Standard emissions reductions as a minimum with preferential support for BREEAM 'Excellent'. Continue to require BREEAM Excellent for major development.
Energy Standards: Residential Development	Maintain net zero requirement for major development. Specify minimum emissions reduction on Part L Building Regulations to align with the Future Homes Standard. Subject to the outcome of viability testing, 'leapfrog' FHS interim targets to introduce 75-80% reductions with immediate effect. Specify that carbon offsetting should be used as a last resort for any outstanding emissions. The funds can be used to deliver a range of projects identified across Wokingham, ideally focusing on opportunities to cross-subsidise the interventions identified in the WBC Climate Emergency Action Plan. Specify FHS as a minimum for minor residential development.
On-site renewable energy potential	On-site renewable energy generation and storage should be encouraged. Energy assessments (as part of the Sustainability Statement) should explain how the opportunities for producing, storing and using renewable energy on-site will be maximised. Consider setting a minimum amount for on-site energy generation.
Circular Economy	Within planning policy, requirements should cover demolition strategies, specification of construction materials, proportions of reused and reusable materials, and mandatory whole life-cycle calculation. WBC could require the submission of Circular Economy Statements, either standalone or as part of the Sustainability Statement, to support circular economy adoption.

Sustainable Design Principles

Topic	Recommendation
Sustainability Assessment Methods	The LPU should mandate the use of BREEAM as the preferred sustainability assessment method. While all standards are considered acceptable, BREEAM is the most widely used green building certification in the UK and complies with national guidance. It also covers a

Topic	Recommendation
	broad range of sustainability themes which ensures a robust approach to sustainability measures.
Water Efficiency	The LPU should continue to require the Building Regulations Part G 'optional' requirement of 110 litres water consumption per day per person for new residential development. For non-residential development, policies require could require developments to achieve BREEAM 'Excellent' requiring set percentage improvements over the defined water consumption baseline performance of the building (at a minimum, this would require 110 litres as the use limit). Under the 2018 BREEAM New Construction Scheme an optional 'post-occupancy' stage of assessment are required. This stage confirms the process of monitoring, reviewing and reporting on the performance (including in terms of water consumption) of a building once occupied, as could be a requirement for approved developments.
Retrofitting	Whilst intervention to existing buildings largely falls outside the remit of planning, it is important for planning policy regarding extensions/refurbishments to attribute significant weight to environmental improvements.

Renewable Energy Capacity

Topic	Recommendation
Stand-alone Renewable and Low Carbon Energy Schemes	WBC should retain its positive framework for renewable energy schemes, supporting such schemes in appropriate locations and where consistent with other policies (e.g. on biodiversity net gain). Subject to site assessment and feasibility studies, the LPU could allocate sites for renewable energy generation to safeguard such sites from alternative development types. These sites would be shown on the accompanying Policies Map.
Community Renewable and Low Carbon Energy	Community renewable and low carbon energy developments in appropriate locations should be supported, where consistent with other relevant policies. The development of renewable energy schemes should demonstrate an element of local ownership.
Ground- mounted solar PV	Wokingham has large tracts of open land which are suitable for ground-mounted solar PV (subject to detailed consideration). Development of ground mounted solar PV should be supported in appropriate locations and where consistent with other relevant policies. WBC should consider allocating sites for solar PV and/or exploring Local Development Orders for solar arrays.
Roof -mounted solar PV	Development of roof-mounted solar PV should be supported in appropriate locations and where consistent with other relevant policies.

Topic	Recommendation
Wind energy	While proposals for wind energy installations of small or medium sized turbines would be considered equally, evidence shows that Wokingham does not have sufficiently high wind speeds to be suitable for wind generation and so allocating sites is inappropriate.
District Heat Networks	Evidence shows that the district heat networks are likely to be suitable in two identified heat network zones. Subject to confirmation of their suitability through further feasibility testing, WBC could consider adopting a policy on district heat networks that is area-specific to the suitable zones. Such a policy would either encourage or require new development within those heat network zones to connect or feed into the heat network (unless it can be demonstrated that doing so is not feasible).

15.2 Challenges for Further Consideration

Monitoring

WBC will need to identify a set of indicators against which to measure progress in meeting policies likely in the Authority Monitoring Reports (AMR). This should include establishing policy specific indicators and monitoring frameworks to measure progress towards Strategic Objectives, including monitoring annual carbon emissions by sector (e.g. commercial buildings; domestic buildings) and fuel type (e.g. electricity and gas) as supporting evidence of progress alongside policy specific indicators to understand how the measures are supporting WBC's climate change targets.

In addition, national guidance stipulates that in schemes that require planning obligations, authorities can charge a monitoring fee through section 106 to cover the cost of monitoring and reporting on delivery of that section 106 obligation.

The Best Practice Review identified how Milton Keynes established a Monitoring Framework to measure progress towards each Strategic Objective within the local plan in an AMR. This includes monitoring yearly carbon emissions by sector (Industry and Commercial, Domestic and Transport) and fuel type (Electricity, Gas, Other). This data is taken from annual BEIS local authority CO2 emissions data. As the plan was adopted in 2019, limited information is available on the AMR.

Policy SC1 – Sustainable Construction part K.6 requires developers to 'Put in place a recognised monitoring regime to allow the assessment of energy use, indoor air quality, and overheating risk for 10% of the proposed dwellings for the first five years of their occupancy and ensure that the information recovered is provided to the applicable occupiers and the planning authority' within the submitted Energy Statement. This information then feeds back into the AMR.

Monitoring indicators in the Monitoring Framework for Milton Keynes include:

Percentage of energy in new developments from renewable sources

Amount of renewable energy provided from strategic energy developments

New dwellings achieving CSH level 4

New developments with a community energy network

National Indicator 185: CO2 reduction from Local Authority operations

National Indicator 186: Per capita reduction in CO2 emissions in the Local Authority area

National Indicator 188: Planning to adapt to climate change

Viability

The potential for viability arguments to undermine policy objectives will need to be considered in full. The higher standards proposed by this Study (and required to meet climate change targets) could impact on viability of schemes themselves or the local plan as a whole. This should be reviewed as part of the overall viability review process of the LPU to ensure it is aligned with the local market. Further, it is possible that some developers might seek to argue against the increased costs incurred by having a policy requirement to meet higher than minimum standards on buildings.

However, the policy recommendations draw on best practice and are underpinned by research and assessments to support the decision-making process to maximise the likelihood of such standards being achieved. A detailed context review has been undertaken which highlights the international and national legislative, policy and strategic context within which need for challenging targets and policy wording is required. It also recognises the advice from organisations such as the UK Committee on Climate Change and BREEAM. This context provides a broad evidence base upon which policies recommendations are based, which make specific reference to the legislative, policy and strategic context

Whilst cost modelling is outside the scope of this evidence base, Tables 23- 25 highlight some indicative cost estimates for decarbonisation and resilience measures from key sources.

Table 23: Selected data extracted from Currie & Brown (2019) Appendix D.1 New build cost data for domestic buildings - fabric

Element	Specification	Unit	New cost (£/m²)	Retrofit cost (£/m²)
External Wall (MW)	0.15	W/m².K	224	100

Element	Specification	Unit	New cost (£/m²)	Retrofit cost (£/m²)
Semi-exposed wall (MW)	0.15	W/m².K	151	
Ground / Exposed Floor	0.15	W/m².K	146	
Exposed Roof - Insulation at Joists	0.12	W/m².K	186	15
Doors	1.2	W/m².K	270	763
Windows	0.8	W/m².K	360	436
Design Air Permeability	3	m³/hm² at 50Pa	5	

Table 24: Selected data extracted from Currie & Brown (2019) Appendix D.2

Element	Specification	New cost (£/home)	Retrofit cost (£/home)
Ventilation	Nat Vent	480	
MVHR unit	Large Flat	720	1000
MVHR ducting and installation	Large Flat	1190	2340
ASHP	Large Flat	3303	3303
ASHP Sundries	Large Flat	1847	568
Gas Connection	Single property (outside London)	346	
District Heat Network - District HP	Large Flat	5285	3430
District Heat Pump - Connection	Large Flat	1200	1543
Battery storage	All, 2kW	2000	2393

Figure 35: Indicative costs of carbon mitigation and resilience measures for a new home and retrofitted home. Source: CCC (2019) UK housing: Fit for the future?

Table 1.1. Costs of designing in measures for a new home at the outset, relative to trying to achieve the same outcomes later

Measure	Cost (£) – new build	Cost (£) - retrofit (equivalent outcome)
Building a home with an air source heat pump and ultra-high levels of fabric efficiency (equivalent to a space heat demand of 15 kWh/m^2/yr)[1]	4,800	26,300
Passive cooling measures package[1,2]	2,300	9,200
Water efficiency package of measures[2]	300	3,300
Flood resilience and resistance package of measures[2]	1,500	3,100

Source: [1] Currie & Brown and Aecom for the CCC (2019) *The costs and benefits of tighter standards for new buildings.* [2] Wood PLC (2018) for the CCC.

Officer Capacity

Through engagement it was clear that there is a drive and commitment for developing policies that make a meaningful contribution towards addressing climate change. However as explored in the Climate Change Literature Review, the implementation of net zero requirements in planning are fairly new and innovative within the UK planning policy landscape. To ensure their efficient application, adequate resource and training for officers and members is required to provide clarity on assessing an application, and the associated Energy and Climate Statement and Whole Life Cycle Assessments which demonstrate they meet mandated regulations sustainability assessment criterion. This will also involve an understanding of viability assessments to confirm when carbon offsetting of the remaining emissions is valid. Some policies will also require coordination across council departments to deliver, such as working with colleagues in Building Regulations, Transport, and Environment.