South Oxfordshire and Vale of White Horse Joint Local Plan: Net Zero Carbon Study

Tasks 1 and 2: Scoping Report and Carbon Reduction, with policy recommendations

12 December 2023

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Introduction

Bioregional, Transition by Design and Currie & Brown have been appointed to provide South Oxfordshire and Vale of White Horse (South & Vale) District Councils with an assessment of options available within the local planning system to achieve net zero carbon development in South Oxfordshire and Vale of White Horse to inform the emerging South & Vale Joint Local Plan.

Local planning authorities (LPA) have a legal duty to deliver carbon reductions through the planning process in line with the Climate Change Act. The Act includes both the 2050 goal for a net zero carbon UK, and sharply-declining five-yearly carbon budgets between today and 2050.

Throughout this report, we acknowledge instances where those local plan powers may be imperfectly suited to deliver the interventions needed for the UK's transition to net zero carbon, whilst assessing more recent, innovative approaches that wield the available powers to best effect.

Our suite of reports for the South & Vale Joint Local Plan consists of six key elements:

1. **Scoping Report**
2. **Carbon Reduction**
3. **Feasibility Assessment**
4. **Costs Report**
5. **Offsetting Report**
6. **Renewable Energy Spatial Assessment**

This report combines Tasks 1 and 2.

To aid South & Vale's decision-making for the Joint Local Plan, this report explores[1]:

- Defining 'net zero carbon' at different scales (the planet, the UK, the District(s), and individual development applications) – and how these fit together
- The trajectory of the UK and South & Vale to net zero carbon, including necessary measures for net zero carbon buildings and other sectors relevant to the local plan
- Planning duties to support this trajectory
- Planning powers to make the changes needed for the UK's pathway to zero carbon, including examples of how those powers have been wielded to date
- Existing and emerging examples of local plan policies
- Existing and emerging examples of how planning duties in carbon and climate have been weighed against other duties
- Policy recommendations
- Position statement setting out the local plan's role for net zero carbon development and a net zero region

[1] This study and its findings were accurate prior to the release of the Written Ministerial Statement entitled 'Planning - Local Energy Efficiency Standards Update' dated 13 December 2023. The Councils will be reviewing their approach to Net Zero Carbon Buildings in light of the Written Ministerial Statement.

Glossary of terms and acronyms

BREDEM	Buildings Research Establishment Domestic Energy Model. A methodology for estimate calculations of the energy use and fuel requirements of a home based on its characteristics. BREDEM is the basis for SAP (see elsewhere in this glossary) but BREDEM retains more flexibility by allowing the user to tailor some assumptions made in the calculations to better reflect the project.
Carbon, or carbon emissions	Short for 'carbon dioxide' but can also include several other gases with a climate-changing effect, that are emitted to the atmosphere from human activities.
Carbon budget	Amount of greenhouse gas that can be emitted by an individual, organisation or geographic area. Usually set to reflect a 'fair share' of the global amount that can be emitted before reaching a level of atmospheric carbon that causes severely harmful climate change.
Carbon intensity/ carbon factors	A measure of how much carbon was emitted to produce and distribute each kWh of grid energy at a certain point in time. For electricity, this has been falling as coal-fired power stations have been phased out over years. It also varies on an hourly basis: at times of high renewable energy generation, the carbon intensity is lower than at points where gas-fired electricity dominates the generation mix.
CO_2	Carbon dioxide. Often shortened to 'carbon'.
CO_2e	Carbon dioxide equivalent. The sum of a mixture of gases, in terms of their climate-changing impact in a 100-year period expressed as the amount of CO_2 that would have the same effect. Often shortened to 'carbon'.
Embodied carbon	Carbon that was emitted during the production, transport and assembly of a building, infrastructure, vehicle or other product, before the product is in use. As opposed to 'operational carbon' which is emitted due to energy use when operating the building / infrastructure / vehicle / other product.
EUI	Energy use intensity, a measure of how much energy a building uses per square metre of floor. Expressed in kilowatt-hours per square metre of floor space per year.
GHG	Greenhouse gas (CO_2 and several other gases: methane, nitrogen dioxide, and fluorinated refrigerant gases). Often collectively referred to as 'carbon'.
MVHR	Mechanical Ventilation with Heat Recovery
Part L	Building regulations section that sets basic legal requirements regarding buildings' energy and CO_2.
Performance gap	The 'energy performance gap' is the difference between the amount of energy a building is predicted to use during design, versus the actual amount of energy it uses. The gap is due to poor prediction methodologies, errors in construction, and unexpected building user behaviour.
PV	Photovoltaics: solar panels that generate electricity.
PHPP	Passivhaus Planning Package – a tool to accurately calculate a building's energy use. It is used to design buildings that seek Passivhaus certification, but can be used without pursuing certification.
Regulated energy or carbon	Carbon emissions associated with energy uses that are 'regulated' by Building Regulations Part L. This covers permanent energy uses in the building, (space heating, space cooling, hot water, fixed lighting, ventilation, fans and pumps).
SAP	Standard Assessment Procedure – the national calculation method for residential buildings' energy and carbon, used to satisfy building regulations Part L. SAP is based on BREDEM model, but with fixed assumptions and thus less flexibility.
SBEM	Simplified Buildings Energy Model – the national calculation method for non-residential buildings' energy and carbon, used to satisfy building regulations Part L.
Sequestration	Removal and storage of carbon dioxide (or other GHGs) so that it cannot perform its harmful climate-changing role in the atmosphere. Currently only achieved by trees/plants, oceans, rocks and soil. May be achieved by technologies in future.
Space heat demand	Amount of energy needed to heat a building to a comfortable temperature. Expressed in in kilowatt-hours per square metre of floor space per year.
TER	Target Emission Rate – a limit set by Part L of building regulations on CO_2 emissions per square metre of floor, from regulated energy use in the building.
TPER	Target Primary Energy Rate – limit set by Part L of building regulations on 'primary energy' use per square metre of floor. Unlike metered energy, 'primary energy' takes into account energy lost to conversion inefficiencies during power generation and distribution.
TFEE	Target Fabric Energy Efficiency – limit on space heat energy demand per square metre of floor, set by Part L of building regulations. Based only on fabric performance; not affected by building services like heating system, lighting, ventilation[i].
TM54	A method to accurately calculate buildings' energy use. Devised by Chartered Institution of Building Services Engineers (CIBSE).
Unregulated energy or carbon	Carbon associated with energy use in a building or development but which is not covered by Building Regulations Part L. Includes plug-in appliances, lifts, escalators, external lighting, and any other use not covered by Part L.

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Defining net zero carbon

On a global level, 'net zero carbon' means a balance between emissions and removals of carbon to/from the atmosphere. 'Carbon' can mean 'carbon dioxide' (CO_2) or it can mean the sum of all gases that have a global warming effect: CO_2 (~80% of UK emissions), methane, nitrous oxide, and 'F-gases'.

Carbon emissions are mostly caused by burning of fossil fuels, but also to a lesser extent by some industrial processes (e.g. the chemical reaction in cement production) and agricultural processes (e.g. digestive systems of livestock, and breakdown of soil fertilisers). Currently, removals are only achieved by natural features like plants, soils, and water bodies. There are ongoing research efforts to develop technology to capture and store carbon, but not yet successful in terms of efficiency and scale.

At smaller scales, we need 'carbon accounting methodologies' to define which emissions or removals 'belong' to a person, organisation, building, or area. This is because activities in one place (e.g. using grid electricity, or buying materials to build with) often cause carbon emissions elsewhere (e.g. burning fuel in a power station, or producing cement). The same is true for carbon removals.

Organisations and buildings that cannot achieve net zero carbon within their own direct activities are sometimes permitted to use 'carbon offsetting' (paying for carbon-reducing actions elsewhere). These are sometimes removals (e.g. tree planting) – or sometimes 'avoided' emissions (paying for measures that reduce the amount of carbon that 'would have been emitted'). Most local-scale carbon accounting methodologies agree that 'net zero carbon' should not include 'carbon offsets' from another area. See full report for detail on the carbon accounting methodologies available.

Most UK local and regional authorities track their area's emissions using official centralised figures from Department of Energy Security and Net Zero (DESNZ) (formerly Department of Business, Energy and Industrial Strategy (BEIS)) each year. DESNZ uses data on each area's buildings, energy use, industrial activity, traffic/transport activity, and types of land area, to estimate the amount of emissions and removals in each local area (carbon dioxide only; no other gases). See *Figures 1 and 2*.

Every part of the UK, including South & Vale, will need to play its role in achieving the overall UK Net Zero Carbon goal by 2050 as per the Climate Change Act. Therefore, efforts to reduce emissions in each local area should be designed to assign a share of responsibility for all emissions caused in the UK by activities in that area, and refrain from double-counting any removals or 'avoided' emissions. The risk of double-counting arises if carbon offsetting is used instead of reducing emissions at source – e.g. if one area buys carbon offset credits generated by another area's woodland or insulation schemes, but those carbon savings were already counted towards the other area's carbon account in the official national figures or local carbon accounting.

The local plan therefore needs to consider several different scales of 'net zero carbon':

- 'Net zero carbon new buildings' – this always includes energy use of the building's operation, and can also include 'embodied carbon' (see glossary)
- 'Net zero carbon South & Vale' – new+existing buildings, transport, industry, agriculture, land use
- 'Net zero carbon UK' – all sectors above, plus aviation and shipping. No international 'offsetting'.

Development and use of land in South & Vale can affect emissions in all sectors – but new buildings, grid energy and transport are the main issues that the local plan can influence.

'Net zero carbon' has different meanings at different scales

- **At global level,** it means greenhouse gas emissions from human activity are balanced by greenhouse gas removals
- **At local scale or building scale,** we need 'carbon accounting methodologies' to decide whose carbon is whose (emissions and removals)
- **'Offsetting' is treated differently** depending on accounting method or planning policy example – most local authorities use DESNZ/BEIS data to track the local area's carbon account; this DESNZ/BEIS data does not count offsets from outside the area or embodied emissions of goods brought into the area
- **The local plan can mainly influence emissions from new buildings, energy & transport.** Policies should be designed to reduce total emissions, and avoid double-counting if offsets are permitted.

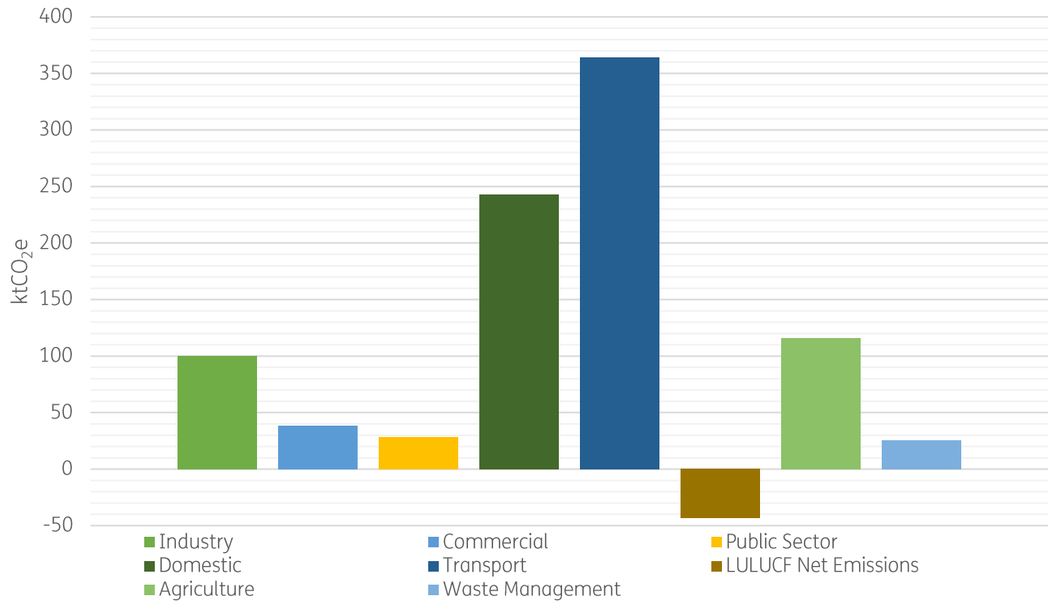


Figure 1: 2021 CO_2e per sector in South Oxfordshire from BEIS/DESNZ subnational data (2023 release).

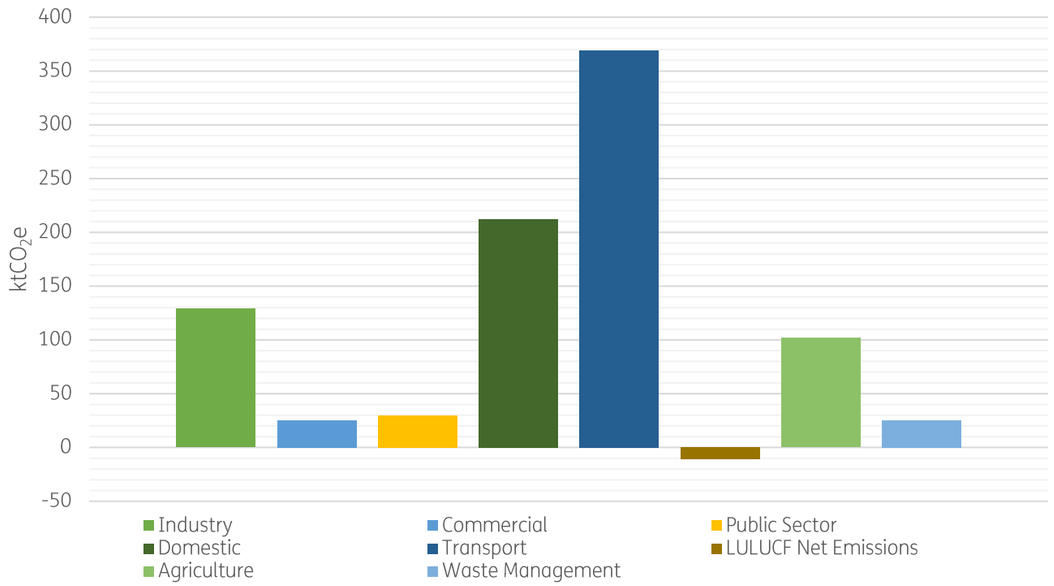


Figure 2: 2021 CO_2e per sector in Vale of White Horse from BEIS/DESNZ subnational data (2023).

Transport is the largest source of carbon emissions from activity within both South Oxfordshire and Vale of White Horse (*Figures 1 and 2*), accounting for 41% of CO_2 emissions in both Districts. There is currently no way for transport to actively remove carbon emissions (other than purchasing offset credits). Transport carbon will therefore only hit zero when its energy is 100% renewable, but a shift to electric transport and less car use is vital for interim carbon budgets. Embodied carbon of vehicles, buildings or infrastructure would appear in the 'industry' sector[ii] (e.g. energy use from production and manufacturing of materials and products), if produced locally. The local plan must therefore reduce transport emissions through sustainable site allocations that minimise the need to drive, provision of infrastructure that promotes active travel, and contributions to support public transport. Emissions reduction at-source is vital (not relying on offsetting), as both figures above show that carbon removals by green infrastructure are very small compared to total emissions.

Importantly, the local plan is able to directly address emissions from the domestic sector (i.e. energy use in homes), which accounts for 27% of emissions in South Oxfordshire and 23% in Vale of White Horse – and the commercial sector. The local plan has an opportunity to directly limit the carbon burden that development places on the domestic and commercial sector, by setting 'net zero' standards for proposed buildings. In contrast, it is more difficult for the local plan to control emissions in the industry and agriculture sectors, as those sectors' emissions come overwhelmingly from existing processes that do not require planning permission. However, all sectors' emissions can benefit from local plan support for renewable energy development proposals.

There are several ways to define a 'net zero carbon building'. These definitions rely on calculations that cover some or all of the following scopes (varying by the definition chosen), on an annual basis:

- Use of different types of fuels and grid energy at the building: These cause carbon emissions.
- Renewable energy use at the building: Usually from on-site generation, but some definitions/calculations of 'net zero carbon buildings' also allow off-site sources.
- Amount of renewable energy that the building *exports to the grid* at times when the building produces more than it is using): This counts as a *negative* amount of carbon emissions, because it actively reduces the amount of fuel burned in power stations to supply grid energy to others.
- Embodied carbon: Carbon emitted to produce/transport and use the construction materials.

The 'National Calculation Methodologies' for buildings' energy use and carbon emissions are called SAP (for homes) or SBEM (for other buildings). These are used in the Building Regulations Part L, which sets limits per m^2 per year for carbon, heat demand, and 'primary energy'[2] use. However:

- They only cover operational carbon (energy use), not embodied carbon (materials/construction)
- They do not include 'unregulated' energy uses like plug-in appliances, which can be 50% of total energy (or total emissions, depending on the carbon intensity of different fuels used).
- They provide inaccurate predictions because they are based on a theoretical model instead of specific conditions, and their predictions do not get validated in practice. They are compliance tools and not designed to accurately assess building energy performance; buildings typically use two or three times the amount of energy predicted by SAP or SBEM (see *Figure 3*).

Thus a 'net zero carbon' building defined by the Building Regulations is not actually net zero carbon. Updates to Building Regulations Part L, SAP and SBEM are due in 2025 (the 'Future Homes Standard' and 'Future Buildings Standard'). However, even the 2025 update will not deliver[iii] the very low space heat demand that the UK needs for its legislated carbon budgets. This is partly because SAP and SBEM underestimate energy demand and are not verified in operation (as there is no regulatory requirement for the building to actually perform to the SAP/SBEM predictions) and partly because Part L sets energy and carbon targets that vary by the building's form (shape and size), not the absolute targets that are needed for UK carbon budgets. For example, we need[iv] new homes' space heat demand to be ≤15-20kWh/m^2/year. Space heat demand is affected by building form not just insulation and airtightness, but Part L doesn't require better insulation and glazing to counter an inefficient form.

Other calculation methods and definitions are available. The two leading alternatives are:

- LETI operational net zero carbon: A building that (each year) generates as much renewable energy as it uses, sometimes using grid electricity and other times sending renewable energy to the grid. The building must also be gas-free, and meet specific energy efficiency targets that match the performance needed for national carbon budgets.
- UKGBC Framework Definition of Net Zero Carbon: This has two parts:
  - Operational: When the carbon associated with a building's energy use is zero, by use of renewable energy (from onsite or offsite sources) or purchasing verified carbon offsets.
  - Embodied: When the carbon associated with a building's construction up to the point of completion is zero or negative, through the purchase of verified carbon offsets.

Because the LETI and UKGBC definitions are for *actual* operational performance not just modelling, they require the use of *accurate* energy calculation methods during design, specifically PHPP or TM54 (glossary). PHPP and TM54 account for total energy, not just the share that is 'regulated' by Part L.

[2] 'Primary energy' is the energy from renewable and non-renewable sources which has not undergone any conversion or transformation process. This metric is meant to show the total amount of energy or fuel that has to be put *in* to a system in order to get one unit of useful energy *out* at the other end, accounting for the losses that occur in (for example) converting fossil fuel to electricity or heat, or in distributing power through the grid.

Net zero carbon in different sectors relevant to local plan

- **Transport is the most carbon-intensive sector in South & Vale** and can only reach 'net zero' via renewable energy and offsetting, but electrification and reduced car use are vital steps.
- **Green landscapes remove only a small fraction of emissions** – therefore overall emissions must fall dramatically at source.
- **Building Regulations calculation methods for energy and carbon are insufficient to define net zero carbon buildings:** these methods dramatically underestimate buildings' energy use and do not include embodied carbon or energy use of plug-in appliances.
- **The industry has created improved approaches to define net zero carbon buildings** – in particular the LETI and UKGBC definitions.

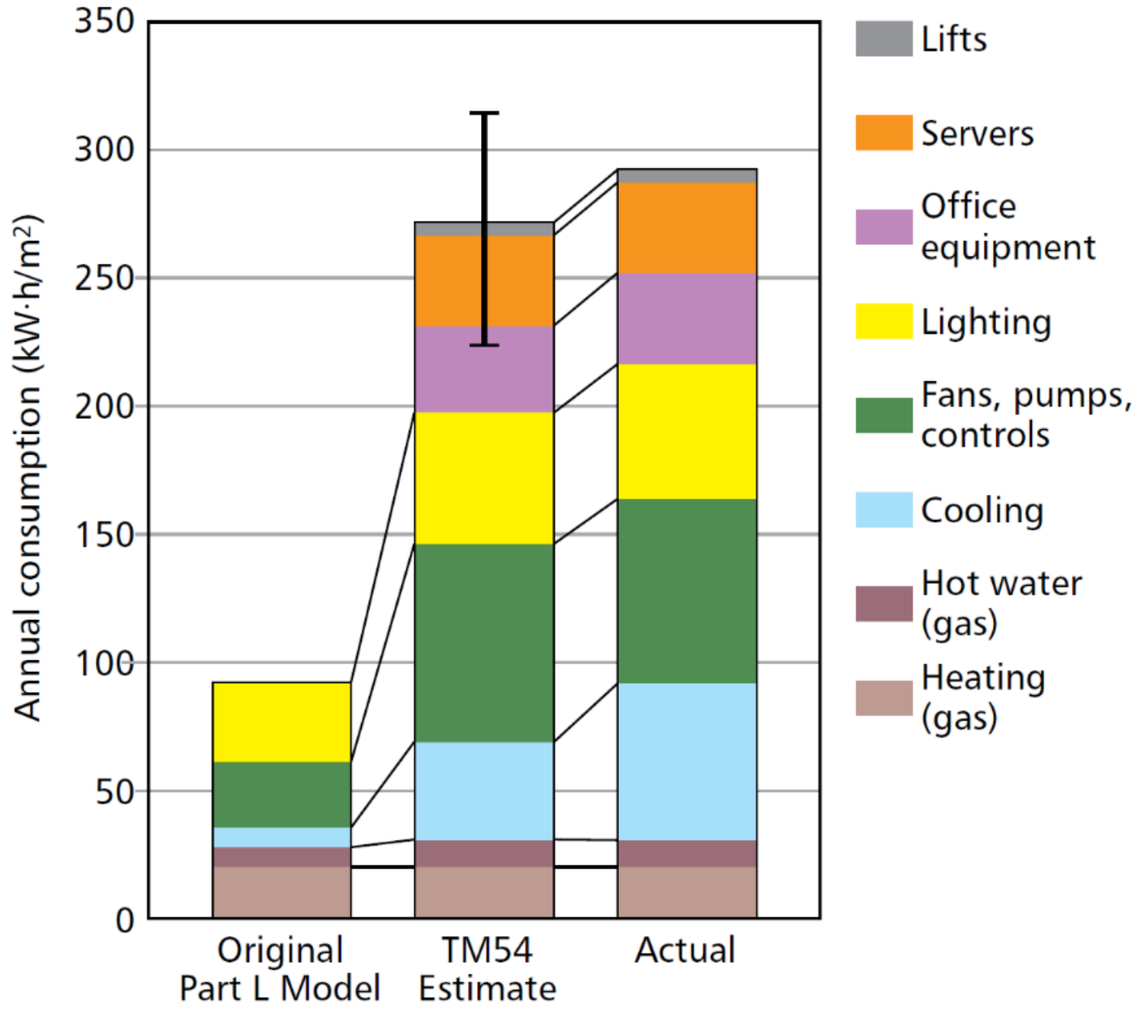


Figure 3: CIBSE graph that reveals the inaccuracies of Part L SBEM prediction of energy use, compared to a prediction using the CIBSE TM54 method, and the building's actual measured energy use in operation. This is for an office building.

About the local plan and what it does

A local plan is a land use or spatial plan that responds to identified issues and needs. Preparation of a local plan must conform with specific legal requirements and national planning policy. It must be evidence-based and informed by community engagement, and co-operation with prescribed partners and organisations.

The local plan sets out policies for change in the type, quality and location that will be considered acceptable for a range of land uses in the area, and includes a strategy for delivering future required growth. It includes policies that are used to determine planning applications. It identifies appropriate areas and sites for development, such as new homes, offices, shops, and community facilities. It also identifies circumstances where development is not appropriate, and it can set certain conditions around changes to existing buildings or other land uses.

The local plan is separate from Building Regulations. Building Regulations apply nation-wide and define the national minimum standards that new buildings must meet in order to be legal. These standards cover a wide range of technical topics including quality of materials, structural design, drainage, contaminants, fire and electrical safety, acoustics, ventilation, sanitation, water efficiency, overheating, electric vehicle charging, and energy efficiency/carbon emissions. Building Regulations apply not just to new developments, but also to extensions and alterations.

The local plan must be in accordance with the National Planning Policy Framework (NPPF), which is set by central government (most recently in 2021). The NPPF sets out principles and aims that the planning system should aim to fulfil. After a local plan is drafted and consulted upon, the local authority must then submit the draft plan to the Planning Inspectorate for independent examination before it is adopted and becomes part of the development plan. The Planning Inspectorate will assess the draft local plan to see if it is 'sound'. The NPPF's four 'tests of soundness' are:

- The plan must be positively prepared: It should respond to objectively assessed needs (in particular, needs for housing), and should deliver sustainable development.
- The plan must be justified: Its approach should be appropriate based on evidence and consideration of reasonable alternative approaches
- The plan must be effective: It should be based on effective joint working on cross-boundary strategic matters (cooperation between local authorities), and 'deliverable in the plan period' (e.g. the policies should not make it impossible to deliver the required amount of housing at the time it is envisaged that it will come forward).
- The plan must be consistent with national policy: This means it is in accordance with the other policies in the NPPF and other relevant statements of national policy.

Some decisions about development in the area are out of scope for the local plan. For example, large infrastructure projects – such as major road/rail, major renewable energy and airports – are considered 'nationally significant'. Such projects require national rather than local consent. The local plan's influence on existing buildings and other existing land uses is also limited, as the local plan cannot force changes to existing buildings where none have been proposed, and there are many typical changes to existing buildings or land use that do not require planning permission. However some changes to existing buildings can occur through permitted development in some cases, without the need for planning permission.

About the local plan

- **Has a duty to deliver 'sustainable development'** that meets environmental, social, and economic needs – especially housing delivery targets
- **Separate from Building Regulations** (which set minimum technical standards for buildings nationwide)
- **Has powers to require new development to do better than some of the standards set by Building Regulations** – including for energy efficiency and carbon emissions
- **Must be based on proportionate evidence** showing that the plan policies are justified, effective, deliverable, and consistent with national policy
- **Must pass an examination by the national Planning Inspectorate** – who will check it is in accordance with the National Planning Policy Framework, including that it proactively enables 'sustainable' development.

About Building Regulations Part L

- **Sets basic targets for new builds' energy and carbon:**
  - Fabric Energy Efficiency in kWh/m^2/year – this is a measure of the building's need for space heating
  - Carbon emissions in kgCO^2/m^2/year
  - Primary Energy Demand in kWh/m^2/year
- **Building must use specific calculation methods to fulfil these targets:** SAP for homes; SBEM for other buildings. However, these do not accurately reflect actual performance.
- **New requirement for 'energy forecasting' in non-residential buildings** – which can use CIBSE TM54 method

Why must the South & Vale Local Plan take action towards net zero carbon?

The Planning & Compulsory Purchase Act 2004 imposes a legal duty for every local development plan to have "policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of … climate change".

Mitigation of climate change means reduction in the impact of human activity on the climate[v] by reducing greenhouse gas in the atmosphere[vi,vii]. It therefore cannot just mean 'minimising the additional emissions from *new* development' – rather it requires an overall reduction in the net amount of emissions from all activities in South & Vale. This has two parts: reduction of emissions, and increase of sequestration (removal and storage of carbon by trees, other natural features, or future technology).

The National Planning Policy Framework clarifies the extent of mitigation, i.e. the local plan should:

- Take a proactive approach in line with the Climate Change Act 2008
- Shape places in ways that contribute to radical reductions in greenhouse gas emissions
- Support the transition to a low carbon future
- Provide a positive strategy to increase the use and supply of renewable and low-carbon energy.

The Climate Change Act 2008 contains the following legislated carbon reduction targets for the whole UK, therefore in order to be in line with the Act the local plan would need to be designed to take the necessary local action to achieve these:

- Net zero carbon by 2050 (based on a 1990 baseline)
- Steeply reducing 'carbon budgets' for each five-year period up to 2050 (see Figure 4: UK legislated carbon budgets under the Climate Change Act. From Committee on Climate Change (2020), The Sixth Carbon Budget: The UK's Path to Net Zero. to right)

The budgets place a limit on the amount of carbon that can be emitted before the net zero goal. This is a vital action towards the UK's commitment to the international Paris Agreement 2015, in which 174 countries worldwide agreed to limit climate change to no more than a 2C rise on pre-industrial temperatures – above which the global impacts would be catastrophic due to 'tipping points'. For context, the world has already passed a 1C rise and is on track for a 3-4C by the end of the century.

These carbon budgets are devised by the Committee on Climate Change, before being legislated every few years by Parliament as per its duties in the Climate Change Act. The Committee also identifies the necessary sectoral changes to deliver those carbon budgets, of which most relevant to the local plan are:

- All new homes from 2025 to have low carbon heat (not gas), and very low space heat demand
- Rapid and large-scale roll-out of heat pumps to existing homes, and expansion of heat networks
- No installation of new fossil fuel boilers from 2033
- Fully decarbonise the electricity grid by 2035 (to be 80% renewable and 20% nuclear by 2050)
- Reduce travel mileage by car, and ensure all new cars/vans are electric from 2032
- Increase woodland cover to 18%, up from today's 13%, and restore peatlands
- All sectors net zero carbon by ~2045 except aviation, waste, & agriculture (most or all of the UK's capacity for carbon removals will be needed to balance these sectors' remaining emissions).

Committee on Climate Change analysis[viii] shows that national government plans are insufficient to deliver all these necessary changes. The government's Net Zero Strategy was (2022) found unlawful[ix] as it fails to deliver on the Climate Change Act obligation to produce sufficiently detailed policies that show how the carbon budgets will be met. Therefore, in order to mitigate climate change in line with the Climate Change Act, the local plan will need to act ahead of national government action, using the powers available to local planning authorities.

The legal and policy mandate

- **Planning & Compulsory Purchase Act 2008** establishes that the local plan has a legal duty to mitigate climate change (reduce carbon)
- **National Planning Policy Framework (2021)** states the mitigation should be in line with the Climate Change Act 2008
- **Climate Change Act 2008** sets the 2050 net zero carbon goal, and also interim 'carbon budgets' that reduce every 5 years
- **Committee on Climate Change analysis and a High Court Ruling (2022)** shows that national government's current policies & plans will not deliver the Climate Change Act goals – so the local plan would need to take further action to fulfil its duty to mitigate climate change in line with that Act.

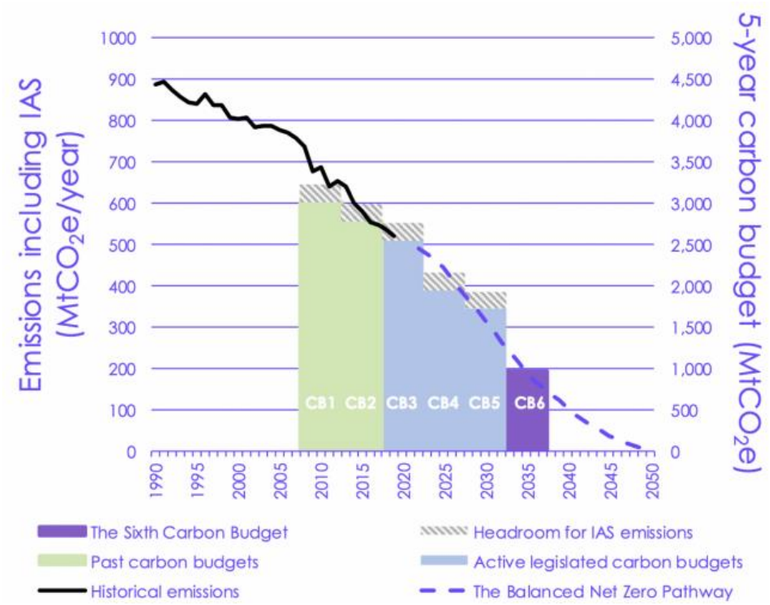


Figure 4: UK legislated carbon budgets under the Climate Change Act. From Committee on Climate Change (2020), The Sixth Carbon Budget: The UK's Path to Net Zero. "IAS" = international aviation & shipping.

How can the South & Vale Local Plan take action towards net zero carbon?

The main sources of emissions (and removals) that a local plan can affect are:

- New buildings – energy efficiency, energy supply / on-site generation, and embodied carbon
- Transport – enabling the right type and location of new development to reduce new and existing communities' car dependence, and bringing forward sustainable transport infrastructure
- Existing buildings – encouraging carbon-reducing renovations where permission is needed
- Renewable energy – encouraging new large-scale renewable energy generation and distribution
- Natural environment – protecting and expanding landscape features that capture or store carbon
- Using the planning permission process to raise funds for the measures above where lacking.

In this report, we focus on planning powers towards net zero carbon in the *buildings* and *energy* sectors.

The Planning and Energy Act 2008 gives the local plan the power to set 'reasonable requirements' for:

- Energy efficiency standards higher than those set by building regulations
- Renewable or low-carbon sources to supply a proportion of energy used at the development.

The Act defines 'energy efficiency standards' as ones that are set out or endorsed by the Secretary of State. This may imply only the methods used in Part L of Building Regulations (SAP or SBEM), despite their aforementioned shortcomings. However, the new non-residential Part L 2021 endorses the more accurate TM54 method for the purpose of energy forecasting (a new requirement to give the building owner a prediction of total metered energy use). Thus, it appears the local plan could require energy efficiency standards based on TM54, which accounts for *total* energy use, not just regulated (glossary).

The Act does not define 'reasonable requirement', nor does it define the term 'energy used at the development'. It therefore appears to empower the local plan to set requirements for renewable energy to meet a proportion of the new building's *total* energy, not just 'regulated' energy (glossary). In that case a method would need to be chosen to account for that unregulated energy, ideally in a way that works alongside the calculation for regulated energy. Several methods could be used: TM54 (as above), BREDEM, and SAP Appendix L. PHPP could also be used but may not be compatible with SAP/SBEM.

The Town & Country Planning Act 1990 gives two key powers often used for carbon reductions:

- Section 106[x] enables the local plan to require payments from new development. These must be reasonable, proportional to the development, and necessary to make the development acceptable. This has sometimes been used as a mechanism to offset new developments' carbon.
- Section 61[xi] enables creation of Local Development Orders. This is a tool used to achieve specific objectives by granting certain types of development fast-track planning permission (or at least certainty of permission). These have been used to promote renewable and low-carbon energy.

The National Planning Policy Framework reaffirms ways the local plan can mitigate climate change:

- Paragraph 154b: "New development should be planned for in ways that … help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards".
- Paragraph 155a-b: "Plans should … provide a positive strategy for energy from [renewable and low carbon] sources … [and] consider identifying suitable areas for [these], and supporting infrastructure".
- Paragraph 190: "Plans should set out a positive strategy for the conservation and enjoyment of the historic environment, including … putting [heritage assets] to viable uses consistent with their conservation".

Local plan powers for net zero carbon development

- **Energy & Planning Act 2008:** The local plan can require new builds to provide / use renewable energy and improved energy efficiency.
- **National Planning Policy Framework (2021)**
  - Policies should 'reflect national technical standards' – this may influence the performance metrics or calculation methods that can be used in local policy around energy efficiency & renewables (*albeit some local plans have successfully adopted alternative metrics, justified by their effectiveness in delivering on national carbon reduction targets – see precedents*)
  - It is appropriate to seek carbon reductions through new development's location, orientation and design, and to plan for renewable energy
- **New building regulations (2021) exceed the supposed previous limit on how far the local plan carbon and energy requirements could go** (the limit was expressed in Planning Practice Guidance and a 2015 Ministerial Statement),
  - Therefore it can be assumed that the limit is obsolete and that local plans can go as far as necessary to fulfil their duty to mitigate climate change
  - … so long as the requirement is shown to be 'reasonable' and does not stop the plan passing the four tests of soundness (justified, effective, consistent with national policy, and positively prepared to deliver development that meets needs)
- **Town & Country Planning Act 1990** allows the local plan to:
  - Seek payments from development (sometimes used to offset new developments' carbon emissions)
  - Make 'local development orders' to fast-track desirable development e.g. renewable energy

How have local plans used their powers towards carbon reductions?

Most adopted local plan example policies on net zero carbon buildings take the following approach:

- A minimum reduction in carbon emissions compared to the standard sent by Building Regulations Part L (the Target Emission rate), and
- The remainder of the Building Regulations 'regulated carbon' (Building Emission Rate) to be offset by a payment per tonne of regulated carbon emissions.

However, newer pioneering examples are taking a potentially more effective route of energy use limits and/or 100% renewable energy. Examples are given below, outlining their differences:

Residential new-build requirement	London Plan (2021)	South Oxfordshire (Policy DES10, 2020)	Central Lincolnshire (2023)	B&NES and Cornwall (2023)
Scope of emissions that must be 'net zero'	Regulated carbon as per Part L (some boroughs also include unregulated)	Regulated carbon as per Part L	Total operational carbon emissions from all energy use (regulated and unregulated)	
Minimum reduction in on-site carbon emissions (vs Building Regulations Part L 2013)	35%	40% (50% reduction from 2026; 100% reduction from 2030)	n/a	n/a
Energy use limits	n/a	n/a	35-60 kWh/m^2/year (EUI) 15 kWh/m^2/year (space heating demand)	40 kWh/m^2/year (EUI) 30 kWh/m^2/year (space heating demand)
On-site net zero (i.e. 100% on-site renewable energy supply)	No	No	Yes, through 100% renewable energy, but with exceptions for feasibility	Yes, through 100% renewable energy
Offset price	Recommend £60-£95/tCO$_2$, but decision by borough (e.g. Lewisham, £104/tCO$_2$)	n/a	£5-15k/dwelling, or direct provision of offsite renewable energy equivalent to dwelling usage	£373/tCO$_2$ (BANES) 10p/kWh (Cornwall)
Years' worth of emissions to be offset	30	n/a	n/a	30

Some examples require energy efficiency to deliver a certain amount of the carbon savings, as this is the first step of the 'energy hierarchy' (list of measures in order of most to least preferred):

- London Plan 2021: Energy efficiency measures should deliver the following minimum improvements in the carbon emissions rate (within the overall minimum 35% on-site):
  - Residential: 10%
  - Non-residential: 15%.

  These levels were set to reflect the technically feasible energy efficiency improvements identified by analysing the Building Regulations Part L figures of recent development.

Some examples require a minimum contribution of renewable energy, either as a percentage of the building's energy use, or as a percentage reduction on the carbon emissions rate. For example:

- Milton Keynes (2019): Renewable energy to contribute a further 20% reduction in the carbon emissions rate, *after* an initial 19% reduction has been made by other measures.
- Solihull (Emerging): Provide at least 15% of energy from renewable or low carbon sources.
- West Berkshire (2012): Renewable/low carbon energy to achieve net zero total carbon emissions (regulated and unregulated) from 2016 for homes, or 2019 for other buildings, unless demonstrated unviable/ unfeasible. We note that this requirement was upheld by the planning inspector at appeal in 2022, although other parts of the same policy that were based on the now-withdrawn Code for Sustainable Homes were deemed inapplicable.

Where carbon offsetting is one of the mechanisms within the net zero carbon policy approach, the cost per tonne of carbon is set by various rationales. London's £95/tCO$_2$ rate matched a previous national carbon value, set annually by BEIS (as of 2023 this national value has risen to £378/tCO$_2$). By contrast, some other plans have used a per-home payment (see Central Lincolnshire in this table) with lower and upper bounds reflecting the amounts of funding that would be needed to install renewable energy sufficient to offset the typical new building's emissions.

Some key new examples have now been achieved that require absolute energy use limits and on-site renewable energy generation capacity to reach net zero carbon. These policies are inspired by LETI and UKGBC net zero carbon buildings definitions (previously explained) and are considered a more effective and reliable approach to energy and carbon reduction as opposed to policy approaches that rely on an improvement relative to the Part L regulated baseline. Key examples include:

- Bath & North East Somerset (B&NES) Council and Cornwall Council (2023):
  - 40 kWh/m^2/year (EUI) and 30 kWh/m^2/year (space heating demand) limits.
  - On-site renewable energy generation requirement to match total energy use.
- Central Lincolnshire Council (2023):
  - Residential: 35 kWh/m^2/year (EUI) and 15-20 kWh/m^2/year (space heating demand) limits.
  - Non-residential: 70 kWh/m^2/year (EUI) and 15-20 kWh/m^2/year (space heating demand).
  - Residential and non-residential development: on-site renewable energy generation to at least match total energy demand.

There are also several other local authorities that aim to follow this net zero carbon development approach by not relying on the Building Regulations Part L carbon emissions rate as the basis for the improvements that must be made. Examples include:

- Greater Cambridge Emerging Local Plan
- Bristol City Council Emerging Local Plan
- London Borough of Merton Emerging Local Plan
- Leeds City Council Emerging Local Plan
- Winchester Emerging Local Plan

Common features of these emerging pioneering plans include performance targets identified by the Committee on Climate Change to be necessary in new builds to help deliver the UK's legislated carbon budgets:

- Limiting space heat demand to 15-20kWh/m^2/year (sometimes up to 30kWh where this is found to be more cost-effective).
- Limiting total energy use intensity in kWh/m^2/year – the target varies by building type but is always set to a level that rules out gas boilers and requires a heat pump or other efficient low carbon heat (as heat pumps use about one-third of the energy of gas boiler or direct electric).
- Use of an accurate energy prediction calculation to demonstrate the building's compliance with these metrics, such as PHPP or TM54 (glossary), not the methods used in Building Regulations.

The policies also require on-site renewable energy generation equal to the building's energy use. The aim is that although the building may use grid energy at times when its own renewable generation is not sufficient, there will be other times when it generates more than it is currently using and exports the excess to the electricity grid, resulting in a net 'zero energy balance' over the year.

These emerging policies are all supported by evidence bases showing feasibility and viability in new building types typical to the local area, using highly accurate specialist energy modelling and analyses of build cost uplift compared to the existing building regulations.

'Energy offsetting' (rather than 'carbon offsetting') is permitted in the case of technical non-feasibility, in these emerging policies. Developers would have to pay an amount per kWh of energy use not matched with on-site renewables. Funds would be used to install renewable energy elsewhere in the local plan area, and priced accordingly per kWh. The aim is to simplify the offsetting process by avoiding the need for complicated calculations about the changing amount of carbon related to use of different fuels and electricity over time linked to grid carbon reductions.

It must be noted that not all plans following the energy-based net zero approach are receiving positive reactions from the Inspectorate at examination. While Cornwall, B&NES and Central Lincolnshire have now adopted such policies, West Oxfordshire and Lancaster City Council have been forced to remove similar policy requirements. In the case of the West Oxfordshire Salt Cross AAP, the Inspector removed the absolute energy requirements to instead suggest them 'as guidelines only'.

Further innovative examples on local plan carbon reductions in transport and green infrastructure are also given in the full report. These approaches mostly rest on spatial choices to reduce car use and protect the carbon-sequestering ability of green landscapes. Although still emerging, it is anticipated that their success at examination will rest on their use of careful and robust evidence bases that reveal and justify the carbon impact of these decisions in relation to the scale of the climate change mitigation duty.

Defining ‘net zero carbon’

Overview

Because climate and carbon emissions are global challenges, consistency of effort is key. If carbon emissions are not consistently accounted for, there will be a risk of not reducing emissions but simply displacing them – or failing to account for the full emissions of new development.

When devising local plan policies for South & Vale, it will be vital to make sure those policies use a definition of ‘net zero carbon development’ that fully contributes to the achievement of a net zero carbon South & Vale and net zero carbon UK.

Before exploring policy elements and net zero carbon examples, we here look at the global, national, area-wide and building-level definitions of net zero carbon that are generally accepted.

This context is important because *most* of the adopted example local plans use a definition of ‘net zero carbon development’ that is significantly different to how a fully-fledged carbon accounting methodology would define it.

The reason for this difference is that these adopted local plan examples, until 2023, have almost always set their ‘carbon reduction’ requirements based on energy and carbon metrics set by national building regulations. These building regulations metrics do not account for the building’s full energy use, let alone the embodied carbon of the building’s materials and construction, or the transport carbon that will be induced in the lifestyles of the building’s users. The use of building regulations metrics in local plan policy has been due to the way in which planning legislation defines the local planning authority’s powers, and the ways in which other pieces of national government policy may constrain how those powers are exercised.

However, as we will discover later in this report, some pioneering local planning policies have begun to move beyond these constraints arising from planning legislation and associated national policy.

This section of the report firstly looks at the global, national, and district-level definitions of net zero carbon. It is subsequently possible to understand the relative merits of different definitions of net zero carbon buildings in existing and emerging example local plans.

The section also helps contextualise the levels of performance or change that would be necessary to achieve those definitions of net zero carbon – in terms of changes to new buildings, existing buildings, transport, the energy system, and land use.

Net Zero Carbon at global level

At global level, "net zero carbon" means that emissions of greenhouse gases (GHGs) are balanced out by removals of GHGs from the atmosphere.

'Greenhouse gas' encompasses a bundle of different gases that have a climate-changing effect. The most common greenhouse gas is carbon dioxide (CO_2) which represents 80% of the UK's climate impact[xii]. Six other GHGs are also relevant: methane (12%), nitrous oxide (5%), and four types of fluorinated gas (refrigerants, 3%). Some of these have a weaker global warming effect, and some have a stronger effect but stay in the atmosphere for longer and therefore cause more change over time.

As CO_2 stays in the atmosphere for a long time, there is a fixed amount – a 'carbon budget' – that we can emit between now and 2100 if the world is to avoid the worst impacts of climate change (limiting global warming to less than 2˚C above pre-industrial climate). The other greenhouse gases are not subject to the 'budget' approach, because they stay in the atmosphere for a different amount of time, but should still be reduced as far as possible.

Together, the bundle of greenhouse gases is referred to as 'carbon dioxide equivalent' or 'CO_2e'. This refers to the global warming effect that the gas would have in a 100-year timeframe, compared to that of carbon dioxide. 'Carbon emissions' can refer to carbon dioxide, or the whole collection of greenhouse gases.

'Net carbon' or 'net emissions' refers to the amount of CO_2 or greenhouse gas that remains after deducting the amount that was removed from the atmosphere, usually over the course of a year.

'Net zero carbon' is sometimes used interchangeably with the term 'carbon neutral'. These are overlapping concepts which essentially mean the same thing at global level, but at sub-global levels they are used slightly differently[xiii], to reflect whether emissions and removals are achieved *directly by* or purely *on behalf of* a particular country or organisation. This becomes a question of 'carbon accounting', discussed next.

Where do the carbon emissions come from and how can carbon be removed from the atmosphere?

The main *source of rising GHG levels* in Earth's atmosphere is the burning of fossil fuels (as this is an emission of carbon that had been locked up underground for many thousands of years until recently). Greenhouse gas is also emitted by many other human activities including fertiliser use (nitrogen fertilisers are often made from fossil fuel), ruminant livestock's digestive systems, breakdown of organic waste, and the chemical reaction during the production of cement.

Greenhouse gas *removals* are achieved by plants and soils such as forests, grassland and wetland. These are currently the only reliable and scalable means to remove greenhouse gases, as no appropriate and efficient technology for carbon capture has yet been developed. Still, research is underway to develop such technologies, and future carbon removal technology is a significant part of many countries' long-term strategy to limit the total amount of carbon emitted this century.

Carbon accounting methodologies: whose carbon is whose?

Human activities and economies are highly interconnected across local, organisational and international lines. Activity by a person in one location (such as using electricity) can cause carbon emissions by another entity elsewhere (such as burning coal to generate energy in power stations). Therefore we need 'carbon accounting' methodologies to work out what share of carbon emissions 'belong' to each entity. That entity could be a person, organisation, building, local area, or country.

Returning to the question of 'net zero carbon' compared to 'carbon neutral', the Intergovernmental Panel on Climate Change[xiv] essentially explains that:

- 'Net zero carbon' typically means a balance of emissions and removals under direct control or territorial responsibility of the entity reporting them (such as a country, district or sector)
- 'Carbon neutral' can also apply to a firm or commodity, and typically also includes emissions and removals beyond the entity's direct control or territorial responsibility.

Following this logic, 'net zero carbon' would be the appropriate term if the district or country achieves enough carbon removals within its own area to balance out its own carbon emissions, while 'carbon neutral' is a less appropriate term for a country/district but would be the term to use if the emission/removal balance is achieved by buying carbon offset credits from outside that location.

For the purposes of a local plan, we should consider the carbon account of two key entities: firstly South & Vale, and secondly each new building. We must consider how the *building's* carbon emissions fit into the carbon account of South & Vale, and how the *districts'* emissions fit within the wider UK's carbon account which is legally bound to reach net zero by 2050 and steep carbon reductions in preceding years. If we use inconsistent definitions or accounting methods, then our 'net zero carbon' buildings might not help South Oxfordshire to achieve its goal to be net zero ('carbon neutral') by 2030 and Vale of White Horse to reduce emissions by 75% by 2030, and subsequently the districts in turn might not help the UK meet its 2050 goal nor its interim carbon budgets.

Several carbon accounting approaches, explained in further detail below, are available to determine how much carbon a geographical area is responsible for:

- Global Greenhouse Gas Protocol for Cities (GPC) – which has three 'scopes'
- PAS2070
- Local area CO_2e inventories, released annually by the UK government BEIS/DESNZ
- Tyndall Centre local carbon budgets / SCATTER local carbon emissions accounts

Each of these methodologies is designed to define the area's 'carbon account' based on the degree of direct or financial control the area has over activities that emit or absorb carbon.

Although each methodology differs slightly from the others, a local area would usually achieve 'net zero carbon' status when the GHG removals achieved within the local area are equal to greenhouse gas emissions from directly within the local area plus the greenhouse gases due to production of grid energy the local area consumes. If an area exports grid energy to other locations, any emissions associated with the production of that energy would not count towards the area's carbon account.

The methodologies generally agree that the local area's carbon account should not include offsets purchased from outside the area. These should be reported separately, if at all. However, such offsets may still help towards the overall UK net zero carbon goal so long as they are within the UK.

The Global Greenhouse Gas Reporting Protocol for Cities (GPC)

The Greenhouse Gas Reporting Protocol is the most widely used and accepted methodology to account for any entity's carbon emissions. The GPC is a version of that methodology that has been adapted for the use of cities or any other local area. Its aim is to enable local area carbon accounts to be tracked consistently enough to be aggregated to the regional or national level.

The GPC covers several gases (along with CO_2) and splits the account into three 'scopes' which reflect the degree of responsibility and control the local area has:

- Scope 1: emissions directly from within the area – such as through burning fuel, or through methane emissions from livestock kept within that area. Ditto, carbon removals achieved directly within the area, such as by trees growing in the area.
- Scope 2: emissions associated with that area's use of grid electricity which may have been produced inside the area or outside the area.
- Scope 3: emissions that happen outside the area but caused by activity or spending by entities inside the area – such as production and transport of goods imported from elsewhere.

The GPC states that if an area purchases carbon offsets from outside the area in order to mitigate some of its emissions, these should be reported separately and not deducted from the total.

If South & Vale chooses to use any external 'offsets' in its quest for emissions reduction (as a last resort), these should be from within the UK so that they fall within the UK's Scope 1 account and thus contribute to the UK's overall net zero carbon goal (which should not include overseas offsets).

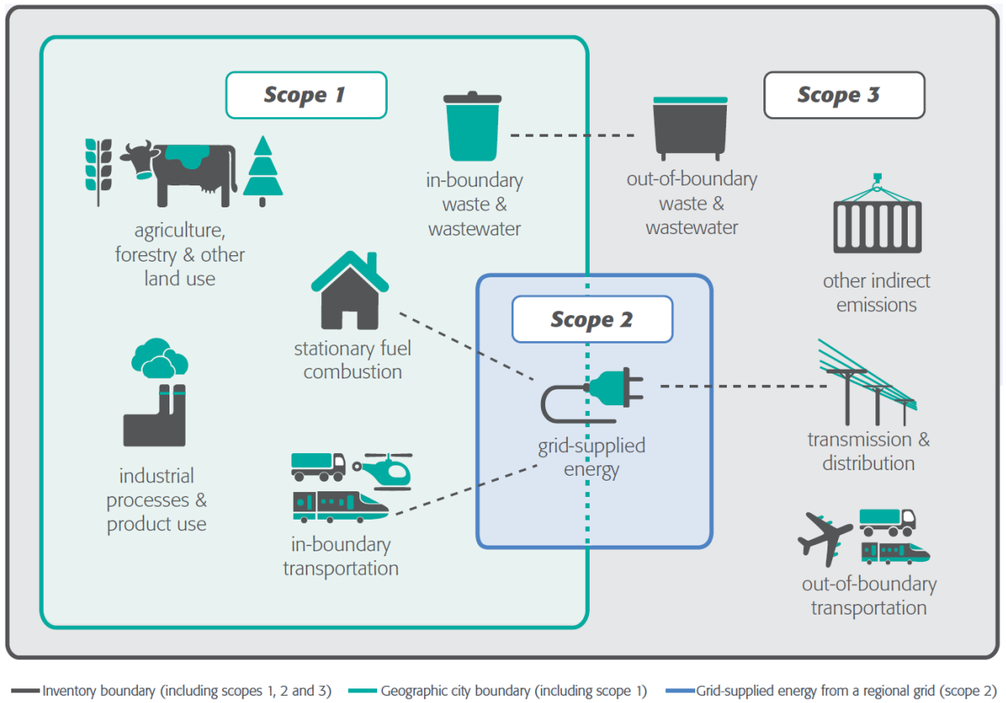


Figure 5: Various emissions sources according to Scopes 1, 2 and 3.

PAS 2070

A PAS is a Publicly Available Specification, which is essentially the precursor to a British Standard or European EN standard. A PAS defines good practice standards for a product, service or process.

PAS 2070 aims to define good practice for the assessment of the greenhouse gas emissions of a city. It builds on the GHG Protocol for Cities (GPC) to include a wider range of emissions sources and a slightly wider bundle of gases. It also offers two ways of accounting, one of which is equivalent to the GPC's three scopes ("direct plus supply chain"), and the other of which allows exclusion of emissions from goods produced in the area that are then exported ("consumption-based emissions").

Just like the GPC, PAS2070 notes that if out-of-boundary offsets have been bought (whether by the municipality, businesses, organisations or residents) these should not form part of the total of a city's GHG account by deducting them from the total. Instead, such offsets should be accounted separately.

UK DESNZ/BEIS official subnational emissions inventories

The Department of Energy Security and Net Zero (DESNZ, formerly BEIS) releases annual figures that break the UK's carbon emissions down to a local level[xv] to help local authorities make decisions. Until recently this counted CO_2 only, but now includes CO_2, methane and nitrogen dioxide (although not F-gases). It uses data from the National Atmospheric Emissions Inventory and national statistics on local area's energy consumption. It excludes aviation, international shipping and military transport because there is no clear basis for how these would be allocated to local areas.

These DESNZ/BEIS figures include only local direct emissions (including from land use and chemical use as well as fuel use) and grid energy use. They are not broken down into 'scopes', but would mostly equate to Scope 1 + Scope 2 as they do not include emissions from the local area's consumption of goods produced elsewhere (except electricity).

The DESNZ/BEIS figures are broken down into several sectors: industry, homes, commercial buildings, public buildings, transport, and 'land use, land-use change and forestry' ('LULUCF'). Transport emissions are calculated based on traffic flow data on local roads, plus fuel use on inland waterways and trains. Electrical trains are accounted for separately in the 'industry' sector.

The DESNZ/BEIS figures show how much carbon is removed by the area's grassland and woodland. This is positive, but also shows the scale of the challenge: The woodland/ grassland is nowhere near enough to zero-out the area's emissions even if the green areas were expanded many times over.

The figures also reveal how important it is to plan for reduced car use and enable low-emissions deliveries – as transport is responsible for more than half the area's emissions.

Tyndall Centre local area carbon dioxide budgets (and SCATTER trajectories)

The Tyndall Centre is a climate change research organisation made up of several UK universities working to get climate science evidence into policy. It created a tool[xvi] that produces municipal-level carbon budgets towards a 2˚C global climate pathway that are necessary and fair, taking into account each location's sectoral base by looking at its historical portion of the country's emissions.

These trajectories show the UK's **total CO_2 budget to 2100** if the UK is to pull its weight towards fulfilling the **Paris Agreement** (to **limit global warming to 2˚C**, with **carbon cuts equitably distributed to each country** in proportion to its technological and financial capability, its needs, and its responsibility for historic emissions). This starts with the middle-range global carbon budget likely to

limit global climate change to "well below" 2˚C, determined by the Intergovernmental Panel on Climate Change. Tyndall derives the CO_2 budget for the UK from this global budget, based on equity principles that account for our existing level of development and sectoral base, and the local budget is derived from the UK one. The resulting totals are split into five-yearly budgets. The Paris-compliant carbon budgets for both South Oxfordshire and Vale of White Horse are shown here (Figure 6, and would be used up by the end of 2026 if emissions continue at the 2017 level.

This methodology **only covers CO_2 occurring due to energy use** (whether in transport, buildings, agriculture or other industries). It does not cover the other six greenhouse gases, or releases of CO_2 from activities other than energy use. The reasons are as follows:

- Other gases are left out because "a cumulative emission budget approach is not appropriate for all non-CO_2 greenhouse gases, as [they have] … differing atmospheric lifetimes and warming effects", with more uncertainties around them.
    - There is a parallel methodology named SCATTER[3] that builds on Tyndall carbon budgets to estimate these other gases.
- Other activities are excluded because energy use is the main source of CO_2 emissions and therefore the main activity that needs to be addressed.
    - Emissions from cement production (except fuel use) are excluded because cement production is assumed to be unavoidable to some extent, therefore a deduction for cement is made from the global budget before the UK's budget is allocated.
    - Aviation and shipping are excluded from the local budget, because it is considered that those cannot be fairly allocated to local areas – so a deduction is made from the UK budget to make room for aviation and shipping, before the local budget is allocated.

Tyndall Centre assumes that global forest levels do not change between 2020-2100, assuming afforestation in certain areas to counteract deforestation in others. It recommends that GHG removals achieved by further afforestation are monitored separately from this budget and used instead to compensate for unavoidable non-CO_2 emissions, such as agricultural methane.

Unlike the Committee on Climate Change national carbon budgets, Tyndall does not assume that carbon capture technologies appear in future, as this would risk over-estimating the budget. If these technologies were to be developed in future, they could expand the size of the available budget.

Offsetting is not part of the budget, because the budget is designed to reveal the actual CO_2 reductions needed locally.

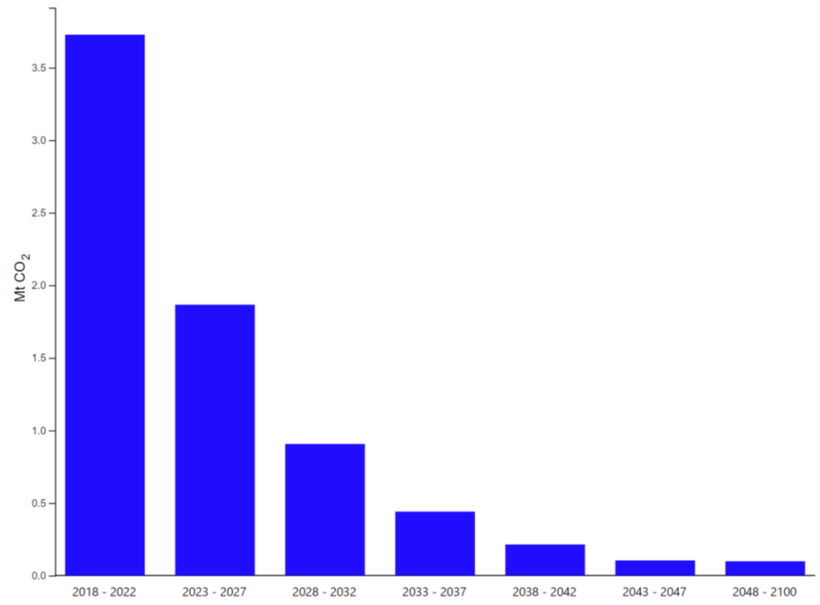


Figure 6: South Oxfordshire's carbon budgets to 2100 (energy-only, CO_2 only) compliant with the UK's commitment to the Paris Agreement. Calculated by the Tyndall Centre.[xvii]

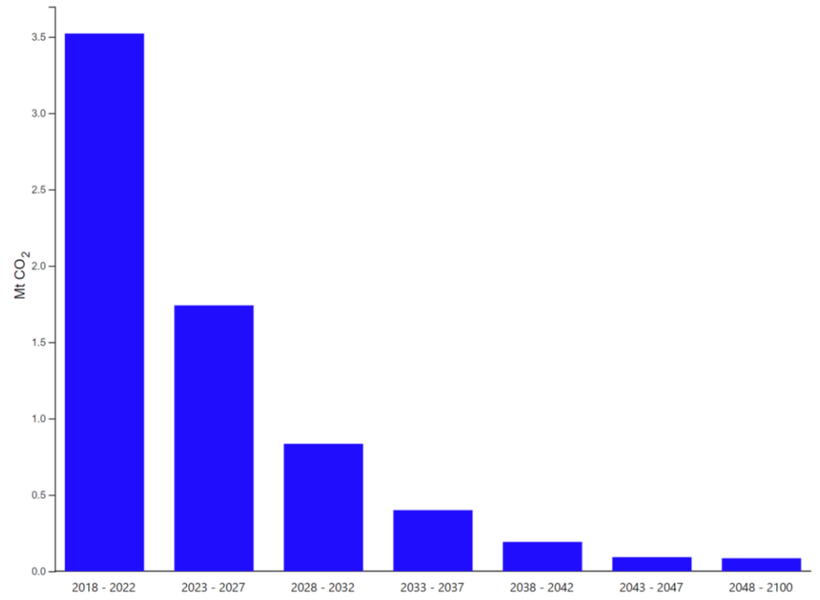


Figure 7: Vale of White Horse's carbon budgets to 2100 (energy-only, CO_2 only) compliant with the UK's commitment to the Paris Agreement. Calculated by the Tyndall Centre.

[3] Setting City Area Targets and Trajectories for Emissions Reduction. https://scattercities.com/

South & Vale's existing carbon commitments and carbon accounting approach

	South Oxfordshire	Vale of White Horse
Climate emergency declared?	Yes (plus ecological emergency)	Yes
Net zero (own operations) by?	2025	2030 – 75% reduction by 2025
Net zero district by?	2030	2045 – 75% reduction by 2030

South Oxfordshire and Vale of White Horse District Councils both declared climate emergencies in 2019 that aim to achieve net zero status of each district, whilst the former has also declared an ecological emergency. South Oxfordshire has set slightly more ambitious target dates to achieve both a net zero ('carbon neutral') council and district, as set out above, yet the district councils will need to follow robust and rapid actions to achieve both sets of targets.

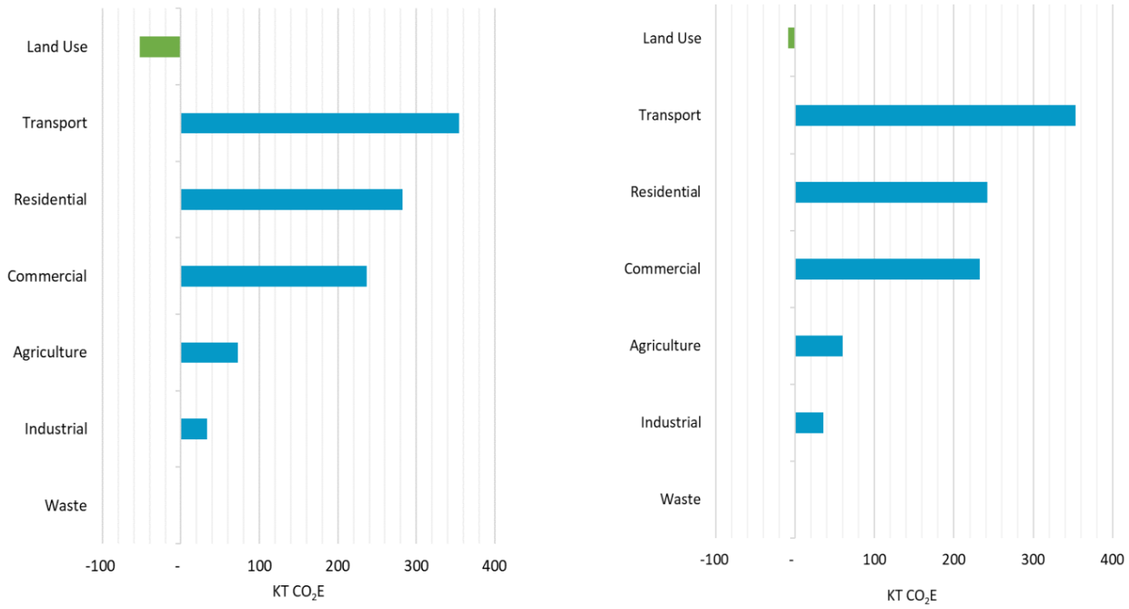


Figure 8: Baseline emissions from 2017 for South Oxfordshire (left) and Vale of White Horse (right); Aether (2020).

In 2020, Aether produced a *Scoping Report and Carbon Baseline Assessment*, which produced baseline emissions from 2017 across both districts. No further district-wide emissions reporting or projections have been carried out since, with the exception of BEIS/DESNZ data explored in the following section. A key conclusion in the Aether report stated that the baseline emissions calculations are an important first step in the process of annual district-wide emissions, yet further work needs to be carried out so that annual emissions changes from the 2017 baseline can be tracked.

The *Pathways to a Zero Carbon Oxfordshire* report from 2021 does not work towards annually calculating and reporting future annual emissions, but instead explores various pathways for Oxfordshire to become a net zero region. It is important to note here that this report has a county-wide scope and therefore takes a larger area into account than South & Vale. The report does however provide a useful summary of how Oxfordshire emissions have reduced by sector, during the period between 2008-2018.

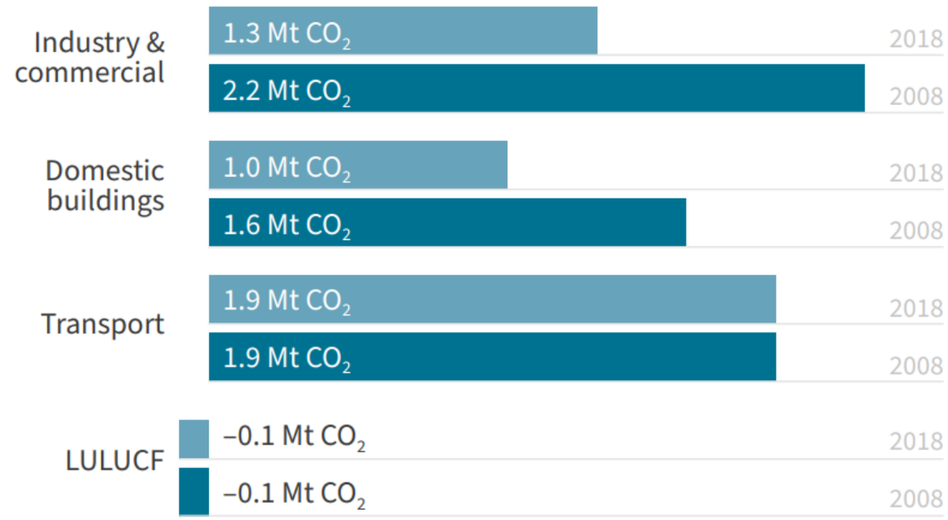


Figure 9: Scope 1 and 2 CO_2 emissions in Oxfordshire by sector, 2008 and 2018; Environmental Change Institute (University of Oxford) and Bioregional, 2021.

To combat emissions reductions to both of the district councils' emissions from their own operations, the production of annual greenhouse gas reports for both South Oxfordshire and Vale of White Horse, aligns the carbon accounting methodology selection. Additionally Climate Actions Plans to reduce council emissions for South Oxfordshire and Vale of White Horse have been produced. The action plans set out key actions that the councils are to take to reduce emissions from their own operations, categorised into the following elements:

- Our ways of working
- Our service delivery
- Our people
- Our land
- Our buildings
- Our communities
- Our partners

Since these documents address only emissions arising from council activity, there is less relevance to the scope of the local plan and this evidence base, and therefore are not explored further in this report.

Current lack of a formalised district-wide carbon accounting methodology

Based on the above, there is currently not an annual district-wide carbon accounting methodology already in place for South & Vale. The *Scoping Paper and Carbon Baseline Assessment* (2020), produced by Aether, makes it clear that for certainty on the scale of action required for both districts to achieve their net zero goals, annual emissions reporting must be undertaken to better understand and act upon emissions reductions.

Both district councils should seek to undertake annual emissions reporting with a view to eventually developing science-based carbon targets for the organisation (carbon reduction targets that would be compatible with the globally limited carbon budget for a safe climate future).

This means there is an opportunity to now select a suitable method. It is crucial that the level of action required to reach net zero carbon is understood so that suitable programs and policies can be devised, in turn so that emissions reductions are delivered in practice. At a local level, sectors and specific measures should be identified to set out clear pathways that work towards achieving a net zero carbon future. Monitoring emissions reductions is a key element of this and should occur annually to track progress.

Local area carbon emissions estimations from central government

To illustrate general progress to date, annual sectoral emissions from the national government Department of Energy Security and Net Zero (DESNZ) are set out below. This data is commonly used by local authority areas to understand their emissions as it is reliably released annually and no further calculations or analysis are needed by the local authority. The scope of each sector is explained here.

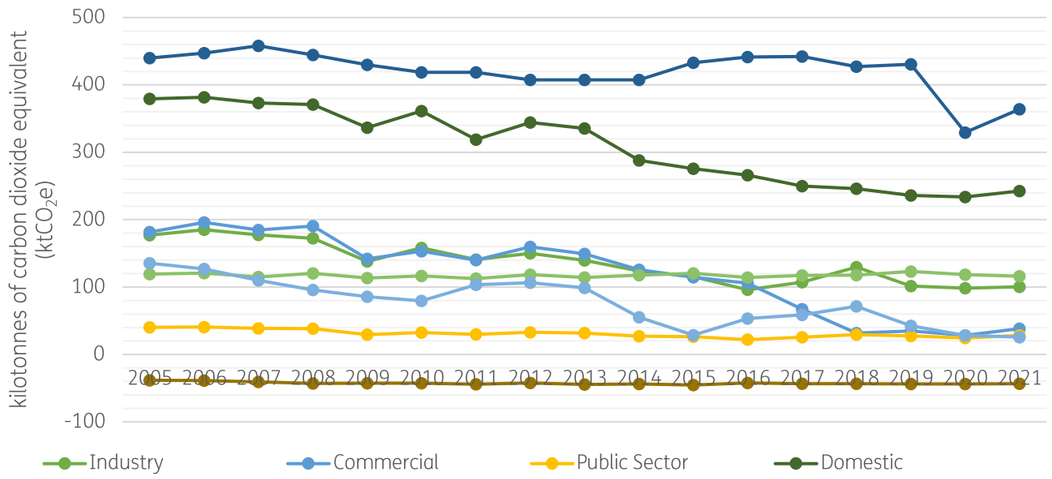


Figure 10: South Oxfordshire sector emissions 2005 – 2021. BEIS/DESNZ subnational CO_2e 2023 data (CO_2 + methane + nitrous oxide).

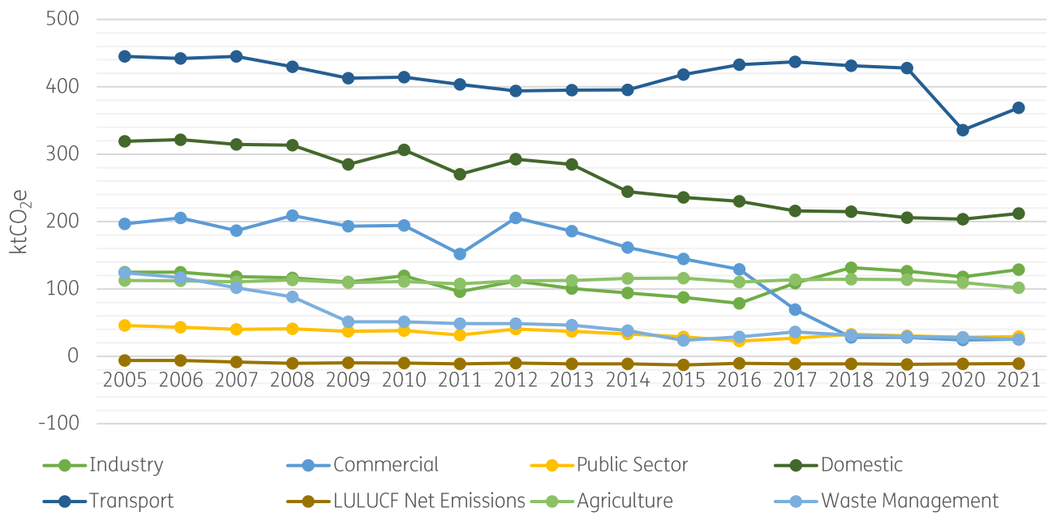


Figure 11: Vale of White Horse sector emissions 2005 – 2021. BEIS/DESNZ subnational CO_2e 2023 data (CO_2 + methane + nitrous oxide).

DESNZ sector	What does DESNZ include in this sector? *(See also DESNZ full report on scopes)*
Industry	On-premises use of grid electricity and fuels; industrial chemical reactions; includes some of the electricity used in the railway system
Transport	Fuel use in road vehicles and trains (other than railway electricity) in the local area
Commercial	On-premises use of grid electricity and fuels; includes some railway electricity
LULUCF	Emissions from wetlands, cropland (conversion & soil management) conversion to built use, fertiliser use in forestry. Carbon removal by forests & grassland
Public sector	On-premises use of grid electricity, gas and other fuels at public sector premises
Agriculture	Digestive methane (local livestock); local breakdown of fertiliser; on-farm fuel/power
Domestic	In-home use of grid electricity, gas and other fuels
Waste	Landfill waste decay (allocated to area where waste arose); wastewater treatment

For both South Oxfordshire and Vale of White Horse, the domestic and transport sectors have clearly contributed the largest proportions of emissions during 2005-2021, as seen in *Figures 10* and *11*.

The reduction seen in the domestic sector is primarily due to a reduction in carbon intensity of the UK electricity grid, due to increased renewable energy generation. The domestic sector's share of overall emissions has reduced over time and may soon fall below that of hard-to-abate sectors such as agriculture, which are not easily influenced by improvements to the grid and cannot be directly controlled via the local plan. Similarly, commercial sector emissions show reasonably steep downward trajectories from 2012 in both Districts, which again can be attributed to grid decarbonisation.

As long as the South & Vale local plan implements net zero policies for new build residential and commercial buildings, the downward trajectories already occurring for domestic and commercial sector emissions will continue as there should be zero or limited additional emissions from new development, whilst grid decarbonisation will continue to reduce emissions of existing buildings.

Transport emissions have remained high since 2005 but show a notable decline in 2020, prior to a slight resurgence in 2021. This is largely due to the COVID-19 pandemic which reduced travel, particularly personal car usage. The local plan cannot directly influence consumer decision making on choosing electric vehicles. Yet the sustainable allocation of development sites in the plan can help reduce transport emissions by allocating sites close to public transport and essential services so as to reduce private car usage. The plan is also able to require standards on electric vehicle charging and active travel measures, although it should be noted that the new Building Regulations Part S already requires electric vehicle charging on schemes that have parking (with some exceptions). However, the present report's focus is buildings, thus this study does not make transport policy recommendations.

Agriculture, industry and public sector emissions have stayed relatively constant since 2005. Emissions arising from these three sectors are difficult to control through local plan policy mechanisms, since new development does not form a large proportion of infrastructure. Local authority investment into public sector infrastructure, where possible, could however be made to show local leadership towards net zero targets for both Districts. However, waste management emissions are similarly stagnant to the aforementioned three sectors and the local plan is able to more significantly impact such emissions. Reducing embodied carbon emissions, following the waste hierarchy and implementing circular economy principles are all effective approaches to reducing waste emissions arising from new development, which the South & Vale local plan and this evidence base will seek to achieve.

Alternative carbon accounting methodology to better understand necessary interventions

Although the DESNZ/BEIS data is useful as an overview, an alternative tool – the Setting City Area Targets and Trajectories for Emissions Reduction (SCATTER) tool – can improve our knowledge of what *interventions* will most effectively push South & Vale towards becoming a net zero carbon geographical area. Various degrees of ambition can be set and tested in the SCATTER tool, allowing the user to adjust the desired level of emissions reductions for activities in the following sectors:

- Domestic
- Industry and commercial
- Transport
- Agriculture and land use
- Waste

Two different scenarios (scopes 1, 2 and 3) are explored here for South & Vale: a high-ambition scenario that significantly exceeds national policy and a business-as-usual scenario.

The table set out below compares the level of intervention between the opposing scenarios of 'High Ambition' and 'Business-As-Usual'. Instead of listing out the whole collection of possible interventions from the SCATTER tool, only the most relevant interventions to **South & Vale and local plan powers** have been selected. Although some of the interventions below are not directly related to policies that could be set in the local plan, they will all be impacted by outcomes of the local plan directly or indirectly. The local plan has the most control over implementing interventions set out under 'Domestic Buildings' and 'Energy Supply'.

Although the interventions selected for the 'High-Ambition' scenario are the most effective available in the SCATTER tool (which has a limited range of interventions that can be selected), many of them result in smaller emissions reductions than the standards set out in the 'Policy recommendations' section, particularly relating to domestic buildings and energy supply. Therefore, the SCATTER tool simply provides an overview of the scale of emissions reductions that could be driven by general interventions. The SCATTER 'High Ambition' scenario includes some features that are echoed in the policy recommendations, but does not fully represent the full policy direction for South & Vale.

		High Ambition	Business-As-Usual
Agriculture and Land Use	*Forestry*	24% increase in forest cover by 2030	5% increase in forest cover by 2030
Domestic Buildings	*New build*	From 2021, 100% new-build properties are built to Passivhaus standard	All new houses are built to 2013 Building Regulations (no change)
	Heating technology	By 2050, 7% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps; 3% district heating	No change to current technology mix for home heating
	Retrofit	By 2050, 10% of current stock is retrofitted to a medium level; 80% deep retrofit	All current households remain at weighted average heat loss
	Lighting and appliances demand	By 2050, domestic lighting and appliance total energy demand has dropped to 27% of current levels.	By 2050, domestic lighting and appliance total energy demand has dropped to 80% of current levels
	Water demand	Hot water demand per household reduces by 8% every 5 years	Hot water demand per household grows 5% every 5 years
Energy Supply	*Biomass/coal power stations*	Solid biomass generation quadruples in 2025, dropping off after that. Coal phase-out follows trajectories from the National Grid's Two Degrees scenario.	No change in solid fuel power generation
	Small-scale solar PV	Local solar capacity grows, generating equivalent to 2500 kWh per household in 2030; 5200 in 2050 (from a baseline of 400 kWh per household.)	Local solar capacity grows to allow generation equivalent to 750 kWh per household in 2030; 1350 in 2050 (from a baseline of 400 kWh per household.)
	Large-scale solar PV	Large-scale solar generation grows to 200 kWh per hectare in 2030; 400 in 2050 (from a baseline of 50 kWh per hectare.)	No change in large-scale solar generation to 2030; growing to 100 kWh per hectare in 2050 (from a baseline of 50 kWh per hectare.)
	Small-scale wind	Small-scale wind grows to 2.8 MWh per hectare in 2030; 3.3 in 2050 (from a baseline of 1.2 MWh per hectare.)	No change to small-scale onshore wind
	Onshore wind	Large-scale onshore wind generation grows to 1.9 MWh per hectare in 2030; 2.2 MWh in 2050	Large-scale onshore wind generation grows to 1.26 MWh per hectare in 2030; 1.46 MWh in 2050

Industry and Commercial	*Commercial heating and cooling demand*	In 2050, commercial heating, cooling and hot water demand is 60% of today's levels	In 2050, commercial heating, cooling and hot water demand is 103% of today's levels
	Commercial heating and cooling technology	By 2050, 7% resistive heating; 60% air-source heat pumps and 30% ground-source heat pumps; 3% district heating	No change to current technology mix for commercial heating
	Lighting and appliances	Commercial lighting & appliance energy demand decreases 25% by 2050	Commercial lighting & appliance energy demand increases 28% by 2050
	Industrial processes efficiency	Industrial electricity consumption is 50% of total energy consumption by 2035; 65% by 2050. Output falls by 2% every year for non-heavy industry	Industry moves to higher natural gas consumption, with electricity consumption falling before 2035 then remaining constant
Transport	*Domestic passenger transport modal shift*	Average modal share of cars, vans and motorbikes decreases from current national average 74% total miles to 38% in 2050	No change to current national average modal split by total miles: 74% transportation by cars, vans and motorcycles
	Domestic passenger transport demand	25% reduction in total distance travelled per individual per year by 2030	No change to total travel demand per person
Waste	*Recycling*	65% recycling, 10% landfill, 25% incineration achieved by 2035, recycling rates increasing to 85% by 2050	65% recycling, 10% landfill, 25% incineration by 2040; remaining constant to 2050
	Waste reduction	Total volume of waste is 61% of 2017 levels by 2040	Total volume of waste is 124% of 2017 levels by 2040

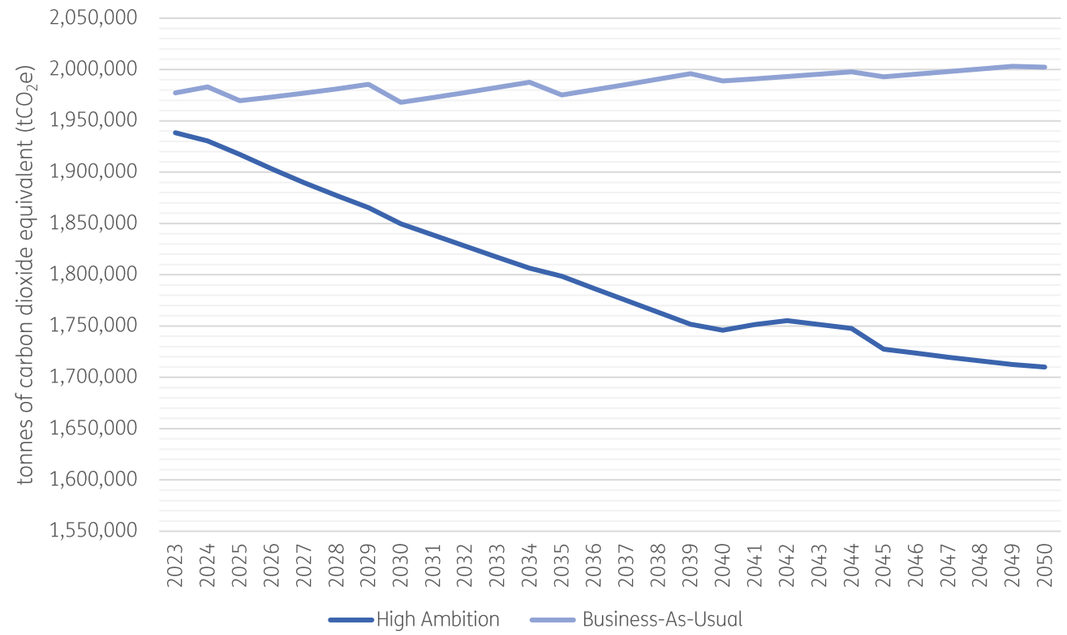


Figure 12: Two SCATTER tool scenarios for South & Vale.

Figure 12 shows that although the SCATTER 'High Ambition' scenario would make very significant progress towards a net zero carbon South & Vale, it does not achieve this by 2050, despite setting all interventions to the maximum level available in the SCATTER tool. This illustrates the magnitude of action required across all sectors to reach net zero by the 2050 net zero target for the UK and interim 2030 targets for South Oxfordshire and Vale of White Horse. The more ambitious standards set out in 'Policy recommendations', if adopted and implemented, will certainly result in improved emissions reductions. However, since the local plan can only affect emissions from new development and other proposals that require planning permission, these reductions are unlikely to guarantee that net zero targets will be hit without significant reductions in areas and sectors the local plan cannot control.

Figure 13 (below) sets out a specific sectoral breakdown of emissions reductions under the High Ambition scenario. This shows that the 'Domestic' sector results in the most significant emissions reduction and in 2023 represents the third most carbon intensive sector, behind 'Industry and Commercial' and 'Agriculture' sectors. These emissions reductions to the 'Domestic' sector represent the major impact the local plan can help to deliver to the sector through the implementation of policies that achieve new net zero carbon homes and promote widespread retrofitting of existing buildings; this is similarly the case for the 'Industry and Commercial' sector relating to new non-residential buildings. Although the 'Waste' sector represents a negligible proportion of overall emissions in South & Vale according to the SCATTER methodology, the High Ambition scenario shows that this sector is able to get to near zero emissions by 2050. The local plan can influence this pathway to near-zero for this sector through the delivery of policies that aim to reduce waste in new buildings, which could include focusing on embodied carbon, circular economy, and material reuse and retention.

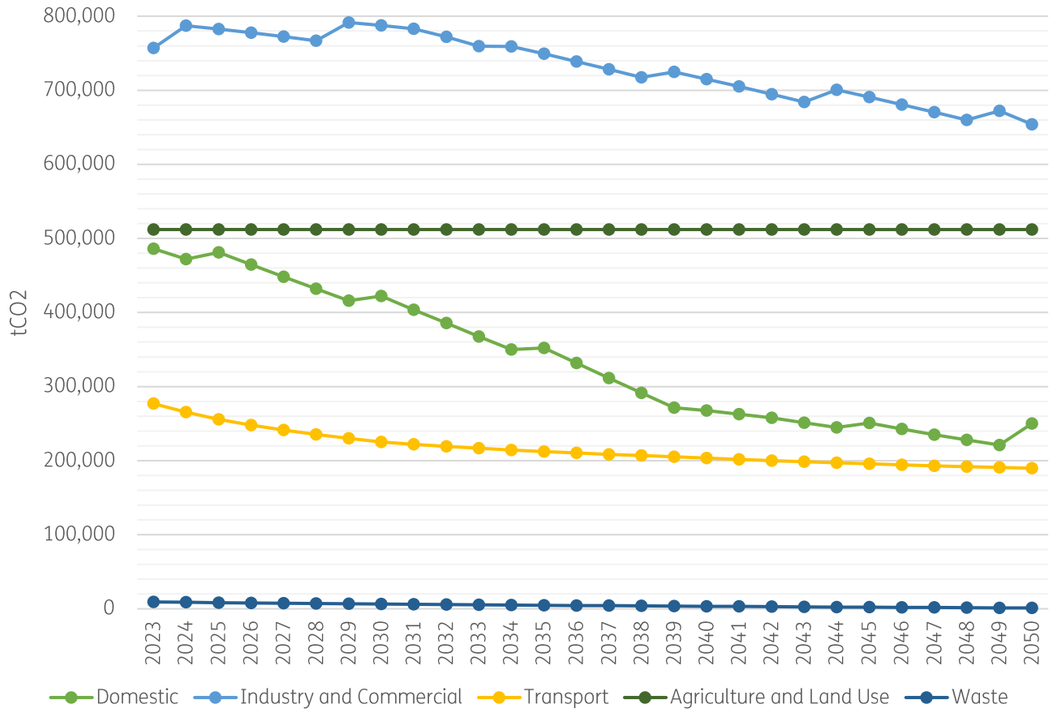


Figure 13: Sectoral breakdown of emissions reductions for the SCATTER High Ambition scenario.

In *Figure 14 as Usual')*, the 'Domestic' sector achieves no emissions reductions to 2050 and in fact shows an increase in emissions, even though it is expected that the electricity grid will significantly decarbonise (please note this does not take into account the existing Policy DES10 set by South Oxfordshire). This failure to achieve reductions is primarily because the existing UK housing stock is reliant on gas for heating and therefore its carbon emissions may not be fully solved by from reduced carbon intensity of electricity generation, unless widespread retrofitting occurs to transition existing buildings from gas to electrical heating. The 'Industry and Commercial' sector shows a similar trend. This SCATTER projection takes account of the major influence the 'Agriculture' industry has on emissions across both districts. As the local plan is not able to easily influence agricultural emissions, it is essential emissions from remaining sectors are mitigated as far as feasible and viable through the local process, to support these hard-to-abate sectors that will require offsetting to get near net zero emissions.

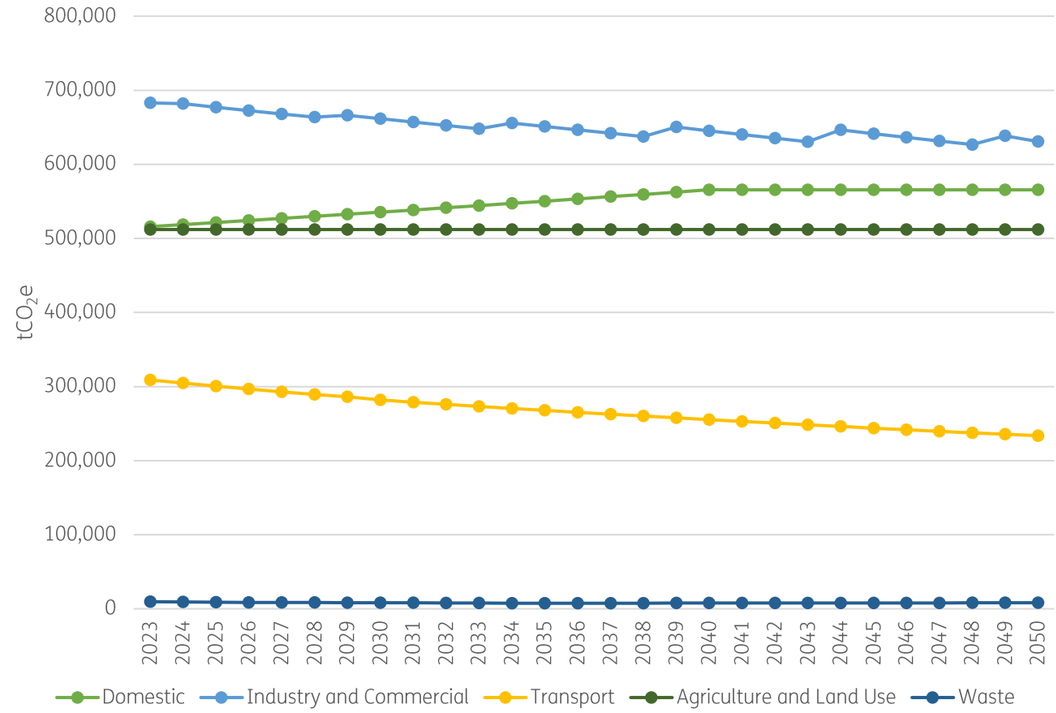


Figure 14: Sectoral breakdown of emissions reductions for the SCATTER Business-As-Usual scenario.

The results from *Figures 13 and 14* show the significant impact that local authority action and policy can have on the 'Domestic' sector. Whilst the 'High Ambition' scenario results in monumental emissions reductions, by contrast the Business-As-Usual scenario reveals that a lack of policy action would leave the 'Domestic' sector highly carbon intensive in South & Vale. Therefore, for South Oxfordshire to become a net zero carbon region by 2030 and for Vale of White Horse to achieve a 75% emissions reduction by 2030, with both contributing its share towards a net zero carbon UK, ambitious local plan policy must be implemented to deliver truly net zero new buildings, ensure retrofitting of existing buildings and provide an attractive policy landscape for renewable energy development. Since SCATTER does not offer many interventions in the 'Transport' sector, transport does not achieve much emissions reduction in either of the scenarios. However, as shown in *Figures 10 and 11*, transport is the largest emitting sector in South & Vale and should therefore be simultaneously addressed in the local plan by allocating sites primarily by their scope for reduced car use, and setting development management policies that promote walking, cycling, support public transport and electric vehicle use.

It is paramount that the South & Vale local plan maximises emissions reductions for all sectors, yet it is clear from the combination of DESNZ/BEIS and SCATTER data that there is most scope for reductions to the domestic buildings sector.

How could carbon accounting methodologies be logically applied to an individual building and how would this impact the carbon footprint of the local area and UK?

There are two ways in which a new building is responsible for carbon emissions:

- Operational carbon: the emissions caused by running of the building, mostly due to energy use.
- Embodied carbon: the emissions that were caused in the production and transport of the materials and their assembly into the finished building. This can also include further embodied carbon emissions as parts of the building are maintained, replaced or eventually demolished.

The Global Greenhouse Gas Protocol's aforementioned 'three scopes' is helpful to conceptualise how the individual building would contribute to South & Vale's overall emissions. The operational carbon emissions of a building appear almost entirely within South & Vale area's Scope 1 (burning of fuel for energy in the building itself, such as a gas boiler) and Scope 2 (use of electricity from the grid, and use of any energy from a heat network if there is one present).

Embodied carbon (emissions related to production, manufacturing, transport and assembly of building materials) would be entirely Scope 3 from the point of view of the building itself. However, that embodied carbon will contribute to the Scope 1 and 2 emissions of South & Vale and the UK, because it includes the transport of materials to site, the use of energy to assemble the building, and potentially the production of the material itself if it is sourced from within South & Vale or the UK. It may also include some Scope 3 if the material was produced overseas.

New development could also cause increased ongoing transport emissions by causing occupants or visitors to drive. This would be part of South & Vale's carbon account (scope 1 for the local plan area), so growth should only be in sustainable locations where there is more potential for active travel and public transport to reduce private transport emissions. However, any increased transport carbon after building completion is not counted within the *building's* carbon account by any existing methodology to account for a building's carbon emissions. Thus a 'net zero carbon building' does not have to ensure that no transport carbon is emitted by its occupants or visitors. The same is generally true for the use of the term 'net zero carbon development' in planning policy and the built environment sector.

Transport is the largest source of carbon emissions in South & Vale and should be a priority for the local plan to address via the spatial strategy and separate policies; recommendations are not made in this report however.

To follow carbon budgets for South & Vale – and to ensure South & Vale plays its role in following the carbon budgets for the UK as a whole – emissions from transport and from buildings' energy use are the key areas that should be targeted by local plan policy. This is because these are the main ways that a new building's carbon emissions would affect South & Vale's carbon account. Embodied carbon of new buildings' materials and construction will less strongly affect a district's carbon account if using the DESNZ/BEIS methodology or the GHG Protocol for Cities methodology. The main exception to this is if new buildings in South & Vale source cement locally; if this happens there will be a more direct link between embodied carbon and South & Vale's direct emissions (Scope 1). However, even if not sourcing from within South & Vale, a significant portion of the embodied carbon will appear in the UK's carbon account. Planning policy should therefore encourage reductions in this.

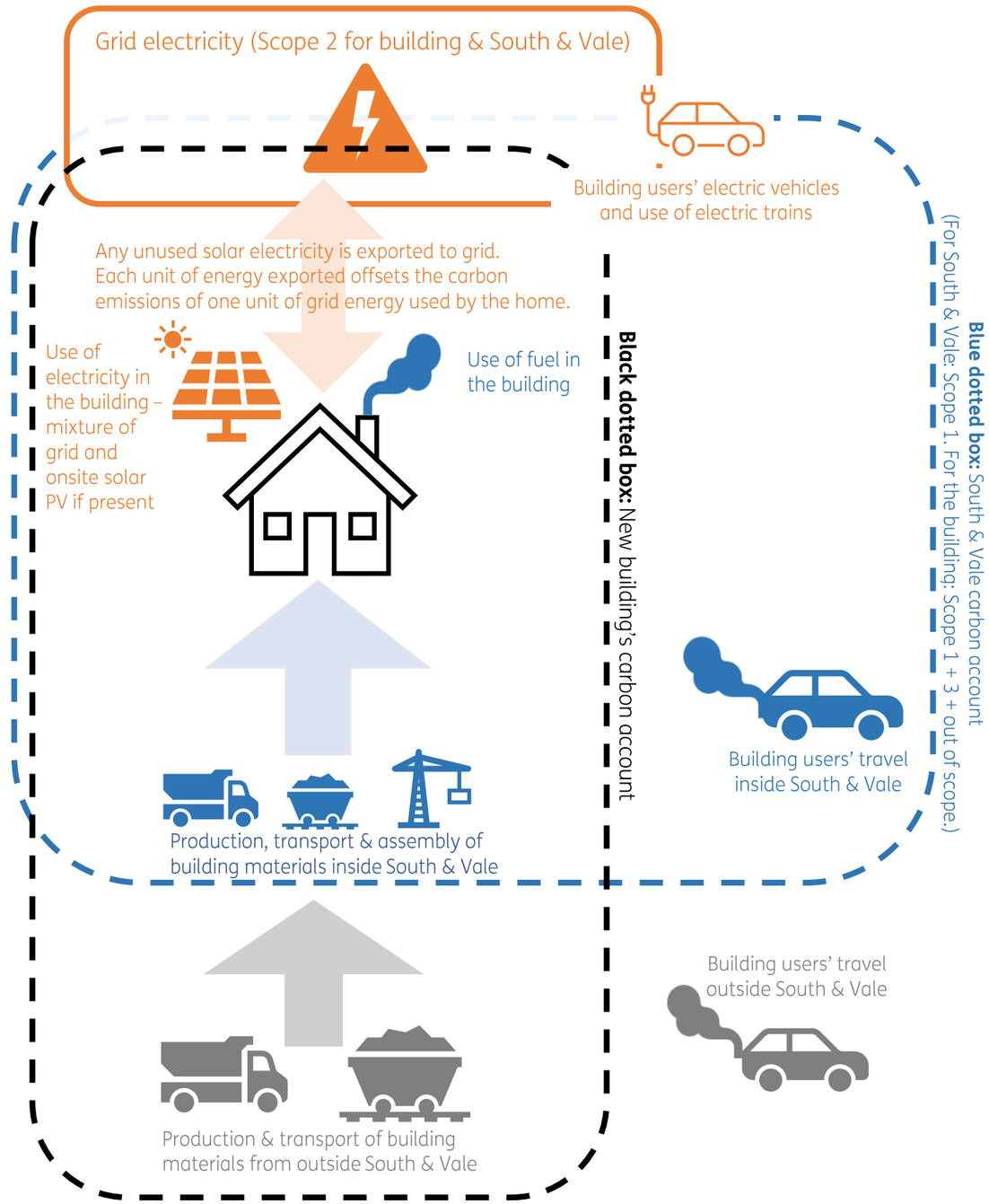


Figure 15: Diagram of how different sources of emissions (that could or will result from new development) would appear in the carbon account for the building itself or the local plan area, affecting whether the building or area is 'net zero carbon'.

*Items that fall within or overlap with the **blue box** will appear in the local area's carbon account. Items that fall within or overlap with the **black box** make up the carbon account of the building itself. The **orange box** will appear in both accounts.*

‘Net zero carbon building’ definition in national building regulations and planning

Building Regulations Part L is the legal tool that controls buildings’ energy and carbon emissions. Most definitions of ‘net zero carbon buildings’ in local and government policy are based on Part L and the associated calculation methods.

Building Regulations Part L looks only at *operational* energy and carbon (and does not even address the entirety of this, as explained below). There is currently no regulatory method to consider *embodied* carbon, nor to hold new development responsible for carbon emitted by new occupants’ transport.

Part L only controls the ‘fixed’ energy uses of a building: space heating/ cooling, hot water, fixed lighting, ventilation, fans, pumps. It ignores plugin appliances, lifts, escalators, and so on (‘unregulated energy’). This means a ‘zero carbon’ building using Part L is not truly zero carbon.

To legally comply with Part L, a proposed development must use an energy and carbon calculation named the Standard Assessment Procedure (SAP, for homes) or the Simplified Buildings Energy Model (SBEM, for non-residential buildings). These calculations are submitted to building control.

SAP and SBEM set limits on the amount of energy a building uses per square metre per year, and the amount of carbon emissions that associated with the building’s energy use. These are the Target Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE). The TFEE relates only to energy used for heating and cooling. The TER is the carbon emissions associated with all ‘regulated’ energy uses.

These limits are set by modelling a ‘notional building’ of the same size and shape as the proposed building, with a range of basic energy saving measures applied (insulation, glazing, air tightness, lighting efficiency, heating system efficiency and so on). Part L defines what these measures are. The proposed building must be designed so that it uses no more energy nor emits more carbon than the ‘notional building’ would. This means the targets vary between buildings, as heat losses are affected not only by the fabric but also the size and shape (more external surface and joins = more heat loss).

Part L is updated periodically, but not often: the previous version was in place from 2013 to 2022. A new version “Part L 2021” was implemented from June 2022, and a further version is expected to arrive in 2025 (the Future Homes Standard). These uplifts come with changes to the ‘notional building’[xviii]. For Part L 2021, this has some small improvements to fabric (insulation/glazing) and solar panels applied to the roof, but it still has a gas boiler. Together these make the target emission rate about 31% lower than it was in Part L 2013. In Part L 2025 the notional building has a heat pump and much better fabric, but no solar panels. Together these measures will make the target emission rate about 75% lower in 2025 than in 2013 (or about 64% lower than it is with Part L 2022).

SAP and SBEM methods are also periodically updated to reflect changes in the carbon emissions of grid electricity, and the efficiency of various appliances or fittings such as boilers and hot water taps. Nevertheless, it is widely acknowledged that these methods are poor at predicting actual energy use (discussed overleaf) and their periodic updates tend to lag far behind the real-world changes to electricity grid carbon or changes to the efficiency of different heating technologies.

The Government’s consultation on the Future Homes Standard noted that their intent is that the Part L 2025 target emission rate will be low enough that new homes would not use a gas boiler. The 75% reduction on Part L 2013 would be essentially impossible to achieve in a home that has a gas boiler, which is likely to prompt the use of heat pumps in most homes, although some may be able to reach that emissions target using direct electric heating combined with extensive solar panels.

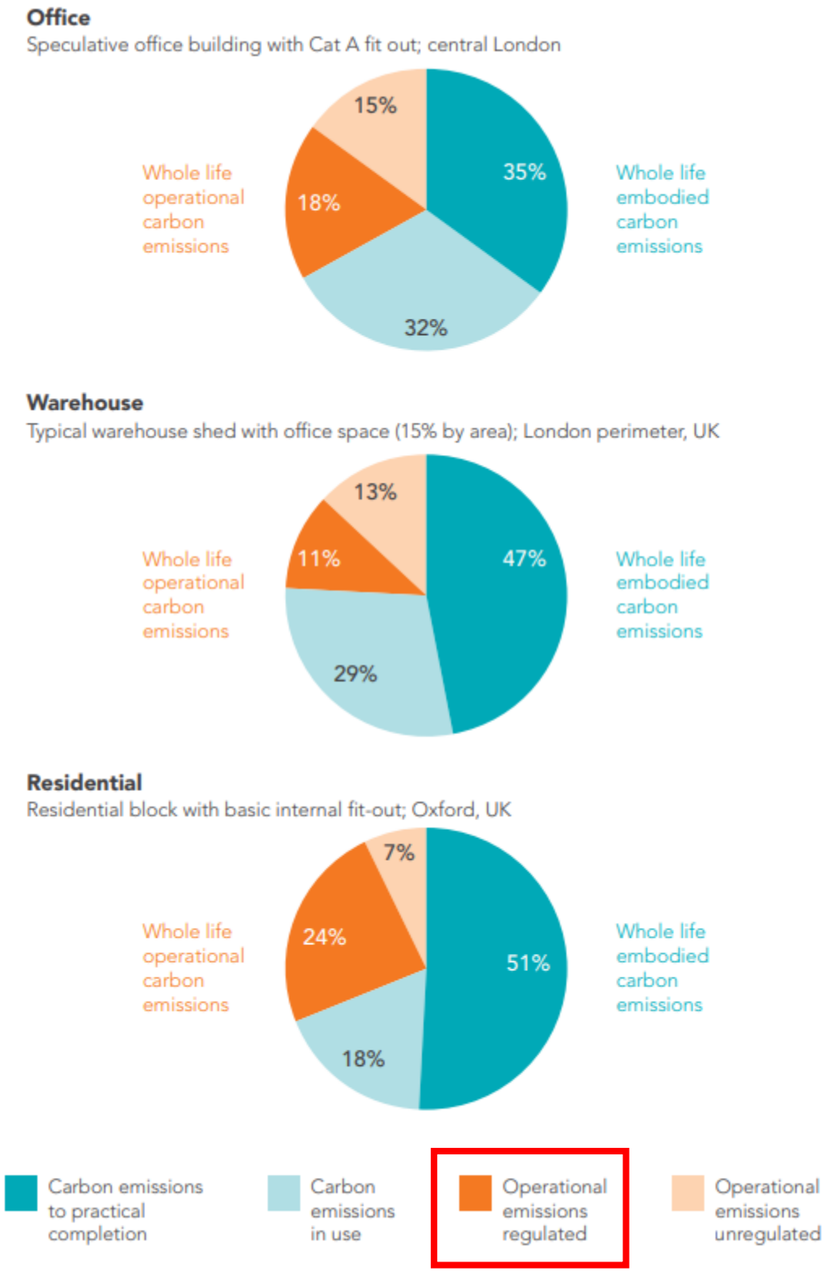


Figure 16: Diagram showing a breakdown of whole-life carbon emissions for three building types. Part L (Building Regulations) only looks at the bright orange segments - and even then quite inaccurately. Source: UKGBC.

‘Net zero carbon building’ – alternative definitions in the construction sector

Green construction experts have recently been developing new approaches to remedy the shortcomings of the national building regulations, SAP and SBEM in defining and delivering net zero carbon buildings. The main weaknesses in Building Regulations identified by the sector are:

- Failure to account for ‘unregulated energy’ – plugin appliances, lifts, escalators, and any other uses not covered by building regulations – which can be 50% of total operational energy use[xix]
- Poor accuracy at predicting buildings’ actual energy use using SAP and SBEM methods (the ‘energy performance gap’), often incorrect by a factor of 200-300%
- Frequently outdated carbon emissions factors for energy, especially electricity
- Failure to sufficiently incentivise energy-efficient building design, due to relatively weak standards for airtightness and not setting absolute targets in kWh/m^2 that all buildings of a certain type must achieve.
- Failure to address embodied carbon (the carbon that was emitted to produce building materials, transport them to site, and assemble them into a finished building).

For all of the reasons above, a ‘net zero carbon building’ calculated by Part L SAP or SBEM will in fact be very far from being carbon-free in operation[xx], before even considering its embodied carbon impacts.

The industry has therefore begun to collaboratively develop new definitions that address not only the end result of net zero carbon, but also inform the design and energy procurement measures that should sensibly be used to achieve it, such as energy efficiency targets and embodied carbon targets.

UK Green Building Council (UKGBC) Framework Definition of Net Zero Carbon, 2019

The UKGBC definition[xxi] of net zero carbon buildings includes twin tracks: operational and embodied. These twin tracks for net zero carbon buildings can be treated separately. However, buildings seeking ‘net zero carbon construction’ should also aim to fulfil the operational track too.

- Net zero carbon in construction [embodied carbon] is: “When the amount of carbon emission 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.”
- Net zero carbon in operation is: “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.”

UKGBC does not require the building to hit any specific targets for space heating, operational energy use, or embodied carbon , although it encourages reductions to be prioritised before offsetting.

UKGBC’s separate energy procurement guidance[xxii] confirms that off-site renewable energy supply does not have to be via a long-term power purchase agreement[4], but can be a green tariff so long as that it meets certain criteria on ‘additionality’ (so the purchase of the energy brings forward additional renewable energy generation capacity, not just buying up existing renewables present in the grid).The guidance notes that at the time of writing (2021) only three such tariffs existed in the UK. It also notes:

- Fossil fuel must not be the primary energy source for heating, hot water and cooking
- All new build energy systems should be compatible with being renewably powered.

[4] A fixed contract between a renewable energy generator and a customer at a pre-negotiated price. This long-term certainty can unlock finance allowing the generator to install dedicated new capacity for generation.

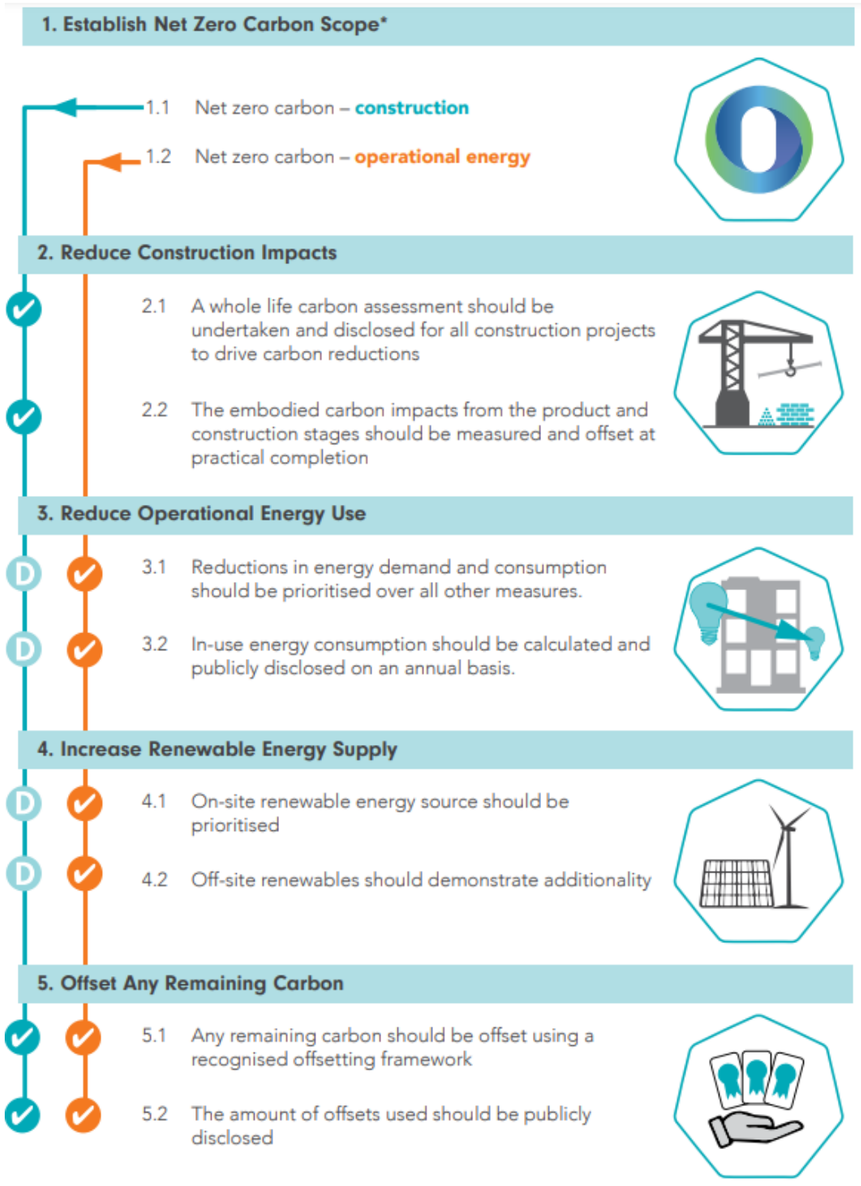


Figure 17: UKGBC Net Zero Carbon Buildings Framework Definition - twin track diagram.

Low Energy Transformation Initiative (LETI) Net Zero Operational Carbon

LETI is a coalition of industry-leading green building experts, architects and surveyors.

Its definition[xxiii] is that the building achieves a zero carbon 'balance' in its energy use across each year. That means that for each unit of energy that the building consumes from the grid, it exports at least one unit of zero-carbon energy produced by the building itself (generally assumed to be through solar panels). Alternatively, the building's energy demands can be entirely met by additional renewable energy supply from off-site.

LETI's definition also requires that the building fulfil the following targets:

- Space heat demand: 15kWh/m_2/year for all building types.
- Total energy use intensity, including unregulated as well as regulated: 35kWh/m_2/year in homes, 65kWh/m_2/year in schools, or 70kWh/m2/year in commercial offices
    - These targets are designed to ensure the use of heat pumps, as these have a ~300% efficiency which translates a 15kWh space heat demand to a 5kWh energy use.
- All space heat and energy demand targets must be fulfilled at the design stage using an accurate predictive energy modelling methodology (not the building regulations methods SAP or SBEM[xxiv]), such as Passivhaus Planning Package (PHPP)[5]
- Heating and hot water not to be generated using fossil fuels
- Onsite renewable energy should be maximised.

These targets – specifically the space heat demand target and fossil-free heating – are in line with the similar targets that apply to the industry certification 'Passivhaus' (although Passivhaus basic certification does not require any level of renewable energy provision or full 'net zero carbon' status). This means the LETI targets are well-aligned to the recommended SCATTER 'high ambition scenario' interventions for the new build sector for South & Vale.

Other sustainable construction frameworks such as the RIBA Climate Challenge[xxv] have adopted similar targets for energy use intensity at similar levels, although not for space heating.

LETI also recommends annual reporting of energy use and renewable energy generation on site for 5 years to verify the net zero carbon status, and that embodied carbon should be separately assessed and reported. It offers separate targets[xxvi] for embodied carbon, but does not expect the embodied carbon to be offset – rather, reduced at source as far as possible.

We note that although UKGBC has not updated its 'framework definition' (discussed in the previous section), it has now endorsed the LETI definition of net zero carbon[xxvii].

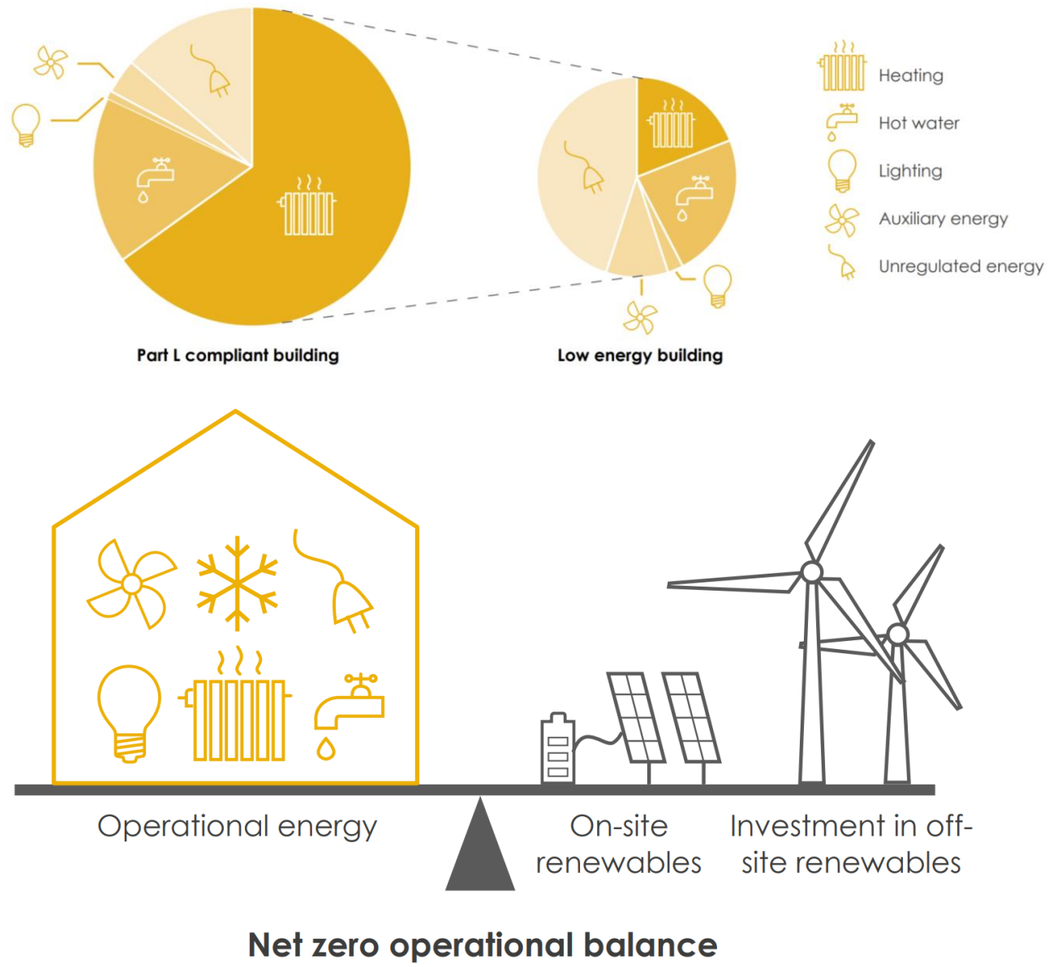


Figure 18: Diagram of LETI net zero operational balance. From LETI Climate Emergency Design Guide.

[5] Please note the Passivhaus Planning Package (PHPP) is a method to model and predict building's energy use. Although it was developed for use in the Passivhaus certification process, there is no obligation to undergo Passivhaus certification – the PHPP tool can be used in any project without pursuing certification.

Why must the South & Vale Local Plan take action towards net zero carbon?

National and international commitments to address climate crisis

The UK is a signatory to the international Paris Agreement 2015, brokered via the United Nations. This commits all signatories to ensure global average temperatures rise is limited to 2˚Celsius on pre-industrial levels, and to pursue a limit of 1.5˚C. This would require very fast and drastic cuts to global carbon emissions, as there is a limited 'carbon budget'[xxviii] to be emitted before the 1.5C and 2C limits will be reached – and a rise of 1 ˚C has already happened. If the 1.5˚C or 2˚C limits are breached, climate change impacts will be devastating worldwide, and the world is currently on track to breach 3˚C by the end of the century[xxix].

The Paris Agreement also commits that the extent of each country's carbon reductions is related to wealth and technological ability. As a rich and technologically advanced country, the UK is responsible for faster and deeper cuts. Given the speed and scale of carbon cuts needed in existing buildings, transport and other energy use, we cannot afford for new buildings to add to the burden.

In 2019 the UK Government declared a climate emergency and updated the legally binding carbon reduction goal for 2050 enshrined in the Climate Change Act 2008. The new goal is to achieve a net zero carbon UK by 2050, rather than the original goal of an 80% reduction on the carbon emissions of 1990. The Act also comes with interim 5-yearly carbon budgets that are devised by the independent Committee on Climate Change (CCC) and then passed into law by Parliament.

The latest five-yearly carbon budgets[xxx] mean that compared to the 1990 baseline, the UK must achieve a 78% reduction by 2035 (this would be roughly equivalent to a 65% reduction compared to current levels, which would require an average drop of about 4.3% a year[6]).

The carbon budgets also show that the sectors of buildings, energy and land transport should all achieve steep and rapid reductions and reach zero or near-zero emissions on their own terms (see *Figure 19*), not relying on offsetting.

The Committee on Climate Change explains that "a little more or a little less may be achieved in any area, or alternative low carbon options could be used, but the overall level of ambition and delivery must match" the proposed carbon budgets.

Given that all sectors face a huge challenge in achieving their own required reductions, this means there is very little room to offset emissions in one sector by reductions or removals in another sector (for example, even highly ambitious levels of tree planting would barely be enough to offset unavoidable emissions from agriculture – see *Figure 20* - therefore the buildings and energy sectors should not rely on tree planting to make up for insufficient reductions in their own energy use and emissions).

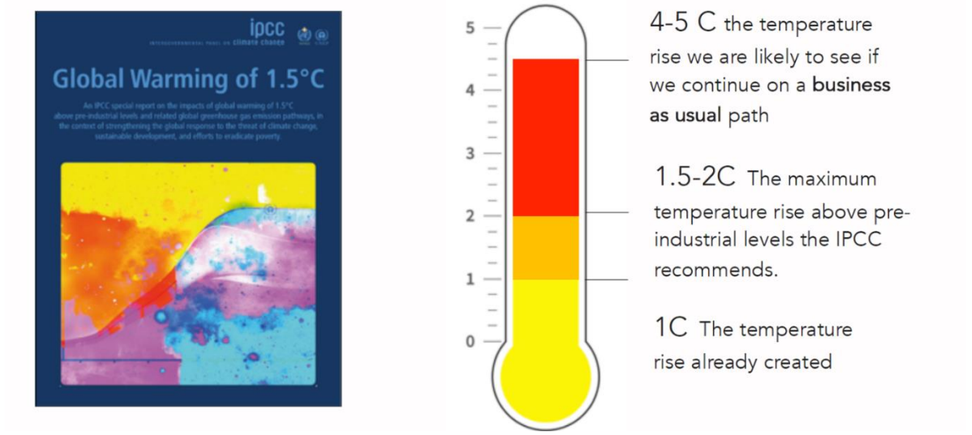


Figure 19: Special Report on 1.5C by IPCC, and diagram of the potential range of climate change to 2100 (Diagram credit: Etude, 2021).

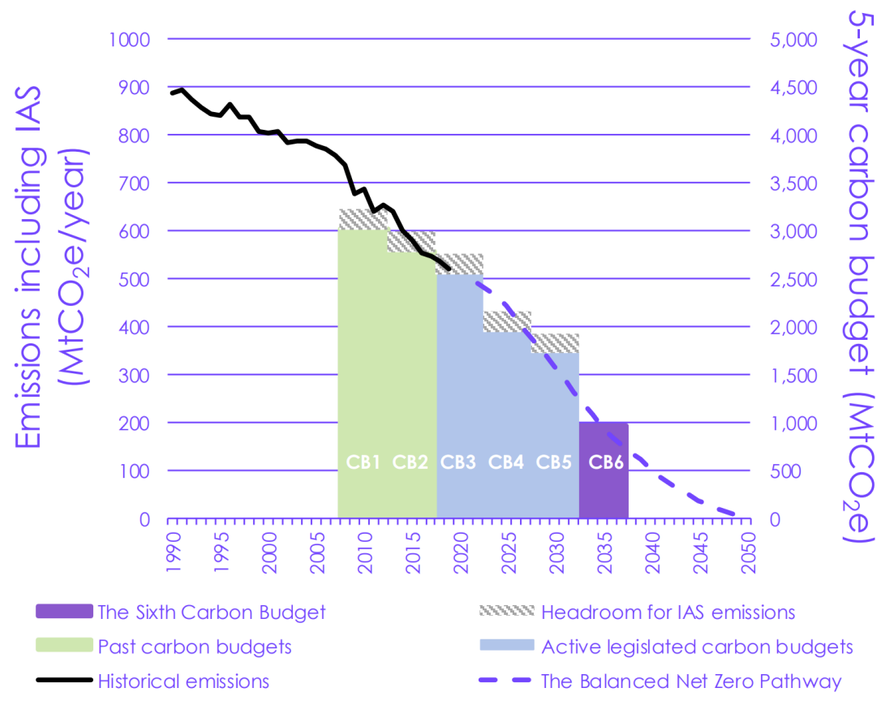


Figure 20: UK legislated carbon budgets under the Climate Change Act. From Committee on Climate Change (2020), The Sixth Carbon Budget: The UK's Path to Net Zero. "IAS" = international aviation & shipping.

[6] For context, the UK's carbon emissions fell by 9.5% in 2020 due to the COVID pandemic but have since rebounded by about half that figure in 2021, while global carbon emissions fell by about 5% in 2020 but have now rebounded to even higher levels than before COVID.

The UK's five-yearly carbon budgets also come with progress reports detailing a combination of actions necessary to stay within the budgets[7]. These include wide-reaching and ambitious changes to buildings (new and existing), the energy system and transport, as well as agriculture/forestry, industry and waste. Most relevant to local planning are:

- No new homes connected to the gas grid from 2025 at the latest[xxxi] (and ideally be zero carbon[xxxii]), instead using low-carbon heat such as heat pumps or gas-free heat networks
- New homes to have a very low space heat demand of only 15-20kWh/m^2/year (a 60-70% reduction on a new home that just complies with current building regulations[xxxiii])
- Accelerate and scale-up rollout of low carbon heat to existing buildings, with 3.3. million heat pumps installed in existing homes by 2030, expansion of low carbon heat networks in the 2020s, and a limited role for hydrogen in the existing gas grid in some locations after 2030
- End the installation of any fossil fuel boilers by 2033 for all existing buildings including homes, commercial and public buildings, unless in hydrogen gas grid areas
- Rapid rollout of insulation and other energy efficiency measures to existing buildings, so that all existing homes for sale from 2028 have EPC rating of C or better, and 15 million homes to receive insulation to their walls, floors or roofs by 2050, to include by 2025:
    - Loft insulations to reach 700,000 per year (from current level of just 27,000/year)
    - Cavity wall insulations to reach 200,000/year (current level: 41,000/year)
    - Solid wall insulations to reach 250,000/year (current level: 11,000/year)
- Construction materials to be used more efficiently and switching to low carbon materials (e.g. timber and low-carbon cement) – although this has only a very small role overall
- Fully decarbonise the electricity grid by 2035, by:
    - Scaling-up renewable electricity to represent 80% of generation by 2050 – primarily wind power but also solar, with much of the wind power being offshore – in step with greater electricity demand as buildings and transport switch away from fossil fuel
    - Add energy storage to the system, including batteries, hydropower, and hydrogen
    - Maintain or restore the existing nuclear power capacity by building new capacity in the 2030s to replace existing plants that are being retired in the 2020s
- Reduction in travel mileage by car, and phase out of new fossil fuel cars and vans from 2032 in favour of fully electric vehicles – and relatedly, decisions on investment in roads should be contingent on analysis justifying how they will contribute to the UK's pathway to net zero and not increase emissions[xxxiv]
- Increase woodland cover to 18% of UK land, up from 13% today, and restore peatlands.

Committee on Climate Change analysis found that the government's policy plans are insufficient to deliver the full suite of necessary actions for the carbon budgets[xxxv]. The 2021 building regulations do not rule out gas (and many buildings granted under the 2021 regime will actually be completed post-2025). The Future Homes Standard (2025) is expected to deliver gas-free new homes, but will not deliver a low enough space heat demand[xxxvi] nor make buildings net zero carbon from first operation, nor include any regulation around low-carbon materials or material efficiency.

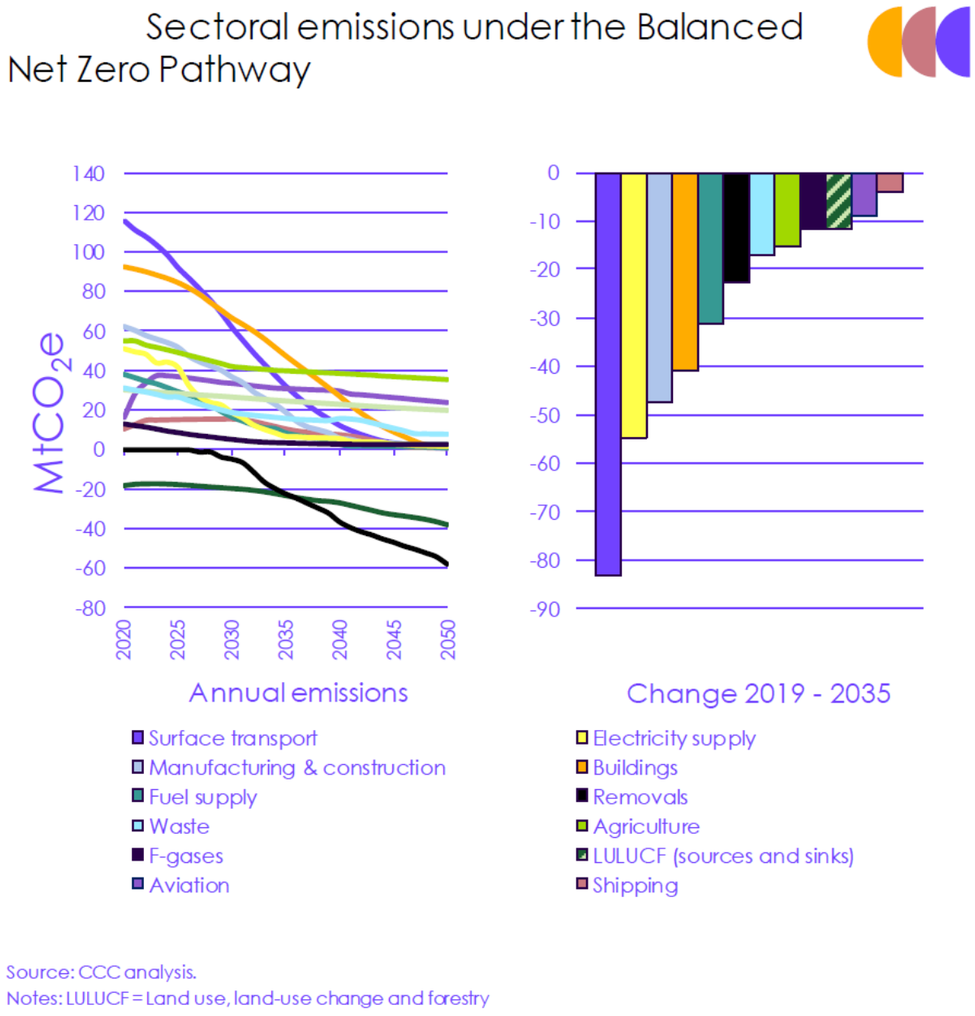


Figure 21: Committee on Climate Change Diagram showing how the carbon emissions of each sector must fall to achieve the 'balanced' pathway towards net zero carbon in 2050 and meet carbon budgets. From Committee on Climate Change (2020), *The Sixth Carbon Budget: The UK's path to net zero*.

[7] It is important to note that the CCC carbon budgets, while challenging, are really the minimum we must do to play our fair role in preventing catastrophic climate change. Other expert analysis of the UK's true 'fair share' of the global carbon budget has found[7] that the carbon budgets should be about half the size of the budgets that the CCC permits. These experts (at the Tyndall Centre) argue that if the UK does not stick to that fair share, it would be failing in its commitment to the Paris Agreement. These experts (at the Tyndall Centre). Beyond the 'fair share' question, the CCC budgets also include future carbon removals through technologies that do not yet exist, and also 'carbon allowances' through emissions trading schemes. Tyndall Centre experts find it wiser to exclude both of these in case the technologies fail to emerge and because the emissions trading schemes are based in economy, not the science of global carbon budgets.

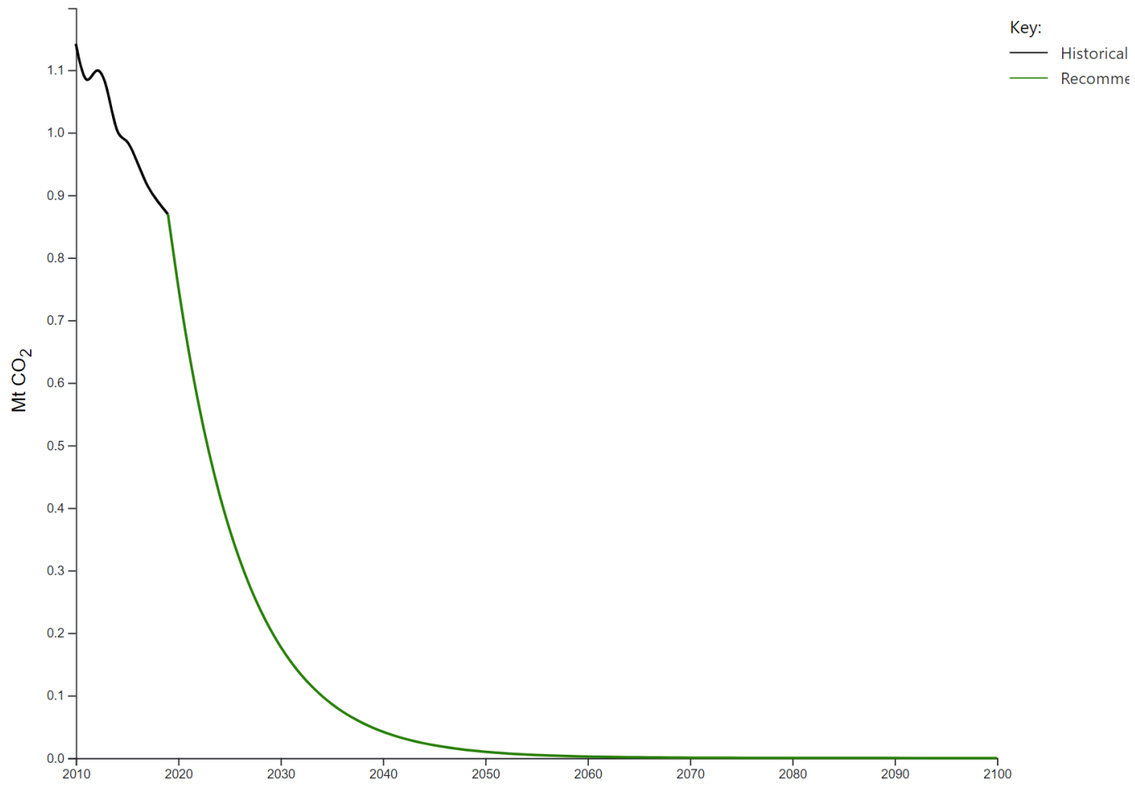


Figure 22: Emissions reduction pathway for energy-only CO_2 emissions to fulfil carbon budgets for South Oxfordshire from 2018 to 2100 compatible with the Paris Agreement. Tyndall Centre (2023).

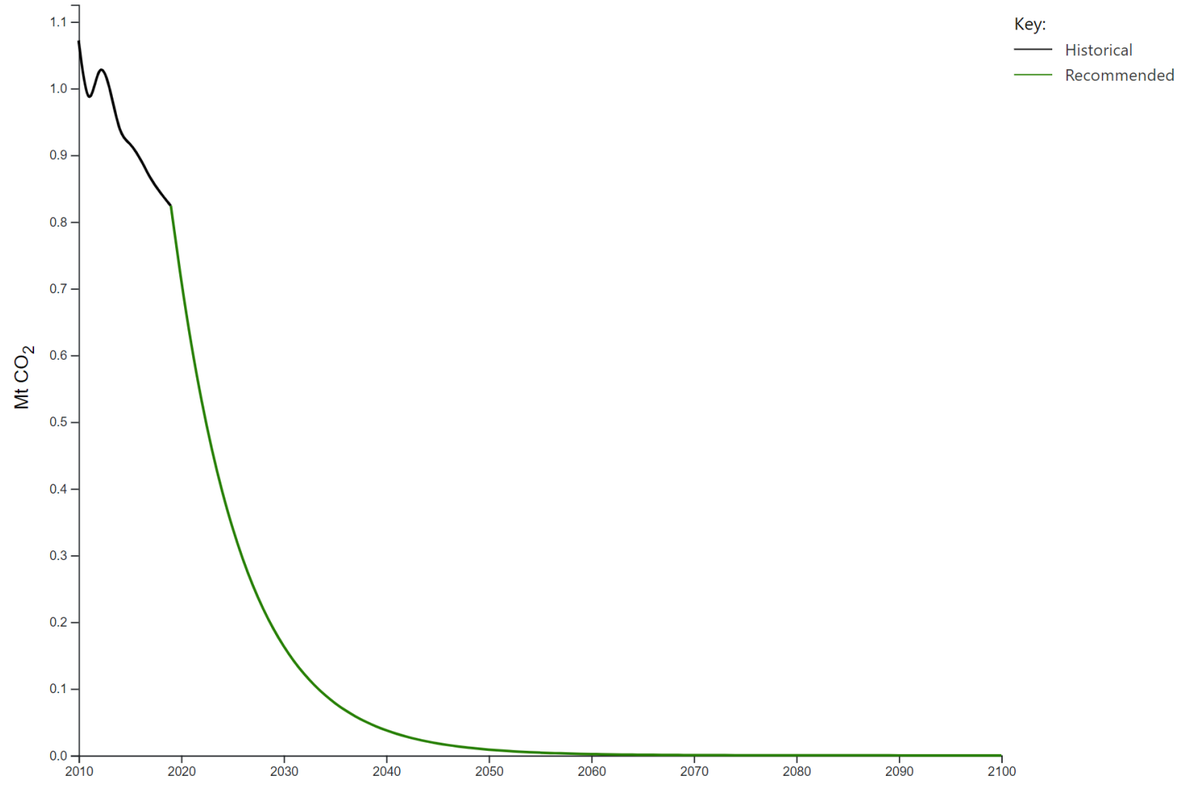


Figure 23: Emissions reduction pathway for energy-only CO_2 emissions to fulfil carbon budgets for Vale of White Horse from 2018 to 2100 compatible with the Paris Agreement. Tyndall Centre (2023).

As the UK's carbon budget should logically represent a share of the global carbon budget, expert analysis by the Tyndall Centre has made an alternative estimation of a fair carbon budget for each UK local authority area to pull their weight towards fulfilling the international Paris Agreement to limit climate change to 2°C. Unlike the national carbon budgets that are legislated through the Climate Change Act 2008, the Tyndall Centre does not presume that carbon removal technology will appear in the future, and they are devised with a more explicit focus on the 'Paris Agreement's equity principle – that is essentially that richer countries make more drastic carbon cuts due to their greater ability and responsibility for the historic emissions already changing the climate. The Tyndall budgets are CO_2-only (no other gases) and energy-only (i.e. no emissions or removals that are not fuel-related e.g. land use). They show only reductions at source, not 'net zero' where emissions are compensated for by removals.

The Tyndall Centre's recommended pathways to net zero within the South Oxfordshire and Vale of White Horse carbon budgets are represented in *Figures 21 and 22, respectively*. To avoid exceeding the Tyndall carbon budget, South Oxfordshire and Vale of White Horse emissions would need to fall as *Figures 21 and 22* show, starting from the 2018 baseline. This pathway amounts to a required annual 13.4% and 13.7% reduction to energy-related CO_2, respectively.

Recognising the global and national urgency of the climate crisis – and in particular the need[xxxvii] to cut global emissions by 2030 – South Oxfordshire has pledged to make the area net zero by 2030, whilst Vale of White Horse aims to reduce emissions by 75% by 2030. (We note that Tyndall budgets do not reflect this –because they are based on what Tyndall Centre finds to be scientifically and ethically justifiable minimum carbon reductions for each area in order to fulfil the UK's international commitment to the Paris Agreement; they are not based on local political commitments).

The challenge of bringing forward net zero carbon new buildings, scaling up retrofit of existing buildings, and decarbonising transport and the wider energy system, will not be possible without the support of the local plan. By shaping what kind of development happens and where, the local plan can help to realise South & Vale's ambitions, especially in transport, buildings and energy.

A local plan that achieves dramatic carbon reductions will help to avoid contributing to the risk of South & Vale's residents being impacted by financial and health-related harms that would come with climate change. The Committee on Climate Change[xxxviii,xxxix] has found (and UK central government has

recognised[xl]) that the changing climate brings risks of harm to the UK population's health, wellbeing and economy in coming decades, all of which could affect South & Vale's citizens. These include:

- Overheating – deaths, health-related productivity losses, additional energy cost for cooling
- Flood – danger to life, health and cost of damage to property and infrastructure
- Drought – perhaps risking the need for expensive solutions to maintain public water supplies
- Future contagious epidemics via disease vectors – ticks are becoming more abundant, and malarial mosquitoes may begin survive in the UK due to warmer winters
- Crop losses or soil damage via droughts, floods, heat and wildfires – impacting jobs in our fragile farming sector, and potentially the availability and affordability of healthy food.

All of the above are in addition to the impact on ecology/wildlife of the UK whereby freshwater ecosystems are already being harmed by over-abstraction of water[xlii], and whereby native UK wildlife may struggle to compete with invasive species that move in as our climate becomes milder.

If the local plan does not take all possible steps within its grasp to achieve rapid and drastic carbon reductions, it would arguably be failing to deliver not just on its carbon reduction duties, but also its duties to protect the natural environment and the wellbeing of its population. The local plan's duties and powers to address carbon are explored next.

National policy expectations and legal duties of the local plan to address carbon reductions in the local area and the UK as a whole

The local plan's role to facilitate dramatic carbon reductions and a net zero carbon future is not only a political choice and a scientific need, but also a legal duty.

This section will explain the key pieces of legislation and national government policy, as well as setting out where in national planning policy and guidance these legal duties are reaffirmed, that impose this duty, providing context for the level of ambitious carbon reduction that the policies should pursue.

Planning and Compulsory Purchase Act 2004

This is the key foundational legislation that enshrines the local plan's duty to act on climate change. Section 19, paragraph 1a, states that:

> "Development plan documents must (taken as a whole) include policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change".

Mitigation of climate change means reduction in the impact of human activity on the climate system[xlii], primarily by reducing the level of greenhouse gas in the atmosphere[xliii],[xliv]. This has two parts: reduction of carbon emissions, and action to increase the sequestration of carbon (removal and storage of carbon by trees, grassland, other green infrastructure, or future technologies).

As outlined previously, if a 2°C global limit is breached, we will hit 'tipping points' where various natural systems will be damaged to the point where they begin to release even more greenhouse gases and result in runaway climate change that may be unmitigable after that point.

Therefore to truly "contribute to the mitigation of climate change", the local plan's policies should facilitate the required carbon budget that would be compatible with staying below a 2°C future. As previously noted, this essentially means there is no room for new development to add to the overall carbon emissions of the UK (given the existing vast challenge of reducing existing emissions). The RTPI and TCPA assert also that "This means that Annual Monitoring Reports should contain assessments of carbon performance against the carbon budget regime set out in the Climate Change Act".

National Planning Policy Framework (NPPF) 2021

This document[xlv] is the framework by which the whole planning system is guided, and by which the soundness of local plans (and planning appeals) is judged by the planning inspectorate. Its following paragraphs reaffirm the duty of local plans (and whole planning system) to mitigate climate change:

- 152: "The planning system should support the transition to a low carbon future … shape places in ways that contribute to radical reductions in greenhouse gas emissions … [and] encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure".
- 153: "Plans should take a proactive approach to mitigating and adapting to climate change … In line with the objectives and provisions of the Climate Change Act 2008".
- 154: "New development should be planned for in ways that … help to reduce greenhouse gas emissions, such as through its location, orientation and design".
- 155: "To help increase the use and supply of renewable and low carbon energy and heat, plans should … provide a positive strategy for energy from these sources … consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development".

To comply with the above imperative for carbon reductions 'in line with the Climate Change Act' would have to mean taking action to achieve the intermediate 5-yearly carbon budgets that the Committee on Climate Change devises and parliament legislates, as well as the eventual net zero goal in 2050.

Planning Practice Guidance (PPG)

The National Planning Practice Guidance is an online resource that adds further context and interpretation to the NPPF. It is separated into a series of topics, including climate change, renewable energy, planning obligations and viability. It makes several points about the duty and expectation for local plans to address carbon reductions.

Its climate change section[xlvi] confirms that:

> "Addressing climate change is one of the core land use planning principles which the National Planning Policy Framework expects to underpin both plan-making and decision-taking. To be found sound, Local Plans will need to reflect this principle and enable the delivery of sustainable development in accordance with the policies in the National Planning Policy Framework. These include the requirements for local authorities to adopt proactive strategies to mitigate and adapt to climate change in line with the … Climate Change Act".

This section reiterates local plans' climate mitigation duty per the Planning & Compulsory Purchase Act 2004, and that plan makers should be aware of the Climate Change Act goal and carbon budgets. The section on renewable and low carbon energy[xlvii] confirms that:

- All communities have a responsibility to help increase the use and supply of green energy, albeit not overriding other environmental protections
- Local planning authorities hold decisions over renewable energy development of 50 megawatts or less, and may soon hold decisions over onshore wind over 50MW[xlviii]. (*Note: As of 2020, energy storage of over 50MW is now the domain of the local planning authority, except pumped hydro[xlix]).

Potential tension with other duties

These carbon reduction duties are often in tension with the local plan's other duties – e.g. to enable economic growth and delivery of government-mandated housing targets. It is often assumed or argued that these other objectives could be inhibited if the carbon reduction provisions are so onerous as to present technical challenges or put at risk the developers' anticipated minimum profit margin of 15-20%. Nevertheless, the NPPF explicitly states that the goal of the planning system is '*sustainable* development' which it defines as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (as per the United Nations definition).

Given that the continued existence of life across much of the Earth is at risk if the planet exceeds 2°C of climate change (as previously discussed) – or at least a good quality of life – there is a strong argument to make that carbon emissions should be treated as the fundamental bottom line for what we can define as 'sustainable' development.

How can the South & Vale Local Plan take action towards achieving net zero carbon?

As previously explained[8], this report's primary focus is to support policy on the carbon emissions of buildings, which are responsible for a large share of local area carbon emissions. Specifically, new builds are the subject of most planning applications and thus the area that local plan policy wording (as opposed to spatial strategy) can most strongly influence. Therefore, this section focuses on the planning powers available to reduce the carbon of buildings, including via their grid energy supply.

The previous section highlighted the key pieces of legislation and national policy that set out the duties local plans hold to address climate change. This section explores many of the same pieces of legislation and policy, but this time sets out how these documents define the powers available to local plans to meet the duty of addressing climate change, as well as the powers available to meet net zero.

The powers afforded to the local plan to set policy requirements towards net zero carbon new buildings flow principally from the Planning and Energy Act 2008. Further direction how these powers can and should be used is given in the National Planning Policy Framework (NPPF) and National Planning Practice Guidance (PPG). Additionally, formal ministerial statements and other official government policies can also affect interpretation of how those powers should be wielded.

Planning and Energy Act 2008

The Planning and Energy Act 2008 grants local plan the power to set "reasonable requirements" for:

- "energy efficiency standards that exceed the energy requirements of building regulations"
- and "a proportion of energy used in development in their area" to be from renewable or low-carbon sources "in the locality of the development".

Policies using these powers "must not be inconsistent with relevant national policies"; that is, those relating to energy from renewable sources, low carbon energy, or furthering energy efficiency.

The Act defines "energy efficiency requirements" as standards that are 'set out or referred to in regulations made by the [Secretary of State]' or 'set out or endorsed in national policies or guidance issued by the [Secretary of State']. This is also repeated in National Planning Policy Framework paragraph 154. The only 'energy efficiency standards' currently clearly set out or endorsed in this way are the energy and carbon calculation methodology used for Part L of the building regulations. Until recently, this was only SAP and SBEM, but the new Part L 2021 for residential also mentions CIBSE TM54 as a suitable method to fulfil the new requirement for energy forecasting. This may be interpreted to mean that energy efficiency requirements must use SAP/SBEM or TM54 calculations. If SAP/SBEM, their scope will be limited to regulated energy only (heating, hot water, fixed lighting, ventilation). If TM54, total energy efficiency could be specified (including unregulated). However, several examples have recently successfully been adopted that use PHPP as well as TM54.

The act does not define 'energy used in their area'. Therefore, it is probable that requirements for renewable energy could cover a proportion of the new building's *entire* energy use, not just the share that is 'regulated' by Part L and calculated using SAP/SBEM.

Most definitions and requirements for 'net zero carbon buildings' in local plans are based on Part L and the associated calculation methods (although some make a separate requirement for renewable energy). This means they are subject to the weaknesses that befall Part L in terms of inaccurate calculations of energy and carbon, and a lack of incentive to create an inherently thermally efficient building shape (see previous section on national and alternative definitions of zero carbon).

Town and Country Planning Act 1990

The key parts of this Act relevant to carbon reductions are:

- Section 106[l], planning obligations – this enables the local plan to require payments for the purpose of making an otherwise unacceptable development into an acceptable one. Section 106 obligations are expected to be reasonable, proportional to the development, necessary to make the development acceptable. This has been used in several example local plans to require carbon offsetting payments from new development.

- Section 61[li] enables the creation of a Local Development Order. This is a legal tool used by local government to achieve specific local plan objectives by permitting certain types of proposal that would otherwise need to go through the planning permission process. These are sometimes used to bring forward renewable energy, or low-carbon heat to existing buildings.

Infrastructure Act 2015

Section 37 of this Act[lii] included provision for the Building Regulations to be amended to require provision for off-site carbon abatement measures. This was in relation to the erstwhile anticipation of the national net zero carbon building standard which was scrapped before coming into force. Nevertheless, this is where the concept of 'allowable solutions' to carbon emissions originated, in terms of allowing buildings to be legally accepted as 'net zero carbon' by delivering measures off-site to reduce carbon emissions or increase carbon sequestration, which could include paying others to perform those measures or purchasing carbon offset certificates through a national scheme.

Although the national net zero carbon buildings plan was scrapped and the government has not yet proceeded to enact the national 'allowable solutions' scheme envisioned by the Act, this is still the concept taken echoed in many subsequent local plans in the form of requirements for carbon offsetting either by payments or by direct delivery of projects that will reduce carbon emissions.

National Planning Policy Framework (2021 update)

This national policy document, updated in 2021[liii], is the framework by which the preparation of local plans is expected to be guided, and by which their soundness is judged by the planning inspectorate. It expresses four key tests of soundness (all of which appear relevant to carbon):

- Plan should be positively prepared (responding to needs; delivering sustainable development)
- Plan should be justified (having considered alternatives and be based on evidence)

[8] Please note that this document focuses mostly on the carbon impact of **buildings**. Beyond this, new development will often also have carbon impacts from the transport induced in the lifestyles of its residents, workers or visitors. This transport carbon would be part of South & Vale's overall carbon emissions – and would therefore need to be reduced to zero in order to hit the national goal of net zero carbon by 2050 (or 2030 for the local target). Nevertheless the transport carbon is not considered part of the carbon that belongs to the building itself, thus it is not part of the definition of 'net zero carbon buildings' for which we now explore the planning powers to regulate. Transport and standalone renewable energy are briefly considered in the section entitled "beyond the building".

- Plan should be effective and deliverable over the plan period
- Plan should be consistent with national policy (again delivering sustainable development and being in accordance with other statements of national planning policy, where relevant).

It also reaffirms the ways in which the local plan (and whole planning system) can mitigate climate change. Beyond the NPPF paragraphs 154-155 in the previous section, the following paragraphs also become relevant to the question of which interventions are considered appropriate by the NPPF:

- **Paragraph 158**: "When determining planning applications for renewable and low carbon development, local planning authorities should not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions".
- **Paragraph 190**: "Plans should set out a positive strategy for the conservation and enjoyment of the historic environment, including heritage assets most at risk through neglect, decay or other threats … taking into account the desirability of sustaining [them] … and putting them to viable uses consistent with their conservation" – This may support a sensitive but permissive approach towards energy retrofit, where this keeps a heritage building fit for long term use.

The NPPF also includes points which could be taken to constrain the extent to which a local plan can require carbon and energy improvements in development, including:

- **Paragraph 154b**: "Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."
- **Paragraph 157a** allows that new development should comply with local requirements for decentralised energy supply unless it is demonstrated to be not feasible or viable.

At present, the relevant 'national technical standards' would largely mean the building regulations Part L uplifts in 2021 and 2025, and perhaps also the electric vehicle charging requirements that are being introduced through the new Part S of building regulations.

National Planning Policy Framework Update Consultation (2022-2023)

The National Planning Policy Framework (NPPF) consultation[liv] ran from 22 December 2022 to 2 March 2023, in the context of the Levelling Up and Regeneration Bill, to primarily seek views on proposed changes to the NPPF and the approach to preparing 'National Development Management Policies' (a completely new element in the planning system, which forms one of the proposals laid out in the Levelling Up & Regeneration Bill - see summary later in this document). The key points from the 2022-23 NPPF consultation relate to:

1. Onshore wind development

A positive amendment to text relating to the repowering of onshore wind states that LPAs should approve applications for the repowering and life-extension of existing renewables sites. This is however arguably the only helpful change on this topic, primarily because footnote 63 continues to take a negative stance to onshore wind development by treating it differently to other types of energy development. As per the current NPPF, this draft NPPF continues the uniquely negative treatment of onshore wind in that its acceptability depends on demonstrating through consultation that it has 'community support', and prior identification of suitable areas in the local plan or in an SPD. A lack of clarity remains over what constitutes sufficient 'community support'. For the purpose of enabling local plans to fulfil their legal duty to mitigate climate change, it could be argued that footnote 63 should be removed to relax barriers experienced by onshore wind development and so that the technology has equal opportunities for growth. Alongside the climate imperative there is also a socioeconomic argument for this especially in context of the recent energy price volatility, given that onshore wind is one of the cheapest forms of energy generation[lv].

Other changes to footnotes 62 and 63 propose that onshore wind applications could be granted permission through Local Development Orders, Neighbourhood Development Order and Community Right to Build Orders. Additionally, it is suggested that supplementary planning documents could be used as a resource to identify suitable sites for onshore wind, instead of through a development plan.

2. Replacement of Supplementary Planning Documents

The proposed reforms to the planning system would replace supplementary planning documents (SPDs) with Supplementary Plans; existing SPDs would expire after a new-style plan has been adopted. The replacement of SPDs is a concern for local authorities as they provide valuable supplementary information on parent policies and guidance on how to achieve them. SPDs enable a deeper explanation and description of policy wording within Local Plans, which can strengthen an overall policy approach towards improved delivery. The expiration of existing SPDs will increase plan-making complexity and place resourcing constraints on local authorities, particularly as proposed Supplementary Plans will be subject to an additional process of examination.

3. Increased weight given to energy efficiency improvements in existing buildings

The insertion of paragraph 161 is a positive move, since it emphasises the importance of that retrofitting existing buildings, which is a key necessary step towards staying within the bounds of the 6th carbon budget. Conservation areas and listed buildings will still be treated more cautiously however, due to the sensitive relationship between heritage and carbon-reducing alterations.

4. The removal of the need for justification to be demonstrated in plan making

A fundamental amendment to the NPPF, the potential removal of the need for policy justification, has created concern among those working in planning. The current requirement that plans must be justified is currently one of key four tests that must be demonstrated for a plan to be found sound.

The removal of the test could adversely impact the quality of housing delivery, particularly in sustainable places, because allocations will not necessarily need to be justified. If plans no longer must be justified, it has been recommended by the Town and County Planning Association that the test should, as a minimum, be replaced with a requirement for a robust evidence base and demonstrate that various policy options have been considered. However, the recent Levelling Up & Regeneration Bill consultation indicates that this requirement for evidence will not be entirely removed. Further information on this is expected in coming months but a lack of clarity on this decision remains.

5. Insufficient reference to the 2008 Climate Act

In the context of climate change, a significant gap remains in the changes to the NPPF text, which is that there is insufficient reference to the legally-binding 2008 Climate Act and subsequent carbon budgets and the exact role that local plans can and must play towards achievement of those legally binding reductions. Without a clear direction set by the Act, policy informed by the NPPF will not necessarily be measurable against the UK 2050 net zero target.

Nevertheless, the draft NPPF update still retains the existing paragraph that confirms that plans' climate mitigation and adaptation should be "in line with the objectives and provisions of the Climate

Change Act 2008", therefore the carbon budgets passed under the aegis of that Act should still form a good logical basis for development of local plan policy that brings forward the actions necessary to fulfil them. However, this argument may be weakened in concert with the proposed removal of 'justification' as a test of soundness – given that such policies are argued to be justified by evidence showing that they are necessary to fulfil the carbon budgets.

National Planning Policy Framework Partial Update (2023)

A partially updated NPPF was published in September 2023, primarily to reflect desired changes to onshore wind development. Other elements outlined above relating to the NPPF consultation have not yet been updated or clarified.

The changes amend paragraphs 155 – 158, with the most notable change being that the impacts of onshore wind development must now be 'appropriately' addressed, replacing previous wording that required impacts to be 'fully' addressed. Another change is that SPDs can be used as a resource to identify suitable sites for wind development, although it is currently unclear whether the wider role of SPDs will be sustained in future NPPF iterations. These minimal changes offer a slight relaxation for onshore wind development, but are insufficient to allow onshore wind development to come forward with equal ease as other energy technologies.

Planning Practice Guidance (PPG)

The PPG section on Climate Change[lvi] reiterates several powers relevant to carbon, and also constraints on how those should be exercised. It highlights several opportunities including:

- Reducing the need for travel and providing sustainable transport
- Providing opportunities for renewable and low carbon energy and decentralised energy
- Promoting low-carbon design approaches to reduce energy consumption in new buildings.

It confirms that appropriate mitigation measures in plan-making can be identified by:

- Using available information on the local area's carbon emissions [such as BEIS subnational carbon inventories referenced elsewhere in this appendix]
- Evaluating future emissions from different emissions sources, taking into account probable trends set in national legislation, and a range of development scenarios
- Testing the carbon impact of different spatial options, as emissions will be affected by the distribution and design of new development and each site's potential to be serviced by sustainable transport
- Noting that different sectors have different opportunities for carbon reductions, noting that "In more energy intensive sectors, energy efficiency and generation of renewable energy can make a significant contribution to emissions reduction".

For existing buildings, the PPG notes that many carbon-reducing measures may not require planning permission, but for those that do, "local planning authorities should ensure any advice to developers is co-ordinated to ensure consistency between energy, design and heritage matters."

It reiterates the Planning & Energy Act powers that the local plan can require developments' energy/carbon performance to be higher than those of national building regulations to an extent:

- For homes: up to the equivalent of Level 4 of the Code for Sustainable Homes
    - [We note that this limit should no longer apply, as it has been exceeded by several adopted example local plans and national building regulations Part L 2021, whereas that part of the PPG citing the Code was last updated in March 2019.]
- For non-residential buildings, the plan is not restricted or limited in setting energy performance standards above the building regulations.
- Requirements for new buildings' sustainability are expected to be set in a way consistent with the government's zero carbon buildings policy … adopt nationally described standards … and be … based on robust and credible evidence and pay careful attention to viability".

The PPG section on renewable and low carbon energy confirms that:

- Local planning authorities hold decisions on renewable energy development of ≤50MW [From 2016, onshore wind over 50MW is also now a local planning decision[lvii]]
- Neighbourhood Development Orders and Community Right to Build Orders can be used to grant planning permission for renewable energy development.
- There are no concrete rules about how to identify suitable areas for renewable energy, but should consider the requirements of the technology and cumulative environmental impacts, and could use tools such as landscape character assessment to inform this.
- Identifying suitable areas gives greater certainty to where renewable energy will be permitted – and wind turbine development should only be approved in such identified suitable areas.

The PPG section on viability confirms that:

- Plans should set out the contributions expected from a new development, including for infrastructure, informed by evidence of need and viability-tested alongside other policies.
- The role of viability assessment is mainly at plan-making stage, and should not compromise sustainable development but should ensure that policies are realistic and deliverable.
- Once the plan is made, the price paid for land is not considered a valid reason for failing to comply with the relevant policies of that adopted plan.

The PPG section on planning obligations[lviii] (such as Section 106 payments) notes that:

- The previous restriction on pooling more than 5 planning obligations towards a single piece of infrastructure has been removed – so LPAs can now pool as many S106 or CIL as they wish, subject to meeting the other tests (necessity, scale and direct relation to development).
- The Community Infrastructure Levy "is the most appropriate mechanism for capturing developer contributions from small developments".
- Planning obligations should not be sought for development that consists only of residential extensions/annexes.

Other government outputs that relate to how local plans can wield powers

Written Ministerial Statement, 2015

In 2015, national government announced that it would update building regulations to deliver the same reduction in on-site carbon emissions that the withdrawn Code for Sustainable Homes Level 4 would have delivered (a 19% reduction on the emissions rate set by Part L 2013). It stated that when those changes were made, it would also remove local plans' Energy and Planning Act powers to require higher energy standards. It stated that in the meantime, local plans should not require more than that 19% reduction, and nor any other higher standards in construction, layouts or performance. It should however be noted that this was framed as *expectation* and not a *requirement*. Additionally the WMS only applied to existing policies and did not include emerging policies in the restrictive text.

This, along with the tension between the duties for carbon and viability/housing delivery, has caused many local plans to adopt 'zero/low-carbon' policies that stop far short of requiring new development to achieve a truly neutral climate impact to the extent that would have been technically feasible.

However, these changes to building regulations and the Energy and Planning Act were in fact never implemented. As a result, the 2015 statement appears to carry limited weight with the planning inspectorate, given that there has been successful adoption of several local plans that go well beyond the supposed limit of a 19% reduction on Part L 2013 (London 35%; Reading 35%; Milton Keynes 39%; South Oxfordshire [DES10] 40%). The London Plan (among others) also requires achievement of other standards relating to 'construction, internal layout or performance' such as the Home Quality Mark or BREEAM, also contrary to the 2015 ministerial statement. Bath & North East Somerset Council, Cornwall Council and Central Lincolnshire Council received positive Inspector's reports and have recently adopted ground-breaking new housing policies that require an on-site net zero energy balance and specific absolute targets for energy efficiency. The Inspector's reports from the relevant examinations explicitly addressed the status of the 2015 WMS and subsequently found it to be no longer relevant. Additionally, a letter received by B&NES from the UK government reaffirmed the ability of local authorities to exceed Building Regulations standards. These policies were supported by evidence bases showing how these improvements were technically feasible and financially viable. Subsequently, developers in these locations have for many years proven able to consistently comply with these higher standards.

We note that the 'interim uplift' to Part L of building regulations in force since June 2022 (see 'Future Homes Standard consultation response') makes the 2015 Ministerial Statement obsolete, because the new Part L already delivers a carbon saving greater than the supposed 19% limit. Relatedly, a recent planning inspectorate appeal decision expressed the view that the 2015 Ministerial Statement is no longer the most relevant expression of national policy, as the Future Homes Standard and Climate Change Act net zero carbon goal are now quite clearly more relevant. Similar views appeared in the Inspectors' reports on several recent successfully adopted plans that go much further than the WMS2015 supposed limit, detailed later in this document (Cornwall, B&NES, Central Lincolnshire).

'Planning For the Future' White Paper 2020

In 2020 the government publicly consulted on a white paper proposing changes to the planning system. This contained various intents relevant to energy and carbon policy for buildings, including:

- **Easier planning permission for energy efficiency and renewable energy measures in existing buildings:** The government commits to update the planning framework for listed buildings and conservation areas to better enable "sympathetic changes to support their continued use and address climate change" because "We particularly want to see more historical buildings have the right energy efficiency measures to support our zero carbon objectives"
- **Different role for local planning authorities in carbon reductions, when the Future Homes Standard is in force**: The government intends that the FHS from 2025 will a 75-80% reduction in homes' (regulated) carbon emissions compared to the Part L 2013 rate, and will deliver homes that reach zero carbon when the electricity grid decarbonises, without further retrofit. Also from 2025, local planning authorities may be expected to "focus more fully on [monitoring and] enforcement" of the national standard, rather than setting different local standards.

Future Homes Standard Consultation Response, 2021

This document is the government's response to public consultation on the new Future Homes Standard, which will update building regulations in 2025 with tighter standards in energy and carbon. The document also lays out an 'interim uplift' titled Part L 2021, which is now in force as of June 2022.

The government had asked whether it should now enact the changes to Planning and Energy Act that would remove local planning authorities' power to require higher standards of energy efficiency and renewable energy, as per the 2015 Written Ministerial Statement. 86% of responses said no. The government's response confirms that "in the immediate term" it will not enact those changes and that local plans thus retain their existing powers. It notes the previous "expectation" set by the 2015 Ministerial Statement (that local plans enforce no more than 19% carbon reduction on Part L 2013), but does not say that this limit still applies, and recognises that many local plans exceed this limit.

The response document also lays out an indicative specification for the 'notional building' for the 2021 & 2025 Part L. This is the imaginary building which includes a range of energy efficiency and renewable energy measures, whose carbon emissions rate the proposed building must not exceed. It includes several new measures that were not in the 2013 notional building (see table below). It was later confirmed that the document forms a piece of official government policy.

Part L Interim uplift 2021 (changes vs 2013)	Part L Future Homes Standard 2025
Minor improvements to roof, windows, doors	Major improvements to walls, roof, floors, windows, doors
Solar PV panel m^2 equal to 40% of ground floor	Low carbon heat pump
Wastewater heat recovery system	Solar panels and wastewater heat recovery are not part of notional building spec
Still has gas boiler as basic assumption	
Result: 31% reduced target emissions rate compared to 2013	Result: 75% reduced target emissions rate compared to 2013 (low enough to rule out gas boilers)

Levelling Up & Regeneration Bill (2023)

The Bill has passed through the House of Commons and, as of 20 February 2023, has reached the Committee stage in the House of Lords. It will affect the planning system in a variety of ways, the most relevant of which for carbon are:

- **Section 106 & Community Infrastructure Levy to be largely replaced** by an 'Infrastructure Levy' set in relation to development value, not floor space. However, specifically Section 106 appears to not be entirely scrapped although its role is scaled back to limited applications[lix]. This may alter the ability to use Section 106 powers to collect carbon offset payments from developers. The charging schedule for the new Levy would still be set by the local authority. An infrastructure delivery strategy must outline how it will be spent. The new Levy may become applicable to permitted development as well as full plans[lx].

- **New 'national development management policies'** with which local plan policies must not be inconsistent. The Bill's wording appears to grant the Secretary of State the right to decide whatever they will cover, with or without consultation. The consultation document suggests that a national development policy for carbon measurement and reduction could be set, yet this is unlikely to affect the ability of LPAs to set their own standards on carbon reduction and energy efficiency in new buildings.

- **A new 'Environmental Outcomes Report'** to replace the existing system of Sustainability Appraisals, Strategic Environment Assessments and EU Environmental Impact Assessment. The outcome topics are yet to be clarified but may conceivably include carbon.

How have existing and emerging local plans used those powers?

Local existing policy context

South Oxfordshire District Council adopted its Local Plan 2035 in December 2020, throughout which climate change has been addressed, as detailed in its Appendix 16.

The existing local plan contains two policies that directly seek to reduce carbon emissions (Chapter 8 – Built Environment):

- DES8: Promoting Sustainable Design
- DES10: Carbon Reduction.

Policy DES10 sets out the following requirement:

- New build dwelling houses and non-residential buildings to achieve a percentage reduction in carbon emissions compared to a 2013 Building Regulations compliant base case.
- For homes, this policy sets an initial required reduction of 40% (equivalent to a 9% and 13% reduction, for residential and non-residential building respectively, over current Building Regulations (Part L 2021).
    - From 31 March 2026, the policy increases this required reduction to at least a 50% reduction in carbon emissions (compared to Part L 2013 – thereby falling behind the Future Homes Standard 2025 which will be a 75% reduction),
        - From 2030 the policy's requirement rises again, to a 100% reduction in carbon emissions (zero carbon).
- Similar requirements are provided for all other major non-residential development. This is in addition to requiring all non-residential proposals to meet the BREEAM excellent standard.

It is anticipated that the South & Vale Joint Local Plan will be adopted before the March 2026 uplift, therefore the 2026 and 2030 uplifts expressed within DES10 will not be made. The emerging new policy of the new Joint Local Plan will however exceed the future planned uplifts laid out by DES10.

Policy DES8 requires:

- All new development to seek to minimise carbon and energy impacts of their design and construction.
- Proposals need to demonstrate that they are seeking to limit greenhouse emissions through location, building orientation, design, landscape and planting.

Climate change is repeated and incorporated into other areas of the 2035 Plan. Appendix 16 of the Plan sets out how other policies in the plan also help to address climate change.

Vale of White Horse District's Local Plan, Part 1 adopted in 2016 and Part 2 adopted in 2019, sets two policies on climate change:

- Core Policy 37: Design and Local Distinctiveness
- Core Policy 41: Renewable Energy (excluding wind energy)

Core Policy 37 is similar to South Oxfordshire's DES8, and requires that new development proposals will be of high-quality design that 'is sustainable and resilient to climate change by taking into account landform, layout, building orientation, massing and landscaping to minimise energy consumption and mitigate water run-off and flood risks'.

Core Policy 41: Renewable Energy (excluding wind energy), encourages schemes for renewable and low carbon energy generation, stating that applications for these schemes will be supported provided they do not cause significantly adverse effects on the environment, amenity and safety.

To conclude the local policy context review: There is no specific carbon reduction policy set for Vale of White Horse, no benchmarks by which 'sustainable and resilient to climate change' can be measured, therefore no metrics to demonstrate its effectiveness in fulfilling the climate mitigation duties described at the start of this subsection.

Meanwhile, South Oxfordshire's Policy DES10 is now viewed as outdated given the previous analysis (in this report) of the shortcomings of Building Regulations Part L metrics, and in light of more recent adopted policy examples from elsewhere, explored in the next section.

Therefore, there is a clear need for a new suite of climate change policies to be introduced for the South & Vale Joint Local Plan in light of the (previously described) most recent available information on the actions needed to mitigate the climate crisis in line with the Climate Change Act.

Existing South & Vale policies represent the starting point for policy improvements to be made and pursue best practice approaches that other local authorities have achieved. We explore a range of examples throughout the rest of this section.

Reductions on the building regulations baseline carbon emissions

Using powers granted by the Planning and Energy Act, most local plans lay out their 'low carbon' or 'net zero carbon' policy requirements in terms of a percentage reduction on the Target Emission Rate set by the previous version of Part L of Building Regulations (Part L 2013) as Part L 2021 is recent and not used as the baseline in most existing local plans.

This percentage reduction in on-site carbon emissions usually ranges from 19% to 40%. Some local plans also require the remaining Part L carbon emissions to be offset at a fixed cost per tonne, payable by the developer through a Section 106 payment, to be spent on local projects for carbon reductions.

Older example plans have sought a 19% reduction, because this reflected the national Code for Sustainable Homes which was previously seen as best practice – and because of a 2015 Written Ministerial Statement previously mentioned, which was taken to mean that 19% was the limit.

Later, requirements for higher percentage improvements in Part L carbon emissions were pioneered by the London Plan, justified by evidence assembled by the GLA and its consultants to show that new developments in preceding years had already been typically achieving 30 to 40% reductions[lxi]. Several other adopted local plans (including South Oxfordshire) have similarly adopted similar requirements (see examples box).

As of 2022, the building regulations Part L has been updated, resulting in a ~31% reduction in the carbon emissions rate compared to Part L 2013. And from 2025, it will be updated again to a 75% reduction. It is important to note that these reduction values exceed the 19% reduction limit referred to in the 2015 WMS, which clarifies the invalidity of the statement.

Requirement to demonstrate implementation of the energy hierarchy

Some local plans divide their carbon and energy requirements into several steps prioritising the most effective and long-lasting carbon reduction measures first. This follows **the energy hierarchy**, generally accepted best practice across the building design sector.

The logic is that if energy demand is minimised first, this reduces not only the burden that the new building places on our limited energy resources in operation, but also the amount of new equipment needed to generate and distribute energy to meet that demand. This reduces the materials, carbon and cost involved in producing and installing that equipment (and lowers energy bills).

The energy hierarchy is as follows:

1. Reduce energy demand (also known as 'be lean')
2. Supply energy efficiently (also known as 'be clean')
3. Supply renewable energy (also known as 'be green').

A policy requiring minimum improvements in each stage of the energy hierarchy makes the developer demonstrate that they have applied the hierarchy before resorting to offsets to reach zero carbon. Local plans usually express this as a requirement for the developer to show that they have made a minimum % improvement in the building's carbon emissions rate by measures taken at each stage. Policy compliance is demonstrated in an energy statement submitted with the planning application.

Example local plans requiring percentage reduction on regulated carbon emissions compared to Part L 2013

South Oxfordshire Plan 2020, Policy DES10: 40% (equivalent to 9% over Part L 2021) reduction on site, rising to 50% in 2026, rising to zero regulated carbon from 2030.

London Plan 2016, Policy 5.2: 35% reduction on site via the use of the energy hierarchy (expressed at the time as 40% reduction on previous Part L 2010) in both homes and non-residential. To rise to zero carbon for homes from 2016 and other buildings from 2019.

Reading Local Plan 2019, Policy H5: 35% reduction on site and offset the rest to zero (major developments). All other new build housing to achieve 19% reduction on site.

New London Plan 2021: 35% on-site emissions reduction, followed by carbon offset payment for the remainder of Part L regulated emissions.

Bath & North East Somerset Local Plan Partial Update 2023: 100% reduction to be met following a fabric-first energy hierarchy (major non-residential). Any residual on-site emissions to be offset.

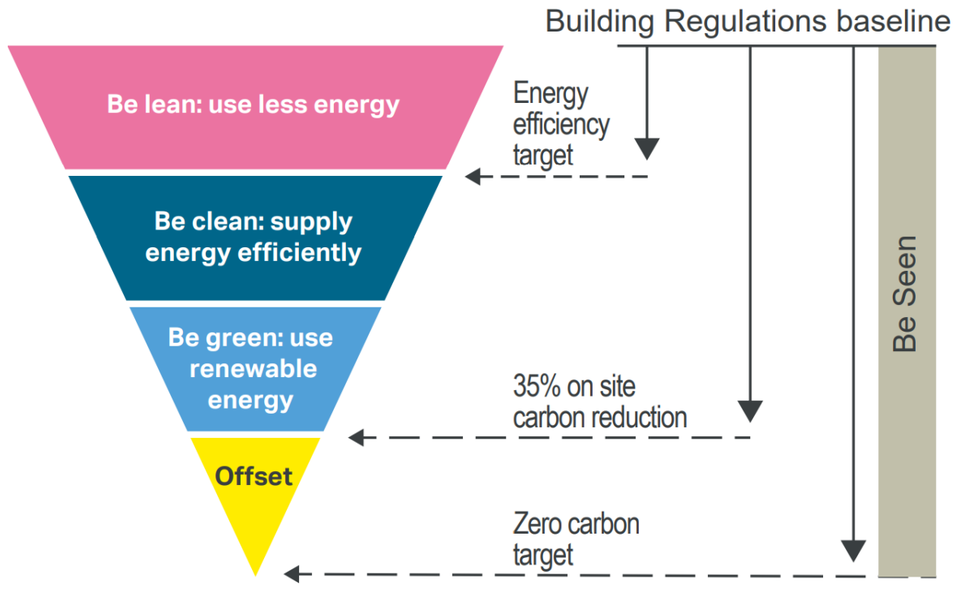


Figure 24: New London Plan (2021) Diagram of the energy hierarchy to reach 35% on-site reduction compared to baseline carbon emissions rate set by Building Regulations Part L 2013.

The current policy position of South Oxfordshire is aligned to the Part L percentage-based approach outlined above, yet this is now outdated and should be updated in accordance with industry best practice, which is explored in the following section. Vale of White Horse policy is less distinct than South Oxfordshire as it does not set a % carbon reduction target and is more qualitative (with no clear minimum improvement to make below which a proposal would be refused).

The following sections explore example local plan policies in each of these steps and how they were justified. Three more sections then look at offsetting, existing buildings, embodied carbon and new innovative approaches based on Energy Use Intensity.

Reducing energy demand

To achieve the legislated target of net zero carbon by 2050, we must reduce our total energy consumption as well as scaling up the supply of renewable energy. In the country's transition to net zero carbon, increased demand will be placed on the electricity grid as vehicles and existing buildings' heating switch from fossil fuels to electricity. Upgrading the electricity grid and expanding renewable generation is already a huge but necessary challenge, involving a great deal of shared cost and embodied carbon to produce that infrastructure. It is thus vital to minimise the extra burden that new buildings place on our energy infrastructure, to ensure that it does not become technically or financially unfeasible to deploy the required amount of renewable energy to meet our demands.

Improving the energy efficiency of new homes (minimising their energy demand) is a very cost-effective way to minimise the new infrastructure that will be required to support them in a future zero-carbon energy system. New homes should therefore target reductions in energy demand to reduce the amount of total energy that must be supplied, both from the electricity grid and from other renewable energy sources. Put simply, optimising the efficiency of the building fabric is the starting point for the whole net zero journey.

It is critical to set higher fabric energy efficiency standards to ensure buildings do not need to be retrofitted expensively at a later date, as the cost of retrofitting to tight energy standards is typically three to five times the cost of achieving the same performance in a new build[lxii]. This argument will be further underscored if the Government proceeds with the recent Committee on Climate Change proposal that no home should be able to be sold unless it reaches EPC Band C by 2028. However, EPCs have recently been deemed 'not fit for purpose' by Lord Deben, the Chair of the Committee on Climate, since the grading system is primarily based on the *cost* of energy and not the actual *amount* of energy used. This statement is supported by research that shows the actual operational energy use of existing buildings differs significantly from values predicted through EPCs.

(However: Please note that this point on the cost of energy performance in new builds vs retrofit is not an argument to allow demolition of existing buildings so that they can be replaced with new buildings – as this would result in greater embodied carbon from new building materials. Reuse of existing buildings is also desirable in that it reduces the need to build on greenfield, and tends to occur in urban areas where there is typically less need for car use. Therefore, planning policy should encourage and enable reuse, especially wherever a proposal includes retrofit that would significantly improve an existing building's energy efficiency. But where new buildings *are* proposed the policy should be designed to avoid a need for *future* retrofit by building to excellent standards in the first place).

Fabric efficiency (insulation and airtightness) is particularly pertinent for housing schemes that use heat pumps and MVHR, as these will require highly insulated and draught-proofed buildings to operate efficiently. The previously referenced costs report also found that if very high thermal efficiency is reached, the whole construction can become more cost-effective because the developer can then save money on smaller-sized heating systems (pipes, radiators, heat pumps, etc.).

A further final justification for including a minimum improvement on energy efficiency is that it helps with the social needs of affordable living, fuel poverty and healthy homes. An energy-efficient home saves energy bill costs for the home occupiers and also often helps make the home interior more comfortable and conducive to good health (warmer, less draughty, and with less condensation on cold spots on walls or windows thus reducing the chance of respiratory harm from mould growth).

How can local plans set requirements for improvement at the *energy efficiency* stage?

The Planning and Energy Act 2008 grants Local Planning Authorities the power to require "energy efficiency standards that exceed the energy requirements of building regulations". It defines "energy efficiency requirements" as standards that are endorsed by national regulations, national policies, or guidance issued by the secretary of state. It defines 'energy requirements' as regulated energy only (the energy affected by Part L of building regulations – this does not include plug-in appliances).

Example adopted plans generally require a set % reduction value to be achieved through energy efficiency measures ranging from circa 5-15% against the emissions rate set by Building Regulations Part L 2013. In the examples we have examined, this contributes part of the total required % improvement on the Part L baseline, and were set to ensure that energy efficiency (not just energy supply) played a role within that total target. These percentages were set according to best practices already being achieved in local proposals at the time, which may now be considered outdated).

An alternative could be a percentage improvement on the 'Target fabric energy efficiency' (TFEE) set by Part L and SAP. The TFEE is the legal limit on how much heat a home needs per m^2, based on the *fabric* not the efficiency of the heating *system*. Part L sets the TFEE to reflect a home of the same size and shape to the proposed home, with a certain minimum standard of insulation, glazing and airtightness. The TFEE therefore varies by the size and shape of the proposed building. By law, new homes must not exceed the TFEE. An improvement on the TFEE would demonstrate effort at this stage of energy hierarchy. The requirement could be a % improvement on the Part L 2021 TFEE, or could be set as an absolute kWh/m2/year figure that the proposed home must achieve. The target may need to be updated when Part L 2025 (Future Homes Standard) enters force.

Potential targets for fabric energy efficiency	Justification
Homes: 10% improvement on the Target Fabric Energy Efficiency Rate set by Part L 2021 using SAP10.2 Non-residential: Energy efficiency measures (fabric and supply) to deliver 19% reduction in carbon emissions compared to Part L 2013 or equivalent vs Part L 2021.	As of June 2022, the new national baseline is Part L 2021. In 2025 it will be replaced again by the Future Homes Standard, which has upgrades to the building fabric. This 10% figure represents the approximate difference in fabric (average of all building element U-Values and airtightness) between Part L 2021 and Future Homes Standard 2025. Unfortunately, the Future Buildings Standard specification 2025 for *non-residential* buildings has not yet been released so no equivalent percentage can be calculated at present. Meanwhile, a 19% improvement on Part L 2013 has been demonstrated feasible and viable in Milton Keynes (see case study).
Homes and schools: 15-20kWh/m^2/year Fabric Energy Efficiency using Part L SAP10.2. Additional energy reporting with PHPP or TM54.	Homes: kWh limit shown to be necessary for the UK to stick to its carbon budgets between now and 2050, and reach the net zero goal by 2050. Schools & homes: kWh limit shown to be feasible in emerging example evidence bases (Greater Cambridge & Central Lincolnshire). However, this evidence used different energy modelling methods (PHPP or TM54) because SAP/SBEM are inaccurate at predicting energy usage.

Example: New London Plan (adopted 2021)

As part of its requirement for an overall 35% reduction in carbon emissions against the building regulations baseline, London requires that part of this carbon reduction is achieved through energy efficiency measures, as follows:

- *New homes: 10%*
- *Other new buildings: 15%.*

A topic paper on energy efficiency (within the New London Plan evidence base) explains the evidence that justified how this was set:

London's requirement for a total 35% reduction in Part L carbon emissions in major developments had been in place since 2013, but not much of this was being delivered through energy demand reduction. Instead, developers were showing the reduction through energy supply, expedited by grid carbon reductions.

The GLA commissioned a study of the carbon savings achieved through energy efficiency across major developments' energy statements submitted to the GLA in 2013-2017 to understand what was already possible with best practice:

- The average carbon saving achieved from energy efficiency alone was only 3.5% (in homes), 11.6% (non-residential) or 6.3% (mixed-use)
- But much higher performance was achieved in many cases (37% of new home projects achieved at least a 5% reduction, and 13% achieved a 10% reduction)
- New homes could technically achieve a 5 – 10% reduction, and other buildings could technically achieve a 15% reduction in many cases.

The GLA the commissioned a further detailed study of the implications of achieving an energy efficiency target of this sort for a set of typical development types. It found that homes could typically achieve a 10% improvement just through the then-current best practice. It also found that offices could achieve a 15% improvement and schools could get close to this.

These percentage improvements were tested and found to be viable for most development types. They were therefore adopted, with flexibility for certain non-domestic development types such as hotels which would struggle to meet the target due to high hot water demand.

The London Plan 2021 also requires action on *unregulated* energy use:

- Policy SI 2 (E): "calculate and minimise carbon emissions … that are not covered by Building Regulations, i.e. unregulated emissions".
- Supplementary guidance instructs that unregulated energy calculations should use "BREDEM (BRE Domestic Energy Model) 2012 methodology".

Example: Milton Keynes Local Plan 2019

Milton Keynes Local Plan 2019 Policy SC1 includes a requirement for a reduction of 19% on the building regulations carbon emission rate, followed by a *further* reduction of 20% through the use of renewable energy and low/zero carbon technologies.

The latter 20% would fall under step 3 of the energy hierarchy ('be green'), implying that the first 19% must be achieved through the first two steps of the hierarchy (reducing energy demand, and supplying energy efficiently)[9]. Milton Keynes draft Sustainable Construction Supplementary Planning Document 2020 explains why the overall requirement is considered to be feasible:

> "We do not anticipate that the requirement to exceed the TER[10] by 19% will be unduly onerous for developers, as our analysis of BRUKL[11] data for consented schemes in Milton Keynes indicates that on average an improvement of 41% over the TER is already being achieved at the design stage."

[9] This is within reason. Bioregional recently worked on a mixed-use planning application in Milton Keynes whose homes achieved a carbon emissions reduction of approximately 26% using energy efficiency measures only. For the non-residential parts of the scheme this figure was 25%. The scheme then adds renewable/low carbon measures to achieve a further 20% site-wide carbon emissions reduction. The site-wide total carbon emissions reduction is 51.39%. Homes were flatted blocks. Non-residential spaces were office, retail and gym.

[10] Building regulations Target Emission Rate for carbon dioxide

[11] BRUKL is Building Regulations UK Part L: the energy data that must always be submitted in order to pass building control.

Efficient energy supply

This stage of the energy hierarchy is also referred to as 'be clean'.

This step generally refers to measures to use heat networks[12] to distribute heat efficiently and cleanly and with minimal losses.

Heat networks usually serve several buildings or sites from a common energy source, and can be expanded over time to serve more sites. Networks have variously included:

- Heat networks fed by local waste heat sources such as from waste incineration or data centres which generate a lot of heat as a by-product of their normal activity
- Heat networks fed by large-scale heat pumps (taking energy from air, ground or water sources) at a standalone energy centre that does not 'belong' to any individual new building
- Heat networks fed by CHP plant (combined heat and power), essentially a small-scale power station which burns fuel to generate electricity and heat at the same time. This was previously seen as 'efficient' because the CHP plant would be close enough to homes and businesses that the heat could be reused. This is generally no longer seen as a sustainable option because they almost always run on fossil gas which needs to be fully phased-out to meet net zero carbon goal and carbon budgets, unless carbon capture technologies emerge in future. The electrical grid now provides electricity at a lower carbon intensity than a CHP plant, and heat pumps are a more efficient and cleaner heat source which is ready to reach zero carbon as the electrical grid decarbonises, and avoids the negative air quality impacts that come with fuel combustion in CHP.

Because local waste energy sources are extremely geographically site-specific and because heat networks in general are dependent on a relatively high density of heat demand, it is not appropriate to seek a universal carbon percentage reduction that should be achieved at this stage of the energy hierarchy.

Because heat networks are often powered by waste incineration or fossil gas – neither of which currently has a path to zero carbon – there is a risk that a building connected to a heat network may not necessarily save carbon compared to a building with an individual heat pump other electrical heating combined with renewable electricity supply. One grey area is waste incineration, where the incineration may occur whether or not the heat is reused. A case-by-case treatment may be the most logical approach (considering the counterfactuals and embodied carbon of the new network).

Thus, it may be beneficial to design a policy so that heat network connection is only sought where the heat source is low- or zero-carbon and/or a lower carbon solution to individual electrical heating solutions per building. If the local plan also has a policy requiring on-site renewable electricity generation (see section), then it is likely that individual heat pumps run on this renewable electricity would be a lower-carbon solution than a heat network – unless in major mixed use development, in which case a communal heat sharing network driven by heat pumps could be the optimal solution as these can (if correctly designed) enable recycling of heat rejected from cooling systems at commercial uses at the scheme.

Local plan examples (see overleaf) are therefore instead expressed as:

- A requirement to connect to an existing or planned heat network, if present
- A requirement to have an energy strategy that is compatible to connect to a future heat network, if the proposed development is within suitable area identified in a heat mapping exercise
- An acknowledgement that lower-carbon energy options may be available, in which case the heat network connection will not be required, and
- An acknowledgement that the requirement may be waived if there are unsolvable feasibility or viability obstacles which make heat networks unsuitable for the specific scheme.

Although the heat network policy examples described here (and below) have previously been viewed as beneficial and useful policies, a heat network policy is not necessary for the South & Vale Joint Local Plan. This is because the Energy Use Intensity approach taken in 'Policy recommendations' implicitly addresses requirements for efficient energy supply – typically likely to be met with an individual heat pump to each property or building, which are often more efficient than heat distribution networks (especially combustion-fed networks). The emerging policy recommended limits for energy consumption (EUI) will only be complied with if efficient energy supply is used, therefore specific technologies such as heat networks do not need to be specified in the policy. In some cases, developers could choose to use networked heat to comply with the emerging EUI targets in instances where it can be proven that this is at least as efficient as individual heat pumps; however, the benefits of networked heat (in terms of cost, energy efficiency and carbon) will vary by the development type, use mix and location of the individual development therefore should not be subject to a blanket requirement in the policy.

[12] Heat networks (also known as district heating) are networks that supply heat across an area through underground piping systems flowing from a central heat source.

Example: New London Plan 2021

Policy SI3: Energy Infrastructure

This policy requires that major development proposals within identified 'Heat Network Priority Areas' should have a communal low-temperature heating system, whose heat source should be selected according the following hierarchy:

Connect to local existing or planned heat networks

Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

Use low-emission 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 (which must meet requirements of a separate air quality policy).

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.

Example: Milton Keynes Local Plan 2019

Policy SC2: Community energy networks and large scale renewable energy schemes

This policy requires that:

- Major development proposals should consider the integration of community energy networks in the development. This consideration should form part of development proposals and take into account the site's characteristics and the existing cooling, heat and power demands on adjacent sites
- All new developments in proximity of an existing or proposed combined heat and power (CHP), combined cooling, heat and power (CCHP) station or local energy network will be expected to connect to the network unless it can be demonstrated that:
    1. A better alternative for reducing carbon emissions from the development can be achieved; or
    2. Heating and/or cooling loads of the scheme do not justify a CHP connection; or
    3. The cost of achieving this would make the proposed development unviable.

Summary: Options for Part L-based energy efficiency policy requirements (energy demand reduction and energy efficient supply)

Percentage reduction on Part L 2013 through energy efficiency (demand reduction and efficient supply)	Justification
10% in homes 15% in nondomestic buildings (except hotels and schools, to be considered case-by-case)	Shown to be feasible and viable across London in 2013–2017 via analysis of consented schemes; adopted as minimum policy across London. Although viability in London is different to South & Vale, this performance was achieved several years ago and should have disseminated to other regions via ongoing industry advances. Not ideal as Part L 2013 baseline became obsolete in June 2022 (therefore further analysis needed to update percentages).
19% in major residential proposals	Shown to be feasible in Milton Keynes via analysis of recent consented schemes' energy statements; evidently acceptable in planning terms via example of the adopted MK local plan. As above, 2013 baseline now obsolete.
Custom % reflecting typical best practice in South & Vale	Analysis of recent successful applications in South & Vale (from building control) to ascertain and demonstrate that the target is feasible locally. Not recommended as it will not deliver much improvement on existing practice and would require additional analysis.

Overall, although Part L-based policy requirements have previously been viewed as best practice where large % reduction targets have been set, this approach is now far from best practice and should not be prioritised as an ambitious approach, which is reflected in this report's policy recommendations. This is primarily because there is insufficient focus on on-site carbon reduction measures and a reliance on offsetting to get towards net zero. These Part L policy targets are also set on a relative basis instead of being based on absolute targets that will be needed to hit the UK's absolute carbon budgets and net zero target. Furthermore, the Part L metrics have been shown to be inaccurate in predicting the building's actual performance (as noted elsewhere in this document). The summary of options presented here is therefore purely for background information on what has been done in the past and how it was justified at examination at the time, not an approach that will be taken for South & Vale Joint Local Plan policy.

Renewable and low carbon energy at new buildings

The third step of the energy hierarchy is to decarbonise energy supply (see Figure 24): both electricity and heat. The Committee on Climate Change 2019 report ('UK housing: Fit for the future') identified that grid decarbonisation is a vital component in the trajectory towards net zero. Onsite renewable generation at new buildings supports this in two ways. First, it drives investment in additional renewable electricity, and second, it can simultaneously reduce peak and annual demand on the grid.

Requirements for renewable or low-carbon energy supply can be expressed as:

- A further percentage reduction in carbon emissions against the building regulations baseline, in addition to the percentage achieved through fabric (*see example from Milton Keynes*), **or**
- A 'Merton Rule'[13]; where the proposal must include renewable energy generation equipment on-site or near-site, sufficient to meet a certain proportion of the building's own energy demand (see example below from Solihull). This can be total energy, or regulated energy only. This uses the Energy and Planning Act power to require a 'reasonable' proportion of the development's energy use to be from renewable sources in the locality.

The value of onsite generation has long been recognised in local planning policy, but has not been without its critics. It has sometimes been argued that the prescriptive nature of such policies may not be applicable for all sites and can occasionally lead to the installation of inefficient onsite renewables[lxiii]. Some sites may not be able to meet a very high requirement for renewables, such as if they are overshadowed (meaning solar PV panels would not work well), or if it is a tall building where there is a larger amount of internal floor space demanding energy but a relatively smaller roof space for PV.

We would therefore recommend including enough flexibility to accommodate unique site constraints, whilst still seeking an ambitious amount of appropriate onsite LZC technologies in all proposals. There is a growing number of adopted example policies that set specific targets for onsite renewable generation towards net zero carbon target. In practice, these policies are often applied flexibly if the developer can show how and why it was not possible to meet the required metric and that they have pursued renewable energy measures to the greatest reasonable extent.

Defining 'low and zero carbon technologies'

If setting a plan policy requirement under this stage of the energy hierarchy, it will be necessary to define the types of measures that will count as 'renewable / low and zero carbon technologies'. Some technologies, such as solar PV panels, solar thermal and turbines, always count. Other technologies – such as heat pumps – may need clarification on where to account for these in an energy statement.

Heat pumps are not automatically zero carbon – they still use mains electricity to run. But they can be a low carbon heating system provided they run at high efficiency (they can deliver about three times as much heat energy as they consume in electrical energy, because take ambient heat from outdoor air – thus there is a renewable element to the heat they deliver). To achieve this level of efficiency, they need to provide heat at a relatively low temperature. This becomes feasible if the heat pump is used in combination with improved thermal efficiency and reduced air permeability[14].

The developer could make the heat pump zero carbon by supplying its electricity from a renewable source such as rooftop solar panels, so long as they are generating the renewable electricity at the same time the heat pump is running or if the building can store the solar electricity in a battery for later use. You will need less energy from your solar panels to run your 300% efficient heat pump, compared to using your solar panels to run direct electric heating which can only ever be 100% efficient – therefore you don't need as many solar panels, resulting in savings in embodied carbon.

Carbon savings from heat pumps are usually treated in planning guidance under the same step of the energy hierarchy as renewables – that is Step 3/'Be Green'. For example, London Plan draft energy guidance[lxiv] asks that heat pumps be accounted for as a Step 3 measure, unless they are powering a heat network, in which case all heat from the heat network would be a Step 2 ('be clean') measure.

Counting heat pumps as a Step 3 / 'be green' measure' gives more flexibility in options for buildings to achieve carbon reductions at this stage even if the building is not suitable for solar panels due to shadow or orientation.

Example: Sutton Local Plan (adopted 2018) Policy 31

In Policy 31, All proposed development must apply the Mayor's energy hierarchy in the following order:

1. Being built to 'the highest standards of energy efficient design and layout',
2. Supplying energy efficiently (low or zero-carbon heat networks and cooling networks),
3. Using on-site renewable energy to achieve a reduction in total CO^2 emissions (regulated and unregulated) of 20% in major developments or 10% in minor developments.

Example: Milton Keynes Local Plan 2019 (adopted)

Policy SC1 (Sustainable Construction) includes that:

All proposals of 11+ dwellings or non-residential space over 1,000m^2 must apply the energy hierarchy to achieve:

1. A ≥19% reduction on Building Regulations 2013 carbon emissions,
2. A further ≥20% reduction through renewables (onsite or a local network),
3. The developer must then pay to offset remaining carbon emissions (see 'carbon offsets' section further on in this brief).

[13] The original Merton Rule (introduced in 2003) required only 10%, but more recently adopted and emerging local plans aim higher.

[14] Air permeability is the opposite of airtightness. As defined in Part F of Building Regulations, airtightness is "a general descriptive term for the resistance of the building envelope to infiltration with ventilators closed. The greater the airtightness at a given pressure difference across the envelope, the lower the infiltration".

Emerging example: Solihull Local Plan: Draft Submission Plan 2020

Policy P9, point 3, requires that:

At a site level, development must apply the 'energy hierarchy' to reduce energy demand for heating, lighting and cooling and minimise carbon dioxide emissions as follows:

- All new dwellings to achieve 30% reduction in energy demand/carbon reduction improvement over and above the requirements of Building Regulations Part L (2013) at the time of commencement up to March 2025.
- From April 2025 for all new dwellings to be net zero carbon.
- Minor non-residential development will conform to at least BREEAM Very Good and major non-residential development will conform to at least BREEAM Excellent.
- Provide at least 15% of energy from renewable and/or low carbon sources for all major housing developments and non-residential developments of 1000sqm or more

Standalone renewables

Growth of renewables, enabling the phase-out of coal in power stations, has been a key driver of the UK's carbon emissions reduction in the past 15 years. Renewables will next have to grow even faster to enable the phase-down of fossil fuel gas in power stations, and to keep pace with larger electricity demand as buildings and transport gradually switch from gas, petrol and diesel to electricity.

As previously cited, to meet the UK's legislated carbon budgets we should be planning to enable for wind and solar power to meet 80% of overall electricity demand by 2050 – which means a growth of 3 megawatts per year for both wind power and solar power respectively. Some of the wind power will be offshore, but not all. The shared challenge becomes even larger given that we must also scale up dramatically to meet the rising electricity demand from the equally necessary switch of heating and transport away from gas and oil and onto electrical power (the role of hydrogen is expected to be limited in geography, scale and application for the foreseeable future). Energy distribution and storage infrastructure is a vital part of this renewable-heavy system, to match generation with demand (as generation fluctuates with wind or sun, and can be generated at a different time to when it is needed).

Development of large-scale renewable energy can be a controversial topic with communities, especially wind. However, in light the aforementioned steps needed to realise the grid decarbonisation that is essential for the entire country's legally binding transition to net zero carbon, it is necessary for all local areas to accept a fair amount of new renewable generation in an equitable way across the UK.

Allocating (or identifying suitable) sites for renewable energy generation, storage and distribution is a way in which a local plan can proactively facilitate the transition to net zero carbon, not just for new growth but for existing buildings and transport. Task 6 of this evidence base will explore these areas in more detail; meanwhile in principle it is provisionally noted that this would be a positive step for this Joint Local Plan to take in light of the urgent need to upscale renewable electricity production as an essential part of the pathway to the UK's legislated carbon budgets and net zero goal.

The National Planning Policy Framework actively encourages this:

- Paragraph 155: "To help increase the use and supply of renewable and low carbon energy and heat, plans should … provide a positive strategy for energy from these sources … [and] consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development".
- Paragraph 156: "Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans".
- Paragraph 158: "When determining planning applications for renewable and low carbon development, local planning authorities should not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions".
- Paragraph 158b: "Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas."

We again note that Planning Practice Guidance confirms that local planning authorities hold decisions over renewable energy development of 50 megawatts or less, and may soon hold decisions over onshore wind over 50MW[lxv]. Also as of 2020, energy storage of over 50MW is now the domain of the local planning authority, except pumped hydropower[lxvi].

The RTPI notes[lxvii] that alongside renewable generation, local plans should also aim to bring forward energy storage and smart systems to bridge gaps between production and demand. It stresses that the policy itself is not the whole answer – rather it is also essential to familiarise council members and planning officers with the implications in determining planning applications for energy storage.

As set out in the previous section on the recent NPPF consultation. Onshore wind continues to be treated differently to other energy generation technologies, whether renewable or not. Until onshore wind has equal opportunity to other energy development, it will become increasingly difficult for local authorities to meet net zero carbon targets.

Task 6 will explore the issues and implications laid out below in more detail, but the policy recommendations explored later in the report provisionally set out how the Joint Local Plan can respond and address these policy areas.

As the grid decarbonises through a greater share of renewables in the mix of electricity generation, infrastructure upgrades will be required since the capacity of the electricity grid will need to be larger than it currently is. As the UK transitions away from fossil fuel transport and gas heating to electric vehicles and heating, electricity demand will significantly increase – however, this is not the only reason why the net zero carbon transition requires grid capacity upgrades. The other reason is to account for the varying levels of electricity generation due to weather variations, such as a prolonged period with or without solar PV or wind energy generation. The UK electricity grid infrastructure is not yet prepared for this anticipated increase in capacity or flexibility to respond to fluctuations in generation. This inhibits growth towards a net zero South & Vale and UK. The Joint Local Plan should therefore support renewable energy applications that represents a balanced and flexible future energy system (for example but not limited to: renewable energy generation, grid-connected energy storage for rapid deployment, and 'demand-side response' automated systems to smooth out peaks and troughs in demand). This support of course needs to be subject to suitable land available for such development, which is to be explored in Task 6.

Upgrades to the capacity of power sub-stations are already becoming difficult to achieve due to a lack of investment; this is subsequently limiting some areas in the UK to no new connections until the mid-2030s. This is a clear barrier to achieving net zero carbon at both a local and national level, as it could resultantly limit the electrification of heat and transport. This could also present obstacles to a net zero carbon new development policy that relies on the development's ability to export zero-carbon power to the grid in order to balance out the amount of grid electricity it has to use at times when the development's own onsite renewables are not able to match its energy use. If (as in some UK locations is already the case) the grid operator refuses to take any energy exports from the new development, the development's only route to net zero carbon would then be through expensive energy storage on-site (to store any excess) or pay towards off-site offsetting.

The Joint Local Plan must therefore provide the best available framework to enable these infrastructure upgrades and move towards a decentralised local energy network that is increasingly self-sufficient and resilient to future challenges.

Increasing the amount of energy storage is essential to create a resilient energy system suitable for our net zero carbon future, to account for periods for renewable energy generation is low. At a local level, this is likely to primarily consist of battery storage, which can respond rapidly to increased energy demand or generation. Ensuring the energy system is able to rapidly respond to increases in electricity demand and generation is the key to a future resilient system. The local plan could work towards encouraging or requiring new development to integrate storage systems alongside renewable energy generation to create a decentralised system that stores electricity on-site. As previously noted, Local Development Orders can provide a useful tool to bring forward infrastructure for renewable energy storage and distribution.

An innovative approach, as laid out in 'Policy recommendations' would be to provide a policy framework that supports smart local grids for new larger development that has peak-demand-response capabilities built in that can operate throughout the site. Supporting a policy approach in this way moves towards truly decentralised energy networks that increase resilience to external grid factors. For example, in a new net zero development that has sufficient on-site renewable energy generation to match total energy consumption over the course of a year, a house with residents working from home during the day will demand more energy at this time than another house where the residents are not occupying the property at the same time. If the occupied house is not producing enough on-site energy from a rooftop solar PV installation to consume 100% renewable energy, it would be able to take any residual generation from the unoccupied house during that time through a purchase agreement throughout the site. This can be upscaled to larger numbers of houses on larger sites to create a development-wide local energy network – this also can help reduce the need for wider grid capacity upgrades by (to a certain extent) keeping the energy exchanges within the local (on-site) grid. Additionally, if a minimal amount of energy is generated from on-site solar PV on one day, if a storage system is in place on-site, the occupied houses will have access to renewable energy generated during preceding days.

While this subsection has outlined the benefits and solutions that renewable generation and energy distribution/storage infrastructure can provide, the *obstacles* to such proposals tend to arise in relation to landscape, heritage, competing land uses (e.g. agriculture), and general community resistance to what is sometimes perceived as a visual impact without an obvious direct community benefit. In particular, end-of-life implications of renewables should be considered at the applications stage to ensure land is restored to its previous state upon removal of technologies. These – and how these may be weighed up against the benefits – will be explored separately in Task 6.

Ensuring community benefit throughout addressing these issues should be of high importance in the Joint Local Plan. One way to achieve this could be to provide an option for community ownership in commercial renewable energy schemes, as seen below with the Cornwall example. A fund could be set up that the scheme pays into to deliver infrastructure improvements to the local area, particularly involving further energy upgrades. This could however conflict with existing mechanisms such as Community Infrastructure Levy and S106 payments.

The Royal Town Planning Institute notes[lxviii,lxix] that planning for renewable energy (generation, storage and other smart energy infrastructure) is most likely to be successful when specific suitable sites are allocated in concert with communities, grid operator/district network operator, and other stakeholders with relevant interests e.g. ecological and landscape conservation bodies. This process can also help communities understand the need and potential benefits of the installation. This RTPI document also highlights the potential usefulness of Local Development Orders to encourage the development of renewable generation, energy storage and expansion of renewable/low-carbon energy distribution infrastructure.

Perhaps the key success factor is to define reasonable requirements to mitigate the impacts and community acceptability, while not creating a planning environment that is so difficult and hostile as to entirely deter or block potential projects for renewable energy and energy storage. Community engagement is a key action to mitigate hostility towards local renewable energy projects. The Centre for Sustainable Energy has carried out Future Energy Landscape workshops and produced a guidance note on how others can replicate the approach. Workshops such as these assist communities to feel empowered in the decision-making process for potential site selection of renewable energy projects.

Recognising this challenge, several emerging local plans are attempting to make provision for such developments (see precedent examples below and overleaf).

The Joint Local Plan can ensure that interventions for new development prevent any new emissions from new development (i.e. require that all residential and non-residential buildings can generate sufficient renewable energy on-site to match the total energy that is consumed).

It is inevitable that grid infrastructure upgrades and a large increase in localised energy storage is necessary to achieve a resilient net zero local system, just as it is at national level. The most important thing the local plan can focus on to reach a net zero future is provide the policy framework to easily enable growth of net zero new builds, energy storage and distribution, alongside creating smooth planning processes for retrofitting and renewable energy proposals.

Policy recommendations for the South & Vale Joint Local Plan on standalone renewable energy and supporting infrastructure are presented here.

Example: Swindon Borough Council's use of Local Development Orders (LDO) to expand renewable and low carbon energy systems

Swindon Borough Council has used LDOs to promote the growth of renewable energy generation and use, both on specific sites and in borough-wide terms.

Examples include:

- A borough-wide LDO for district heating
- Identifying specific sites for solar photovoltaic arrays including solar farms. This was created by issuing a 'call for sites' and then assessing these sites against various criteria.

These LDOs promote these types of development by making it clear that they will be welcomed, thus inviting and speeding up the process. The LDO on solar farms has been particularly successful, by de-risking the planning application process and thus making solar PV opportunities more attractive for potential developers (whether commercial or community-led).

Emerging example: City of York Draft Local Plan (2018)

Policy CC1 of this emerging local plan confirms that:

> *"Renewable and Low Carbon Energy Generation and Storage: Proposals for renewable and low carbon energy storage developments will be supported and encouraged. Developments should be sited a suitable distance from major residential areas and have suitable fire suppression procedures".*

The policy also explains why storage is crucial, acknowledges that this is an emerging field and commits the council to work with experts to understand what the options are and develop an SPD which will include safety considerations.

This plan is still with the inspector *as of May 2022, but the CC1 policy stance already formed the basis of a 2019 planning approval for a 50MW battery storage development in greenbelt, due to its location (near a substation) and its contribution to sustainable development, innovation, and energy resilience.*

Emerging example: Greater Cambridge Local Plan (First Proposals 2021[lxx])

Policy CC/RE aims to bring forward standalone renewable energy development, in an acceptable way. *This will include:*

- A positive policy framework for development of renewable energy generation capacity, and associated infrastructure such as battery storage and grid capacity
- Identify broad areas of suitability for different types of renewable energy generation equipment, informed by Cambridgeshire Renewables Infrastructure Framework and a Landscape Sensitivity Assessment
- Indicate support for community-led projects
- Identify a set of criteria which will apply to all renewable energy projects with regards to their impact on amenity, landscape appearance, biodiversity, geodiversity, water, history/heritage, highway safety, aviation and telecoms
- Require special community engagement in the case of wind turbines
- Consideration of green belt impact and the potential for renewable energy development to be justified by 'very special circumstances'.

The need for this policy is evidenced by reference to national planning policy expectations that local plans should recognise the responsibility of all communities to contribute to energy generation from renewable sources, and a Net Zero Carbon study which had identified how much a 'fair share' of that contribution would be for the area. It is also noted that the alternative – having no policy to identify such areas – may not generate the renewable energy required for the net zero carbon transition.

Example: Cornwall Climate Emergency Development Plan Document

The Cornwall Climate Emergency DPD was adopted in February 2023.

Background text notes that Cornwall is already ahead of the national average in the percentage of its electricity that is from renewables, with potential for more. Also, to fulfil the national policy requirements around approval of wind turbines, it states:

> "The Policy map identifies broad areas that may be suitable for wind energy. [This] does not mean that proposals will automatically be granted … They are essentially an 'area of search' within which the Council will consider whether turbines should be granted permission in line with local and national policy which sets out a series of technical tests (including distances from homes and heritage assets …) and demonstrate the acceptability of their visual impact. An interactive map … sets out constraints against which proposals will be considered".

Policy RE1 proceeds to affirm that proposals for renewable generation and distribution projects will be supported where they:

- Contribute to Cornwall's target of 100% renewable electricity supply by 2030,
- Balance the wider environmental benefits and not result in significant adverse impacts on the local environment that cannot be satisfactorily mitigated (in AONBs they must be small scale and only in exceptional circumstances),
- Allow for the continuation of some form of agricultural activity on the site
- Provide for 10% net biodiversity gain
- Provide for community benefit (including offering an option for communities to own at least 5% of the scheme if it is 5MW or more)
- Have appropriate plans in place for removal of the technology 'on cessation of generation' and restoration of site to original or acceptable alternative use.

Wind energy development proposals will be permitted where they:

- Are located in a 'broadly suitable area' identified on the Policies Map or are for the repowering of an existing wind turbine/farm
- Demonstrate that various impacts have been consulted on and mitigated (community, shadow, flicker, noise, air traffic, radar, overshadowing / overbearing effect on habitations, integrity of European Sites, foraging zones for waders in 3km buffer zone of specific coastal habitat areas).

Solar energy development proposals for building mounted installations will be supported and encouraged wherever possible. Standalone ground-mounted solar will be supported on previously developed land and away from 'best and most versatile' agricultural land 'unless exceptionally justified'.

Hydroelectricity energy development (including tidal) will be supported subject to acceptable impacts on the water regime and nature conservation.

There is a presumption in favour of grid energy storage development where it is collocated with renewables, alleviates grid constraints, or enables further renewables to be deployed.

Setting absolute targets for energy use intensity, space heating and on-site renewable energy generation

There is a growing number of local authorities pursuing the industry-recommended approach to achieving genuine net zero new build development. The approach does not use baselines and % reductions based on previous iterations of Part L, as previously explored (and of which is the policy position currently adopted by South Oxfordshire), and instead sets threshold limits on energy use. A policy that follows this approach sets three key requirements:

1. Energy use intensity (EUI) – the predicted total amount of regulated and unregulated energy used.
2. Space heating demand – the amount of energy required to heat the building.
3. On-site renewable energy generation – must match total energy to be a net zero building.

Comparison of targets for residential development

Space heating demand (kWh/m²/year)	Energy use intensity (kWh/m²/year)	Target referenced
30	40	Cornwall Climate Emergency DPD
		Bath & North East Somerset Local Plan Partial Update
15-20	35	Central Lincolnshire Local Plan
		Greater Cambridgeshire Draft Local Plan
	n/a	Committee on Climate Change
15	35	Low Energy Transformation Initiative
		CIBSE
		Good Homes Alliance

The EUI target includes all energy used by the building, importantly accounting for unregulated energy, which Part L does not. EUI does however exclude contributions from renewable energy generation and does not consider electric vehicle charging in the calculation. Reducing the energy used by the building is the primary aim of the EUI approach, which can then be supplemented to net zero by the renewable energy generation requirement that supplies the energy demand of the building.

Following an energy metric approach ensures more control over the fabric and systems installed in buildings. For example, high performance U-values are essential to achieve space heating demand targets set out above. Part L of Building Regulations does not however guarantee such high-performance since absolute energy targets are not set for certain building typologies. An additional benefit of this assessment is that EUI can be easily monitored and verified in practice from meter readings.

Additionally, the EUI target essentially bans the use of on-site fossil fuels, and more specifically, gas boilers for heating. Although explicitly stating the ban of gas boilers in policy wording may cause concern, the EUI target does this implicitly since gas boiler efficiency (c. 90%) will likely result in too large a contribution of overall energy use to result in a compliant EUI value. Contrarily, the superior efficiency of heat pumps makes achieving the EUI target significantly easier, as the technology can produce over 3 units of heat per 1 unit of electricity used.

Particularly for more stringent EUI and space heating demand targets, as proposed by Central Lincolnshire and Greater Cambridgeshire, more than just the installation of a heat pump and high fabric efficiency will be required to achieve such targets. To meet the more stringent targets, decisions must be made at an early stage of the development process to make appropriate decisions on form factor, glazing ratios and building orientation, which encompasses a fabric first approach. These decisions will contribute towards the maximisation of energy demand reductions and the ability of the renewable energy generation system to create an on-site net zero energy balance.

This remedies a key weakness in Building Regulations, which fail to incentivise applicants to design a building with an inherently thermally efficient form or orientation because all of the Part L targets are not fixed targets but are set in relation to a building of the same size and shape as the proposed building.

To further strengthen a policy informed by this approach, a robustly accurate energy modelling methodology will need to be used. SAP 10.2, used for Part L compliance, is currently unable to accurately assess unregulated energy since the relevant equation is based on 1998 appliances, which clearly does not reflect modern efficiencies. It is therefore more difficult to comply with an EUI target using SAP because the proportion of unregulated energy, which can be up to 50%, is severely overestimated. SAP also frequently underestimates space heat demand by up to 270%, and SBEM has also been shown to generally underestimate overall energy use.

To mitigate such inaccuracies, an alternative energy modelling methodology is required to ensure design-stage performance values correspond to the as-built performance of the building. The industry-recommended energy modelling method to minimise such a performance gap is Passivhaus Planning Package (PHPP), which is used for the leading Passivhaus standard. Contrary to common misconceptions, PHPP can be used without needing to pursue the stringent Passivhaus certification process. An alternative accurate energy modelling calculation method, if used correctly, is CIBSE TM54. TM54 works by starting with the SBEM calculation and making adjustments to the inputs to reflect how the building will be used based on reasonable adjustments about occupancy and so on.

On-site renewable energy generation must match the EUI (multiplied by the floor space) to reach an on-site net zero energy balance. In the majority of cases, this has been shown to be technically feasible for EUI targets up to 40 kWh/m²/year. The taller the building, the less likely it is that there will be sufficient roof space to match EUI. However, even for such taller, more shaded buildings, façade-mounted panels and other ground-mounted renewable energy technology should be considered.

Several examples are explored overleaf, which, although they take a similar approach, have received very different reactions from their respective Inspectors during examination.

Example: Cornwall Climate Emergency DPD 2023 (adopted)

The Cornwall Climate Emergency Development Plan Document (DPD) was adopted in February 2023 and retained all key elements of its net zero carbon policies.

Policy SEC1 (Sustainable Energy and Construction) includes that (paraphrased):

1. Major non-residential development (over 1,000m^2) to achieve BREEAM Excellent (or "equivalent or better methodology")
2. New residential development to achieve all of the following:
    i. Space heating demand of <30kWh/m2/year
    ii. Total energy consumption of <40kWh/m2/year
    iii. On-site renewable generation to match the total energy consumption, with a preference for roof-mounted solar PV. Where it is not feasible or viable to include enough renewable energy generation to match total energy consumption, the development should pursue the following:
        - Renewable energy generation to be maximised as far as possible
        - Connection to an existing or proposed district energy network
        - Offset the residual energy demand by a contribution to Cornwall Council's Offset Fund.

This is supported by evidence in the form of energy modelling analysis[1] by expert green building engineers. This analysis used accurate energy modelling method (PHPP) to identify a range of energy performance targets that are feasible in Cornwall and can reach the net zero carbon target in a variety of ways (different combinations of fabric / energy efficiency and renewable energy measures). This evidence piece also compared the proposed 'net zero carbon' building performance options against how a building would perform if it simply met the Future Homes Standard.

The analysis included cost information for each modelled building that was then used in the viability assessment for the DPD. That viability assessment found that most residential development scenarios remained viable with the policies applied, and that the majority of the cost uplifts over the 2013 building regulations will be incurred by developers anyway in order to meet the new 2021 building regulations, even without the local plan carbon policy.

Contrarily to the Salt Cross AAP, the Inspector's report positively stated that the 2015 WMS has clearly been overtaken by more recent events.

A difference between standards set between residential and non-residential development may be noted in these examples. This an important aspect of the energy-based policy approach. The typical usage of residential buildings is less variable therefore relatively easy to predict and understand, whereas non-residential buildings can vary significantly in terms of energy use. For example, an office with computers at each desk (and potentially a computer server bank) will have a far higher energy consumption than a retail unit that primarily consumes energy only through lighting and heating.

Therefore, non-residential buildings need to be treated in isolation of the archetype assessed because the whole scope of non-residential buildings involves a very wide range of energy consumption levels associated with the unique activities of the occupier. Setting specific energy use limits per archetype is one approach that has been used, whilst setting a level of BREEAM certification acts as another. The latter approach may not be as stringent on energy use (as BREEAM does not set absolute targets for energy use or renewable energy and does not guarantee net zero carbon schemes), but ensures a wider range of sustainability issues are considered and addressed (for example, materials, management, water, biodiversity and other issues beyond energy use).

Example: Bath & North East Somerset Local Plan Partial Update (adopted)

The Local Plan Partial Update (LPPU) was adopted in January 2023 and became the first local plan in the UK to set net zero energy standards for new housing.

Policy SCR6 sets identical standards to Cornwall for residential development and was informed by the same technical evidence base. As set out in the Sustainable Construction Checklist Supplementary Planning Document, PHPP is required for major development, whilst an option to use SAP with the Energy Summary Tool is available for minor residential development. The Energy Summary Tool adjusts outputs from SAP to reflect in practice performance. These options reflect the same approach as Cornwall. It is however important to note that the calculation approaches were not tested at examination as the requirements are set out in supplementary guidance.

A specific technical study for the Bath & North East Somerset (B&NES) area was not seen as necessary because Cornwall and B&NES share the same prominent housing typologies and climate patterns that influence the efficiency of solar PV to provide an on-site net zero energy balance.

A key piece of evidence that assisted B&NES to successful adoption was a letter received from DLUHC, which reiterated the fact that local authorities are able to set standards that exceed Building Regulations i.e. that exceed the standards set out in the 2015 WMS. The 2015 WMS was not explicitly stated in this correspondence from government, yet the clarification on exceeding Building Regulations all but confirms that the 2015 WMS is no longer relevant.

This view was directly stated in the Inspector's report:

"*The **WMS 2015 has clearly been overtaken by events** and does not reflect Part L of the Building Regulations, the Future Homes Standard, or the legally binding commitment to bring all greenhouse gas emissions to net zero by 2050.*

*I therefore consider that the **relevance of the WMS 2015 to assessing the soundness of the Policy has been reduced significantly**, along with the relevant parts of the PPG on Climate Change, given national policy on climate change. The NPPF is clear that mitigating and adapting to climate change, including moving to a low carbon economy, is one of the key elements of sustainable development, and that the planning system should support the transition to a low carbon future in a changing climate. Whilst NPPF154b sets out that any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards, for the reasons set out, that whilst I give the WMS 2015 some weight, any inconsistency with it, given that it has been overtaken by events, **does not lead me to conclude that Policy SCR6 is unsound, nor inconsistent with relevant national policies**.*"

The logical view provided by the B&NES Inspector appropriately summarises the context of local authority powers to set their own energy efficiency standards. In contrast, the West Oxfordshire Inspectors' views represent inconsistency in decision making on net zero policies at PINS. As more local authorities propose ambitious policies that will need to be weighted against consistency with national policy, increased consistency should become apparent.

Example: Central Lincolnshire Local Plan (adopted)

The Central Lincolnshire Local Plan was adopted in April 2023[1]. The adoption of this plan is significant as the energy requirements for Policy S7 and S8 are aligned with recommendations from LETI and the Committee on Climate Change.

Proposed Policy S7 (Reducing Energy Consumption - residential) includes that:

> "Unless covered by an exceptional basis … all new residential development proposals must include an Energy Statement which confirms in addition to the requirements of Policy S6 that all such residential units:
>
> 1. Can generate at least the same amount of renewable electricity on-site (and preferably on-plot) as the electricity they demand over the course of a year, such demand including all energy use (regulated and unregulated), calculated using a methodology proven to accurately predict a building's actual energy performance; and
> 2. To help achieve point 1 above, target achieving a space heating demand of around 15-20kWh/m^2/yr and a total energy demand of 35 kWh/m^2/yr … No unit to have a total energy demand in excess of 60 kWh/m^2/yr [which means] the amount of energy used as measured by the metering of that home, with no deduction for renewable energy."

The policy also includes a clause to address the energy performance gap:

> "The Energy Statement must include details of assured performance arrangements. As a minimum, this will require:
>
> a) The submission of 'pre-built' estimates of energy performance; and
> b) Prior to each dwelling being occupied, the submission of updated, accurate and verified 'as built' calculations of energy performance. [This] should also be provided to the first occupier … Weight will be given to proposals which demonstrate a deliverable commitment to on-going monitoring of energy consumption … which has the effect … of notifying the occupier [if] their energy use appears to significantly exceed the expected performance of the building, and explaining to the occupier steps they could take to identify the potential causes."

Proposed Policy S8 (Reducing energy consumption – non-residential) replicates the clauses except with a higher permitted total energy demand of 70-90kWh/m^2/year. The assured performance clause is also mirrored.

If a non-residential proposal can demonstrate why the metrics are not achievable, it can instead source renewable energy from off-site, pay the local authority to deliver equivalent renewable energy or other offsite infrastructure to deliver the appropriate carbon saving, or connect to a decentralised energy scheme.

Alternatively, a non-residential proposal may demonstrate achievement of BREEAM Excellent or Outstanding, instead of complying with the energy metrics.

Emerging example: Merton New Local Plan (draft 2022)

In April 2023, the inspectors expressed concerns in the Post-Hearings Letter[lxxi] around the viability of policies set out below, particularly for smaller development, that may negatively impact delivery. This relates to potential issues for small housebuilders in that required expertise in energy efficient construction may not be widespread.

The currently proposed draft with main modifications after the inspectors' first comments[lxxii,lxxiii] sets Policy CC2.3, which includes the following maximum **Energy Use Intensity** targets from Jan 2025 – this is likely to change now following the Post-Hearings Letter:

- Residential and multi-residential – 35 kWh/m^2/year
- Offices, retail, GP surgery, hotels and higher education – 55 kWh/m^2/yr
- Schools – 65 kWh/m^2/yr
- Leisure – 100 kWh/m^2/yr
- Light industrial uses – 110 kWh/m^2/yr

Supporting text paragraph 2.3.18 explains that major developments should calculate these with (CIBSE) TM54, (PHPP) methodology or equivalent. Minor residential schemes are permitted to instead calculate these with Part L SAP. 5-year post occupancy monitoring is also required for major development.

The targets match those developed by the Low Energy Transformation Initiative to be consistent with achieving national net-zero carbon targets (paragraph 2.3.21) and proven feasible by energy modelling for another emerging local plan. In contrast, paragraph 2.1.14 notes that typical current Part L EUI is 140/kWh/m^2/yr.

The policy also includes the following **space heat demand** targets, with SAP:

Development type	Until 31/12/2022	01/01/2023 – 31/12/2024	From 01/01/2025
Block of flats & mid-terrace house	<43 kWh/m^2/year	39 kWh/m^2/year	15 kWh/m^2/year
Semi-detached, end-terrace & detached house	52 kWh/m^2/year	46 kWh/m^2/year	20 kWh/m^2/year
Non-residential (target flexible)	-	-	15 kWh/m^2/year

Supporting text paragraphs 2.3.9 – 2.3.13 explain that the gradual uplift allows time for developers to adapt, and that the 2022-24 targets reflect the Zero Carbon Hub 'interim fabric energy efficiency standard' and 'full fabric energy efficiency standard' which have been demonstrated to be feasible, viable, and achieved in several schemes in Merton.

In Policy CC2.4, proposals must use low carbon heat. Proposals must demonstrate "how the proposal has made the best potential use of roof space" to maximise renewable energy generation, which should meet "100% of energy demand … where possible".

Emerging example: Winchester Draft Local Plan (draft 2022)

This proposed submission underwent Regulation 19 consultation in March-May 2022[lxxiv].

Proposed Policy CN3 (Energy efficiency standards to reduce carbon emissions) requires that all residential development must demonstrate the following:

- **No on-site fossil fuels** for space heating, hot water or cooking.
- Space heating demand of **15 kWh/m^2/year.**
- Energy consumption (EUI) of the building(s) to less than **35 kWh/m^2/year.**
- **Passivhaus Planning Package or CIBSE TM54** to be used for predicted energy modelling.
- On-site renewable energy generation to provide 100% of the energy consumption required by residential buildings.

It appears in the Draft Plan that there is no option to offset shortfalls to the renewable energy generation and/or EUI target. No other authority has proposed the EUI approach without a last resort option to offset, although most evidence studies prove that the absolute energy requirements are technically feasible for the majority of housing typologies and therefore offsetting may not be required.

High-rise flat block is the primary typology that may struggle to meet on-site renewable energy requirements since there is limited roof space relative to the internal floor area. Given the housing mix in Winchester is unlikely to include this typology, this could explain why offsetting is not currently included in the Plan – this could be an approach South & Vale also explore for the same reasons.

Emerging example: Greater Cambridge Local Plan (First Proposals 2021[lxxv])

Policy CC/NZ *will require and guide net zero carbon new builds.* This will include:

- Space heat demand of 15-20 kWh/m^2/year in all new developments
- No new developments to be connected to the gas grid; all heating low-carbon
- Total energy use intensity targets to be achieved as follows:
    - Dwellings including multi-residential: 35 kWh/m^2/year
    - Office, retail, higher education, hotel, GP surgery: 55 kWh/m^2/year
    - School: 65 kWh/m^2/year
    - Leisure: 100 kWh/m^2/year
    - Light industrial: 110 kWh/m^2/year
- Proposals should generate at least the same amount of renewable energy (preferably on-plot) as they demand over the course of a year [including] all energy use (regulated and unregulated), calculated using a methodology proven to accurately predict a building's actual energy performance.

The need and deliverability of this policy is evidenced by a suite of net zero carbon evidence reports including:

- Local area carbon reduction targets that would represent a fair local contribution to the national net zero carbon transition and Paris Agreement
- Expert analysis by the Committee on Climate Change and various building industry experts about what must happen in the buildings sector to deliver the national net zero goal and interim carbon budgets – including proposed targets for heat demand, total energy use, and on-site renewable energy generation – and explaining how/why this is not delivered by building regulations (current or incoming)
- Technical feasibility studies which modelled whether it was possible to reach the proposed zero carbon energy balance in the typical types of development expected to come forward in the plan period (based on applying a range of energy improvement measures to real recent development proposals that received permission) – this showed that the targets were feasible
- Cost modelling to show the cost uplifts to meet the modelled energy improvement measures, as above, for inclusion in the viability assessment.

The supporting text notes that the alternative – having no policy and relying instead on incoming uplifts to building regulations – would fail to fulfil the plan's statutory duty to help fulfil the Climate Change Act and would fail to play Greater Cambridge's role in helping the UK fulfil its commitment to the Paris Agreement to limit climate change to 1.5C or 2C.

The plan is still in its relatively early stages as of May 2022. It completed its First Proposals/Preferred Options consultation in December 2021, from which issues are being explored. A draft of the local plan itself is expected be released in 2023.

Emerging example: Leeds City Council Draft Local Plan (2023)[lxxvi]

Policy EN1 Part B *requires new development to be operationally net zero.*

All development must demonstrate a space heating demand of 15 kWh/m^2/year.

Energy use intensity required targets vary significantly between typologies, as set out below:

- All residential development – 35 kWh/m^2/year
- Offices, retail, GP surgery, hotels and university facilities – 55 kWh/m^2/year
- Schools – 65 kWh/m^2/year
- Leisure – 100 kWh/m^2/year
- Light industrial uses – 110 kWh/m^2/year
- Research facility – 150 kWh/m^2/year

On-site renewable energy generation is to deliver an annual net zero carbon balance (including regulated and unregulated emissions).

Additional secondary requirements:

- Calculations must be carried out using an approved building modelling software such as IES-VE, SBEM and PHPP.
- Gas boilers and direct electric resistive heating will not be supported.
- Expected official UK government electricity grid carbon intensity values to be used instead of static SAP10.2 factors.
- Offsetting at a cost of £248/tCO_2 – rising to £280 by 2030 to reflect further predicted grid intensity reductions.

Policy EN1 Part B goes further than similar recently adopted policies, since it prescribes EUI targets for non-residential typologies alongside residential. The policy is also explicitly refers to the use of gas boilers, whereas other policies rely on the energy targets themselves to rule out gas boilers and direct electric heating.

Emerging example: Bristol City Council Draft Local Plan (2022)[lxxvii]

Policy NZC2 requires new development to be operationally net zero based on absolute energy limits.

All development will be expected to:

- Achieve a maximum 15 kWh/m^2/year space heating demand
- Achieve a maximum 35 kWh/m^2/year energy use intensity – new homes and other forms of accommodation to achieve
- Comply with operational energy/carbon requirements of BREEAM 'Excellent' – major non-residential
- Provide on-site renewable electricity generation with an output equivalent to at least the annual energy consumption of the development
- Development should provide onsite renewable energy of 105 kWh/m^{2}fp/year

In the case of Policy NZC2, offsetting is a last resort option for energy use intensity instead of on-site renewable energy generation – price set at £90/MWh or 9p/kWh. See *previous section* for further information.

The key policy element here that is unique to similar emerging examples is the expectation of a certain amount of renewable energy based on the footprint of the building. Best practice for this metric is currently 120 kWh/m^{2}fp/year. Setting a target for this ensures that it is easy for planning officers to assess whether a development has truly maximised all available roof space. In most cases, if on-site roof top solar PV generation is predicted to be lower than the target set out, it can be assumed that all opportunities for generation have not been maximised from the earliest stage of the scheme.

Now that confirmed examples and emergent policies have been explored thoroughly, it is clear what the Joint Local Plan can achieve. Exactly what should be included is explored in 'Policy recommendations', but the examples above show that the equivalent South & Vale policies could include standards on:

- Energy Use Intensity
- Space heating demand
- On-site renewable energy generation
- Potentially an additional technical certification for non-residential buildings such as BREEAM

To ensure it is clear that on-site renewable energy generation has been truly maximised, a target using a kWh/m$^2_{\text{building footprint}}$/year should be set and is recommended later in this report.

Policy recommendations for the South & Vale Joint Local Plan on operational energy requirements, alongside measures to reduce the performance gap, are found later in the report for both residential and non-residential development.

In addition to the key energy metrics for these policies, the South & Vale Joint Local Plan should seek to incorporate measures on climate adaptation, most notably overheating risk, which is linked to energy efficiency; this is explored later in the report. An overview of overheating risk and how it could be integrated into policy is explored below.

Overheating risk becomes a greater concern as buildings (necessarily) become more energy efficient and thermally insulated. Overheating risk can decrease comfort or even safety of residents. Integrating overheating assessment requirements into policy alongside operational energy/carbon requirements works towards a well-rounded policy approach, that can address mitigation and adaptation holistically.

Building Regulations Part O offers either a simplified method or a dynamic modelling method to assess overheating, but the more effective 'dynamic method' is not necessarily required although it provides more detailed information on specific risks and their locations within a building. Alternatively, CIBSE TM52 and TM59 overheating risk assessment methodologies provide a robust approach for accurately assessing and mitigating such risks, which could be implemented as policy alongside operational energy/carbon measures. Requiring that new development appropriately integrates the cooling hierarchy into design decision-making also best ensures that overheating risks are considered throughout the entire decision process, allowing for more effective measures to be selected. The cooling hierarchy prioritises passive measures to reduce overheating risk, instead of allowing active cooling measures to be installed, such as air conditioning units that will unnecessarily increase energy demand and impact Energy Use Intensity levels.

Although a 2021 Written Ministerial Statement claims that now Building Regulations Part O (Overheating) has been introduced "there will be no need for policies in development plans to duplicate this", we note that Part O does not make mandatory the more effective full dynamic overheating modelling approach exemplified by CIBSE TM52 and TM59 as above. Therefore, we recommend that this more detailed policy approach requiring CIBSE overheating methods should be utilised.

Overheating and operational energy/carbon should be treated together, for example to ensure that the development does not increase overheating risk by excessively pursuing solar gain to reduce heating demand, and that the design does not require energy use for active cooling now or in future climate conditions. Therefore, it is important that passive cooling measures are prioritised and active cooling measures are only used as a last resort because their use will increase energy consumption and subsequent associated carbon emissions. Design elements such as building form, orientation, shading and passive ventilation should be decided at the earliest possible stage to ensure passive measures are maximised and overheating is sufficiently addressed. Overheating policy recommendations are found later in the report.

Carbon and energy offset payments

Offsetting in the context of the policy recommendations made in this report is specifically addressed in the separate 'Task 5' report, where the recommended approach and prices are laid out. This section of the evidence base explores existing offset approaches.

Carbon offsetting

Carbon offset payments are sometimes set as a Section 106 requirement in order to make a development's unavoidable carbon emissions acceptable through off-site actions to mitigate them.

Carbon offset payments from developers were pioneered by Milton Keynes in 2008 and later adopted by Ashford and Islington, then across London, and now also Reading. These funds are meant to deliver actions that will prevent or remove the same amount of carbon that the development is calculated to emit over a certain number of years. Several key differences arise in how this kind of policy is applied:

- Calculation and scope
- Pricing
- Collection and spending.

Calculation and scope

Key differences here are:

- Whether to offset only regulated carbon emissions as calculated by SAP or SBEM (national calculation methods), or also unregulated emissions (and how to calculate these if so)
- Number of years of carbon emissions that the developer should pay for
- When the calculation should be performed – i.e. at the time of planning application, or on completion or post-occupation to ensure the offset amount reflects reality.

In the London Plan 2021, only regulated emissions must be offset (as calculated by SAP/SBEM). Some local authorities in London and elsewhere also seek offsets for unregulated emissions.

Where local plans require *carbon* offsetting to 'net zero' we have not found any examples that use a non-SAP / non-SBEM method to calculate the *regulated* portion of the carbon emissions that must be offset (although some seek offsetting of the *unregulated* portion using a different method). However, some energy-based policies that offset energy and not carbon use tools such as PHPP when calculating the amount of offsetting required for policy compliance.

Pricing

- Either tied to a nationally recognised 'carbon price' such as the BEIS carbon valuation,
- Or the cost of delivering local projects that would remove or prevent the same amount of carbon.

The recommended London offset price is based on a 2017 study by AECOM. This explored a range of costs to enact carbon-saving projects, minus the amount of 'copayment' that can be secured (e.g. if homeowners pay part of the cost towards insulating their home, and the fund pays the rest). These projects mostly consisted of retrofitting existing buildings with insulation or renewables. It concluded:

> "Given the wide variability in the costs and carbon savings for potential carbon offsetting projects combined with the uncertainty in the percentage copayments that could be secured, it would be difficult to assemble sufficient evidence … to analytically derive a robust [London-wide] carbon price based on the cost of offsetting projects. As such, the approach adopted in this study is to … base [offset] prices … on a nationally recognised carbon pricing mechanism".

The AECOM study notes that offsetting [within the London Plan policy approach] must be considered in viability studies, and could be varied by the location in the same way that CIL zones differ. The London Plan 2021 lets boroughs set their own price, noting that "a nationally recognised non-traded price of £95/tonne has been tested as part of the viability assessment for the London Plan". The equivalent cost of offsetting based on the original £95/tCO_2 is now set at £378/tCO_2 (2023 price) to reflect a decrease in carbon intensity of the grid. 2018 Mayoral guidance notes some LPAs have based their price on the average cost of local projects to save carbon, e.g. Lewisham (£104/tonne), which is re-tested in a local viability assessment. We note that it is important that viability assessments must not 'double count' the cost impact of net zero carbon policy: that is, the viability assessment should firstly consider the cost of meeting policy requirements for carbon reductions on-site through improvements to the building, and then only apply the cost of offsetting where there is any *remaining* carbon.

In the context of the South & Vale recommended offset approach in Task 5, offsetting does not need to be considered in viability assessments because the price set is equal to the cost of on-site measures and therefore does not represent an additional cost to the developer.

Collection and spending of offset payments

London mayoral guidance (2018) notes that offset payments should be collected via Section 106 agreements in the usual way and by the same team, and that:

> "LPAs generally choose to take **payment on commencement of construction** on site. Some choose to **split the payment**, with 50 per cent paid post-construction and 50 per cent prior to occupation. This is up to the LPA to determine. However, taking payment later than commencement of works can mean a high degree of uncertainty as to when funding will be received and is unlikely to enable carbon savings from the offset fund to be delivered before the development is occupied, creating a delay in offsetting a development's carbon impact. LPAs should also note the time limits that apply to discharging Section 106 agreements and ensure funds are collected and spent in this time period."

One potential pitfall is that carbon offset payments received via S106 agreements have sometimes had to be returned after not being spent in the allotted timescale. National Planning Practice Guidance notes that:

> "[S106] agreements should normally include clauses stating when and how the funds will be used by and allow for their return, after an agreed period of time, where they are not."

This can be avoided. London's 2019 annual survey of the use of offset funds notes that in that financial year, "No LPAs reported returning offset payments to developers" and also that "The GLA would not expect offset payments to be returned in any instance and expects LPAs to be collecting offset payments for all applicable developments and identifying suitable projects for spending funds."

The Centre for Sustainable Energy notes that developers can ask for a refund of carbon offset payments that are unspent within 5 years. To avoid this, it recommends setting up:

"defined structures and processes to stimulate new markets and opportunities for carbon saving measures ... [Creating] an open application process to stimulate and attract carbon saving projects from council departments, the market and community that would be unviable without subsidy, for example community energy projects or insulation schemes. Applications should be proportionate to the scale of the funding provided, the emissions to be saved and the risk profile of projects."

"Programmes of standardised measures, low unit cost, low risk and lower variability of carbon savings (such as the many domestic insulation programmes, run by council housing departments) should be required to apply to the fund just once as a whole programme, with detailed implementation targets, specifications, predicted carbon savings and reporting processes and timetables. Once approved, it should be as simple as possible for residents, communities or businesses to access funding through these programmes."

The 2018 London mayoral guidance encourages LPAs to pool Section 106 carbon offset payments rather than committing to spend them on specific projects. When the guidance was written, local planning authorities were only permitted to pool up to five S106 payments towards the same project, but this restriction was removed in 2019 and this can now be pooled with CIL payments too. Councils using either CIL or S106 must publish an infrastructure funding statement annually. When setting the carbon price, the LPA should factor in a cost to administer the fund and set up a pipeline of projects to be funded.

Example: Milton Keynes

A 2016 review of offsetting practices noted that both Ashford and Milton Keynes originally established their local carbon price in 2008 using an estimate of typical costs of making carbon savings elsewhere in their respective districts. This was set at £200/tonne in 2008, plus inflation.

The MK Adopted Local Plan 2019 Policy SC1 retains this requirement: Offsets must be paid for carbon emissions that remain subsequent to complying with the first two requirements for a 19% reduction in Part L 2013 carbon emissions, plus a further 20% emissions reduction through renewable energy.

Milton Keynes adopted Sustainable Construction SPD 2021 notes that Policy SC1 does not require offsetting of *unregulated* emissions. This is notable because the draft version of that SPD (2020) had sought offsets for both regulated emissions (calculated by SAP in homes or SBEM in non-domestic buildings) and unregulated emissions (calculated by BREDEM for homes; in nondomestic buildings this can be calculated using CIBSE Guide F, CIBSE TM54, or metered evidence from previous work). This requirement appears to have been removed after one public consultee pointed out that the SPD could not require this because the plan policy SC1 itself did not specify that it included unregulated energy.

This SPD confirms that the price remains at £200/tonne plus 'indexation fluctuations' which will be decided at the time of calculation. The developer must only offset 1 year of emissions, but the SPD notes that they may apply an annual multiplier in future iterations of the local plan.

Example: New London Plan 2021

Policy SI2 allows offset payments to partially meet the net zero carbon requirement. It applies to:

- Major development only
- Any regulated residual emissions over a period of 30 years, after enough upgrades have been designed-in to result in at least a 35% on-site reduction in the regulated emissions (using SAP/SBEM calculation).

There is no London-wide requirement to offset unregulated emissions, but major developments must still "calculate and minimise" these.

At least one London Borough (Islington) does additionally require an offset for unregulated emissions (as of a 2016 National Energy Foundation review[lxxviii] of practices across London).

The same NEF review found that most London local planning authorities (LPAs) require that the carbon is calculated at the time of the planning application. However, several of these LPAs then update the calculation later:

- Recalculation at detailed design stage or discharge of planning conditions (Croydon, Hackney, Islington, Hillingdon, Kingston)
- Recalculation at 'as built' stage, on completion (Brent, Enfield, City).

The London Plan Policy SI2 requires that each borough must maintain its own fund to hold and use these offset payments. This must be

- Ring-fenced for carbon reducing actions, and
- Its activities monitored and reported on annually.

Mayoral guidance (2018) expects the local carbon offset price per tonne to be based on:

  - either a nationally recognised carbon pricing mechanism (starting at £60/tonne as the nationally recognised non-traded price, although the Plan 2021 raises this to £95/tonne),
  - or the cost of offsetting carbon emissions across the local planning authority area.

Example: Islington Local Plan Core Strategy 2011

Policy CS10: "All major development should achieve an on-site reduction in total (regulated and unregulated) CO_2 emissions of at least 40% in comparison with ... Building Regulations 2006" and the rest offset via a contribution at £920/tonne for one year's emissions, or a flat fee for minor developments.

Neither the policy nor SPD say how unregulated emissions should be calculated, nor do they differentiate between regulated and unregulated emissions for offsetting. This implies that unregulated emissions are included in the offsetting.

Energy offsetting

Due to the rising number of local authorities setting standards based on the approach set out in the previous section (with fixed energy targets and 100% renewable supply), energy offsetting is becoming more prominent. In this context, it is preferred over *carbon* offsetting because the cost of offsetting is based directly on residual kWh (£/kWh), instead of tCO_2 (£/tCO_2). Carbon intensity factors (see glossary) of the grid or other energy sources are not required for calculations when energy is offset (instead of a carbon offset), which leads to a more direct reflection of exactly what is being offset. Carbon factors for offsetting are often quickly outdated, and are somewhat crude in their estimation since they are annually averaged and do not reflect seasonal grid intensity variations. Planning decisions on carbon offsetting could also face a stumbling block around uncertainty about what the grid carbon factor will be by the time the development is completed; energy offsetting avoids this problem.

Energy offsetting simplifies the process for project selection due to the absence of carbon factors, since it becomes easier to assess how many kWh a new rooftop solar PV installation will produce, for example. This better ensures that the residual kWh that were not mitigated on-site can be directly measured and mitigated off-site through a funded project through an energy offset fund.

With *carbon* offset funds, several types of project including energy efficiency, retrofitting, and renewable energy could be appropriate for the delivery of those offsets, because the residual amount of CO_2 is not directly assigned to a particular measure. In some cases even tree planting is proposed despite uncertainty about its longevity, or transport measures despite uncertainty that this will deliver the required CO_2 savings in reality. This uncertainty can result in political disagreement about how to spend the fund on competing priorities, and administrative complexity in assembling a portfolio of projects, thus the required amount of carbon mitigation may not be swiftly (if at all) achieved.

When *energy* needs to be offset, it is usually due to a technical inability to deliver the required on-site renewable energy generation. This makes it a simple decision to spend the fund on off-site solar PV installations, preferably on existing buildings, which should aim to at least generate the residual on-site kWh. Through this simplified system, energy offsetting can become a reliable mechanism to ensure that any residual on-site renewable energy generation is wholly mitigated elsewhere.

It should however be explicitly noted that offsetting in this context, as well as a carbon offset context, should strictly be a last resort only acceptable in exceptional circumstances. The risk of offsetting is that it may increase the burden on existing district-wide decarbonisation plans and use up low hanging fruit resources. Additionality must therefore be the primary consideration of both offset approaches to ensure that the offset funding delivers something that would not have otherwise been created.

To best guarantee offset mechanism effectiveness, a locally-specific net zero offset price should ideally be set, which should be based on the cost of existing delivered renewable energy schemes of varying size. Subsequently, an appropriate price should be set to sufficiently deliver the residual kWh not mitigated on-site. In recent examples, prices to achieve this have been set at 9-12p/kWh.

Assuming the current electricity emissions factor in SAP10.2 (136 gCO_2/kWh), an estimated net zero local offset price - £652/tCO_2 for Bath & North East Somerset Council – can be close to double the price of the 2023 BEIS Green Book valuation of £378/tCO_2. This represents the importance of a correctly set price, which otherwise risks insufficient funds to deliver the residual on-site energy elsewhere.

A recent study by the Centre for Sustainable Energy (CSE) for West of England (WoE) authorities determined the cost of energy offsetting based on 131 domestic rooftop PV installations that were delivered through the Local Authority Delivery Scheme (LADS), which was managed by Bristol City Council's energy service. The installation costs of solar PV projects through the LADS scheme well represents the costs of energy offset fund projects that are likely to occur in the WoE in the future, particularly due to the average installation capacity of 3.37kWp. The subsequent median installation cost under the LADS scheme was £2,180/kWp, in contrast to the BEIS installed cost statistics for 4-10kWp solar PV installations (2020-2021) value of £1,586/kWp. This again reiterates the importance of establishing a *locally-specific* offset price as nationally-averaged costs can produce a price 25% lower than the local cost, as demonstrated above. Using the £2180/kWp median installation cost value, an offset price (including 15% administration costs for the fund) of 9p/kWh was estimated by CSE, which can be considered a local net zero energy offset price for the West of England authorities.

Example: Cornwall Climate Emergency DPD (2023)

Policy SEC1 (Part 2b) "*allows offsetting where it is not feasible to meet all the renewable energy requirements for new-build residential and there is no connection to a low carbon district energy network*".

Cornwall will run a pilot offsetting spending scheme, which will install solar PV on existing Cornwall Council housing.

A study by the South West Net Zero Hub set the cost for energy offsetting, which is set at **10p/kWh** to reflect overall costs to deliver residual on-site renewable energy generation elsewhere. Over the assumed 30-year lifetime, the price accounts for:

- Administrative costs
- Annual maintenance
- Solar PV panel degradation
- Inverter replacement for a typical 3kW solar PV array for each home

Example: Bath & North East Somerset Council Local Plan Partial Update (adopted 2023)

Policy SCR6 provides a last-resort option for major development in exceptional circumstances.

The funds will be spent on solar PV installations on existing social housing and low-income households, which will be delivered in partnership with a community energy group and local housing provider.

A *study* by the South West Net Zero Hub established an initial local net zero cost for energy offsetting, set at £652tCO_2 (converted from kWh). B&NES however selected the 2023 BEIS Green Book value of **£373/tCO_2**. 10% administrative costs are then added onto the final calculation for the lifetime financial contribution.

The lower yet nationally-recognised valuation was primarily selected due to time constraints with the Examination in Public, which did not allow the production of an in-depth study to establish a more robust local net zero offset price (an initial study only assessed one solar PV installation so was not deemed a robust basis for a price).

Emerging example: Bristol City Council Draft Local Plan (2022)

Bristol City Council have proposed two offsetting schemes in their Draft Local Plan: operational energy offsetting and embodied carbon offsetting. The latter is described in a following section, whilst operational energy offsetting is discussed here.

Policy NZC2 takes a different approach to energy offsetting to the two adopted examples set out above. Instead of offsetting a shortfall to on-site renewable energy generation to meeting a net zero energy balance, it is residual kWh to energy use intensity that is to be offset as a last resort.

The offset cost is set at **9p/kWh** that is required over the typically assumed 30-year building lifetime. This is stated to be equivalent to providing additional renewable energy generation elsewhere in the city and is therefore a locally-specific net zero offset price. Cornwall (above) set a similar cost of 10p/kWh, which is the same as the estimated price for West of England authorities by the Centre for Sustainable Energy.

Taking into account the range of offsetting approaches within both carbon and energy contexts, the recommendation for the Joint Local Plan is to offset residual on-site renewable energy generation, which is based on a £/kWh price. Embodied carbon should offset under a carbon metric. (£/tCO_2). This is explored in detail in separate report 'Task 5'.

Policy recommendations for operational energy (residential and non-residential) and embodied carbon are presented later in this report.

Energy performance gap

The energy performance gap is the difference between the predictions for a designed building's energy use, and the amount of energy it actually uses in operation. This is due to three factors:

1. Poor methods used to predict the energy use of a building (including poor calculations, incorrect assumptions, and exclusion of 'unregulated' energy loads)
2. Errors in construction which lead to worse airtightness or thermal envelope
3. Errors in system operation, and user behaviour different to assumptions (for example, turning up space heating while opening windows to dry laundry, not using heat system as intended, spending more time in the building than anticipated, or bright lighting left on overnight).

Unfortunately, the calculation methods used in Building Regulations Part L (SAP and SBEM) are very poor predictors[lxxix] of the actual energy use of a building. SAP and SBEM are compliance tools[lxxx], not really tools to predict energy and carbon performance (even though they purport to be). This is not only due to out-of-date carbon factors used for different energy sources, but the entire methodology.

For this reason, recalculating SAP on completion[15] will not prove that the building *performs* to the same metrics as in the SAP output (kWh/m^2 and CO_2/m^2), only that it is *built* as designed in terms of installed specification of insulation, heating system and renewable energy generation. The nation-wide lack of post-occupation energy monitoring means that both developers and planning/building control enforcers are often unaware of the scale of difference between SAP outputs and actual performance.

Point (2) above relates to how imperfections in the construction process can lead to worse energy performance than predicted. For example, a building may leak a lot of heat if insulation is incorrectly installed, or if a hatch to a cold loft is put in the wrong place and then moved, leaving holes in the air tightness membrane. Lower-spec products or poor substitutions may be made in the building –for cost-cutting reasons, supply difficulties, or simply because the right person was not on site at the time[lxxxi].

Methods to address the performance gap

There are energy modelling methods that give much more accurate predictions than SAP/SBEM, such as the Passivhaus Planning Package (PHPP) and the CIBSE TM54 method. However, it is not entirely clear whether local planning authorities are legally empowered to require conformance with standards set using these alternative calculation methods because of definitions in the powers granted by Planning & Energy Act 2008 (discussed). The Local Plan may be able to require *reporting* of predicted energy use using these methods (subject to viability linked to the cost of the modelling), but it is uncertain whether the plan could require the building to *achieve* a certain metric using them (although please note the new examples from Bath/North-East Somerset, Cornwall and Central Lincolnshire have all successfully required this, sometimes through supplementary guidance). Of the two, TM54 is likely to be more clearly supported by the 2008 Act as it uses building regulations Part L as a starting point[lxxxii] and is now recognised in Part L 2021 for non-residential as a valid method to fulfil the new requirement for accurate energy forecasting).

There are also several quality assurance processes that can be applied during construction to avoid the unnecessary errors that can cause the building to perform worse than expected. Examples include:

- BEPIT (Building Energy Performance Improvement Toolkit) – a set of checks during construction that identify and remedy defects in the construction at every stage up to completion
- Passivhaus process – in addition to using accurate energy modelling, a Passivhaus project undergoes a series of stages during design and construction which improve the build quality
- NEF/GHA Assured Performance Process™ – this maps to the five stages of the RIBA Plan of Work (inception to verification) and involves expert impartial review by accredited assessor.
- Soft Landings – recommended by the UKGBC (as above) but discounted by some local planning authorities as an acceptable 'quality assurance' method (see example of Milton Keynes).

There may be other suitable quality assurance processes. These **must** be based on quality of energy performance, not just generic building quality. South & Vale would need to decide whether these are acceptable based on their individual merits and evidence that they are effective (verified by track record of previous projects' post-completion testing or post-occupation energy monitoring).

The Local Plan could require the use of these processes, subject to viability (again relating to the cost of appointing qualified professionals to undertake these processes). Proposals could submit:

- Energy modelling: evidence to be submitted in energy statement with planning application, and recalculation of this if any relevant details are changed at reserved matters / amendments. (This would be necessary in any case to demonstrate compliance with energy intensity targets even at design stage, even without an in-use verification requirement.)
- Quality assured construction: evidence to be submitted along with other documentation to gain sign-off on completion from building control and discharge of planning conditions.
- UKGBC Policy Playbook recommends "a recognised performance gap / assured performance tool will be used to minimise the potential performance gap between design aspiration and the completed development. The effectiveness of measures will be reviewed and ratified as part of the post-completion discharge of conditions".
- Evidence requirements in the case of no 'quality assured construction' scheme relating to energy use: set a standalone requirement to carry out air tightness tests whilst the air barrier is still accessible as a construction requirement, if the full use of specific third-party quality assurance schemes would make necessary development unviable.

Verifying energy performance post-completion

Post Completion certificates can be issued once Planning Conditions are discharged. Local Authorities can condition to ensure that buildings are performing as anticipated; however, this would require engagement with the main contractor outside of their practical completion contract. Examples have sought this through an Area Action Plan and site-specific allocations.

There is debate about whether it is reasonable to hold developers accountable for carbon impacts of unregulated energy use, which would be untested by Part L SAP and largely out of their influence in

[15] As-built SAP calculations have been used by several local authorities to determine the final amount of offset payments the developer must provide, but it does not verify performance or change the energy performance gap. Relying only on SAP will always mean the developer offsets far less carbon than the building will actually emit – although it does simplify the offset decision-making and data gathering process.

terms of unconfirmed occupant fit-out, operational hours, occupancy, and other third-party factors. These uncertainties are larger in non-residential buildings, where there is a wider range of variation in how the buildings are used compared to residential building use patterns which tend to be more homogenous and predictable. However, even for non-residential, reasonable assumptions can be made about many of these uncertain factors, in order for the developer to include the appropriate amount of renewable energy in the design, even if the metered data in any post-occupation monitoring turns out to vary from the design-stage assumptions.

The following pre-completion testing requirements would help in the assurance of as-built performance against the design standard. Outline costs[16] are provided:

- Air tightness testing ~£1000 per property
- Thermographic testing[17] ~£400 per property
- U Value testing ~£400 for a dwelling (3 weeks per property)[18]
- Post-occupancy evaluation testing: ~£5000[19]. (if applied to scalable developments >c.50 dwellings, the economy of scale would reduce the cost burden through sample testing only).

[16] Communities and Local Government (2008), Performance Testing of Buildings BD 2535
[17] Thermographic surveys can only be completed during the heating season. Where building completion occurs outside that season, the applicant could commit test at the earliest opportunity and perform remedial measures where needed. Homeowners must be fully informed.
[18] Accredited construction details are to be checked through thermographic testing performed according to BS EN 13187: 1999 Thermal performance of buildings. Qualitative detection of thermal irregularities in building envelopes. Infrared method. Identified locations with deviations from expected performance are further investigated through a borescope survey and remedial works performed if practical.
[19] https://www.pollardthomasedwards.co.uk/download/PTEpost-occupancy_evaluation2015_LR.pdf

Example: Milton Keynes Local Plan 2019 (adopted)

Policy SC1 includes that:

- K. 5 All proposals of 11+ dwellings or non-residential space over 1,000m^2 must
    - "implement a recognised quality regime, which assures that 'as built' performance (energy use, carbon emissions, indoor air quality, and overheating) matches the calculated design performance", and
    - "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..
- The Sustainable Construction SPD explains that a 'recognised quality regime' must include
    - (1) modelling of different scenarios at design stage and issuing performance targets such as kgCO2e/year or energy use (which must use expected usage profiles rather than standard ones, and should ideally include Dynamic Simulation Modelling using the National Calculation Methodology [SAP or SBEM] as a baseline),
    - (2) processes and plans in place to ensure everyone in construction and dwelling management knows how to avoid common reasons for the performance gap,
    - (3) suitable fabric testing and iterative feedback mechanisms,
    - (4) demonstrating that the 'as built' targets set are achieved, and
    - (5) third-party verification that the quality regime has been carried out.
- The SPD also asserts that the quality regime must ensure the post-occupancy data will be available by implementing a suitable metering and monitoring strategy that can deliver performance data to compare with the designed performance targets.
- The SPD also notes that two suitable regimes are the Quality Assurance sections of Home Quality Mark ONE, and BSRIA Soft Landings Framework.
- The above specified requirement for the 'quality regime' means that the developer must also test the 'as-built' performance and submit data to the council. A report is then submitted to both occupiers and to Milton Keynes Council, which states the performance gap metric and identifies any reasons for deviation from predicted energy usage, carbon emissions, indoor air quality and overheating performance, as well as specific actions that have or will be taken to reduce the gap.

Example: Greater London Energy Monitoring Guidance 2020 (adopted)

The 'Be Seen' energy monitoring guidance (April 2020) requests that[lxxxiii]:

"Analysis guided by CIBSE TM54, which recommends using a tailored Part L model for the estimates of regulated and unregulated loads, should be undertaken and its findings should be reported in the 'be seen' reporting webform. A TM54 analysis gives more accurate predictions of a building's energy use. This approach also aligns with the reporting requirements under the GLA's Whole Life-Cycle Carbon (WLC) Assessment Guidance. The CIBSE TM54 findings should therefore also be used to represent the regulated and unregulated energy requirements for non-residential uses of Module B (operational energy use) of BS EN 15978."

Example: B&NES and Cornwall 2023 (adopted)

Supplementary guidance from Cornwall Council, and the Sustainable Construction Checklist SPD from B&NES respectively set out compliance and reporting frameworks for the councils' recently adopted net zero homes policies.

Both documents recognise the inaccuracy of SAP to accurately assess building energy performance, particularly with policies that assess energy use intensity and space heating demand. To resolve issues with SAP and subsequently minimise a performance gap, the councils take the same approach, which provides two options to developers for new build residential applications:

- **Passivhaus Planning Package** (PHPP) – suitable for all residential development
- **SAP + Energy Summary Tool** – suitable for minor residential development

PHPP is the preferred option for any size of development, but it is a requirement for major residential development.

The option for SAP to be used alongside the Energy Summary Tool is offered as a benefit to developers, so that the use of familiar Part L software can continue for minor residential development. The use of the Energy Summary Tool ensures that final outputs from SAP for energy use intensity and space heating demand reflect genuine in practice performance.

It is important to note that these requirements, which have the intention to reduce the performance gap, were not subject to deep interrogation during Examination.

Emerging Example: Solihull Draft Local Plan (draft 2021)

Policy P9 requires that all major developments must “implement a recognised quality regime that ensures the 'as built' performance (energy use, carbon emissions, indoor air quality, and overheating risk) matches the calculated design performance of dwellings as specified above [a 30% reduction on Part L 2013 commencing from now, and net zero carbon for all new development commencing from April 2025]”

Emerging Example: Merton New Local Plan (draft 2021)

Merton is currently awaiting a response from the Inspector following the submission of additional requested information and documents post-examination. Its proposed draft with main modifications after inspector’s first comments[lxxxiv] Policy CC2.3 includes a range of space heat and energy use intensity targets whose compliance must be demonstrated using calculations with (CIBSE) TM54, (PHPP) methodology or equivalent.

The supporting text explains that these calculation methodologies help to reduce the performance gap because they generate much more accurate predictions of energy use, compared to the SAP methodology used to fulfil Building Regulations Part L.

Setting effective energy performance targets is crucial, yet it is equally important to ensure that they are effectively implemented in practice. Therefore, policies need to be in place to address and monitor the energy performance gap. As shown in the examples above, policies in this area address accurate energy performance calculations, assured performance processes throughout construction, and post-occupancy monitoring mechanisms. The South & Vale local plan should seek to address these key areas in policy development, which have been recommended later in this report.

Existing buildings

There is less clear direction in legislation, and fewer examples available, to demonstrate the acceptability of seeking energy and carbon improvements in existing buildings compared to new ones.

The variety of types, ages, uses and conditions of existing buildings make it impractical to devise universal requirements for their energy and carbon performance that could be reasonably sought through local plan policies. It is difficult or impossible to retrofit them to the same energy performance standard as new builds can achieve, and the workforce has a shortage of skills to do this effectively.

The decarbonisation of existing buildings is actually a more important challenge compared to new buildings, simply due to scale. This is supported by the fact the approximately 1/3 of the districts' emissions are sourced from existing buildings. The Committee on Climate Change has shown[lxxxv] (and Government has recognised[lxxxvi]) that in order for the UK to meet its legally binding carbon reduction goals, it is vital that the existing building stock must be decarbonised via three main courses of action:

- Upgrades to building fabric and other energy efficiency measures
- Switching from gas or oil boilers to low carbon heating (largely heat pumps; some heat networks; and a small role for hydrogen in some areas in the future)
- Decarbonisation of the electricity grid via increases in wind and solar electricity generation to allow phase-out of fossil fuelled power stations.

The rollout of insulation and low carbon heating to existing buildings ('energy retrofit') have been far slower than predicted and needed[lxxxvii]. Heat pump rollout in particularly must be vastly accelerated[lxxxviii]. Costs for these technologies are decreasing and will continue to do so, particularly with Government grant assistance. It is important to note however that fabric measures should be prioritised initially before heat pump installation to avoid excessive energy use; this is to ensure heat retention as heat pumps operate at lower temperatures than conventional gas boilers. These measures are vital for net zero carbon and will deliver economic and wellbeing-related benefits in the long term if implemented correctly.

Take-up of solar panels to existing homes dropped steeply[lxxxix] since the closure of the Feed-In Tariff scheme in 2019, as new installations no longer generate income from energy sent to the grid. Solar PV installations are however now back on the rise due to householders becoming increasingly concerned about the cost-of-living and energy crises.

Local plans also have only a very limited influence on the carbon and energy performance of existing buildings, as they can only seek changes to buildings where the building owner is seeking to require a change to the building that requires planning permission.

However: The planning system can (correctly or incorrectly) be perceived by building owners as yet another obstacle to retrofitting, on top of the cost, disruption, and risk of building damage. Owners may (wrongly) assume that all changes need permission, or that permission is likely to be refused. Building owners' willing action and investment is essential to the net zero carbon transition, and therefore it is vital that the planning system becomes a facilitator and not an obstacle to this.

The National Planning Policy Framework confirms that (paragraph 152): "The planning system should support the transition to a low carbon future … [by] encourag[ing] the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure". It also confirms that (paragraph 158) when determining applications for renewable and low carbon development, the local planning authority should not require the applicant to demonstrate the overall need for renewable energy, and should approve the application if its impacts are acceptable or can be made so. This supports a permissive approach towards proposals for the addition of carbon-saving and renewable energy measures to existing buildings.

The role of local plan policy in reducing existing buildings' carbon therefore has two main strands:

1. Removing the actual or perceived planning barriers to energy retrofit changes to buildings.
2. Allocating or identifying sites suitable for renewable energy generation and distribution in order to decarbonise the energy that existing buildings use.

Point 1 (a permissive, supportive approach) could be pursued through the following tools:

- A local plan policy that explicitly encourages energy efficiency and carbon improvements to existing buildings with significant weight attached to those benefits, and signposts the reader to further guidance about how to make such changes acceptable in heritage-sensitive settings
- Supplementary planning guidance that clearly explains the range of retrofit measures that can be effective in improving energy performance of existing buildings, which kinds of changes are acceptable in different settings, how to make acceptable changes in heritage settings (referencing available expert guidance[xc]), and advising which changes simply do not need permission in most settings
- A Local Development Order giving blanket permission to specific changes in geographic locations that are not considered heritage-sensitive – such as certain acceptable types of upgraded windows, doors, external insulation, or heat pumps visible from the street.

One further option is to seek 'consequential improvements' when changes are being made to a building that require planning permission. This could expand on Building Regulations requirements for the same. We have identified one example for this. However, discussions with energy officers at that local authority reveal that this has not proven very effective because very few relevant proposals pass over their desk, and the improvements can only be applied to the part of the building that is undergoing works, not the whole building – which can render some retrofit measures ineffective (such as airtightness). Nonetheless, the Joint Local Plan can look to encourage low-carbon measures to be integrated into the areas of the building where planning permission is needed, and require that the energy hierarchy is followed for design decisions.

Point 2 (proactive promotion of renewable energy generation and low-carbon energy distribution) could be pursued through the following tools:

- Spatial strategy (allocating or identifying suitable locations for such renewable energy features and potential low carbon heat network locations, in consultation with citizens, local business, conservation bodies and the electrical grid District Network Operator) – this can help to de-risk the prospect for potential investors, site owners and developers of renewable energy
- Infrastructure Delivery Plan – ensuring the electrical grid District Network Operator is ready to make the capacity upgrades necessary to serve a growing proportion of all-electric, gas-free, solar-exporting buildings, electric vehicles, and suitably located large-scale renewable energy
- A Local Development Order that gives blanket permission to add solar panels to buildings in locations not considered heritage-sensitive, expansion of strategic low carbon heat networks.

Example for actively welcoming energy improvements to existing buildings: Milton Keynes Local Plan (adopted 2019) [xci]

Policy SC1 (Sustainable Construction) includes that:

> "Proposals which would result in considerable improvements to the energy efficiency, carbon emissions and/or general suitability, condition and longevity of existing buildings will be supported, with significant weight attributed to those benefits."

Supporting text notes that:

- "existing domestic buildings contribute 28% of the Borough's carbon dioxide emissions (1.5 tonnes of CO_2 per capita in 2014). Along with other non-domestic buildings, retrofitting the existing building stock in the Borough presents a significant opportunity to help meet the strategic carbon dioxide reduction target of 57 per cent by 2030".

- Policy SC1 recognises the benefits that retrofitting buildings can bring [such as fit-for-purpose housing as well as carbon reductions], giving significant weight to them … in order to help achieve Strategic Objectives 11 [delivery of housing that meets needs] and 13 [mitigation of climate change]. The Council will encourage retrofit improvements to existing buildings in the Borough, on an individual and area-wide basis. Where appropriate the Council may employ Local Development Orders to support area-wide schemes".

Example using a Listed Building Consent Order to enable easier solar PV installation in listed buildings: Kensington and Chelsea (2022)

The Royal Borough of Kensington & Chelsea is the first council in the UK to issue a Listed Building Consent Order, which gives consent for solar PV on the majority of Grade II and Grade II* listed buildings without a requirement for listed building consent.

Certain conditions must be demonstrated on:

- Positioning
- Materials
- Fixings
- Protecting the appearance of fabric of the listed building

Providing the conditions are demonstrated, a far simpler application compared to a usual listed building consent application is required. This makes solar PV installations a more attractive and less time intensive prospect for householders in Kensington and Chelsea.

Examples (various): using Local Development Orders to expand renewable and low carbon energy systems and promote energy retrofit

Swindon Borough Council has used LDOs to promote the growth of renewable energy generation and use, both on specific sites and in borough-wide terms. Examples include:

- A borough-wide LDO for non-domestic air source heat pumps and district heating
- Hydrogen and electric vehicle charging stations (specific sites) –
- Identifying specific sites for solar photovoltaic arrays including solar farms. The LDO on solar farms has been particularly successful, by de-risking the process. It was created by issuing a 'call for sites' and then assessing these sites against various criteria.

Across several London Boroughs, an LDO was created to make it easier to deliver heating and cooling networks. By removing the need to make a separate application for each new network section, this makes the network more flexible for new connections and reduces the costs of expansion. It also creates a common standard for new heat networks.

Milton Keynes local plan 2019 indicates a willingness to use LDOs to encourage wide scale energy retrofit.

Actively welcoming energy and carbon improvements to existing buildings

The following policies are not intended to be strict requirements, as the local plan cannot do this. Yet they are important examples of how to signal a positive stance by the council towards retrofitting, offering confidence to potential applicants and steering officers to take very seriously the benefits of energy efficiency retrofitting when weighing up its impacts.

Emerging example: Wokingham Draft Local Plan Update 2020

Draft Climate Change Policy SS8 confirms the local plan will "support retrofitting existing buildings with measures to improve their energy efficiency and generate onsite renewable energy".

Supporting text notes that "Proposals to sensitively refurbish or retrospectively improve the performance to reduce their energy use and improve comfort will be supported. Interventions to upgrade historic buildings should be undertaken sensitively in recognition of their heritage value."

This is supported by policy DH7 (Energy) which includes that:

> "Development proposals which would result in considerable improvements to the energy efficiency, carbon emissions and/or general suitability, condition and longevity of existing buildings will be supported, with significant weight attributed to those benefits[*]. The sensitive retrofitting of energy efficiency measures and the appropriate use of micro-renewables in historic buildings, including listed buildings and buildings within conservation areas will be encouraged, providing the special characteristics of the heritage assets are protected."

Example: Cornwall Climate Emergency Development Plan Document (adopted)

This emerging plan has been through Regulation 19 consultation, underwent independent examination in Summer 2022[xcii], and was adopted in early 2023.

Policy SEC1 (Sustainable Energy and Construction) includes that:

> Significant weight will be given to the benefits of development resulting in considerable improvements to the energy efficiency and reduction in carbon emissions in existing buildings.
> Proposals that help to increase resilience to climate change and secure a sustainable future for historic buildings and other designated and non-designated heritage assets will be supported and encouraged where they:
> 1. conserve (and where appropriate enhance/better reveal) the design, character, appearance and historical significance of the building; or
> 2. facilitate their sensitive re-use where they have fallen into a state of disrepair or dereliction (subject to such a re-use being appropriate to the specific heritage asset).

Emerging example: Greater Cambridge Local Plan (First Proposals 2021[xciii])

Policy GP/CC *is titled* 'Adapting heritage assets to climate change'.

The proposed policy direction includes

- "Require retrofit works to be carried out in accordance with the BSI PAS 2035 framework and Historic England guidance for energy improvements to heritage assets
- Require proposals to take a 'whole building' approach to undertaking works to heritage assets to enhance environmental performance"
- Support proposals which seek to undo the damage caused by previous inappropriate interventions (e.g. removal of cement render and replacement with breathable options).
- Give consideration to measures that will reduce carbon emissions and assist with adaptation to our changing climate (for example external shading or property level flood protection).
- The plan will also direct residents to further guidance on how to approach works to older homes."

The supporting text notes that need for this policy is evidenced by the local plan's Net Zero Carbon Study which showed that existing buildings cause one-third of the area's greenhouse gas emissions and therefore "we cannot meet our climate targets without reducing emissions and energy usage in all our homes", given that "the Committee on Climate Change have concluded that at least 90% of existing buildings in the UK should have energy efficient retrofits for the UK to meet its zero carbon targets".

The supporting text emphasises that this is particularly relevant because 20% of homes were built before 1919, and Listed Building Status applies to 1% of homes in Cambridge and 3% of homes in South Cambridgeshire. It also notes that such improvement to existing buildings reduces running costs and also increases the lifespan of the building.

It explains that "Policy is therefore needed to support owners of heritage assets to undertake sensitive works to address the performance of their buildings, in line with best practice guidance for heritage assets".

The South & Vale local plan should ensure that policy is in place to support energy and carbon improvements to existing buildings. Although these cannot strictly be set as requirements due to limited planning powers, it is important for the local plan to take a stance that supports positive measures to existing buildings.

Embodied carbon

Embodied carbon means the carbon that was emitted in the production and transport of building materials, and their assembly on site. It can also include the emissions associated with maintaining and eventually disposing of a building too. If the latter are included, this is termed 'whole-life embodied carbon'.

These emissions rise largely from fossil fuel energy use to extract and process raw materials such as minerals and metals, then transport them. There can also be emissions from chemical processes to produce building elements (such the carbon dioxide that is cooked-off minerals to make cement) or from the breakdown of the material at the end of its lifespan.

Embodied carbon makes up a very large share of the total carbon emissions caused by the creation and use of a building across a typical 'design lifetime' of a building, usually 60 years (see UKGBC pie charts diagram previously referenced). Many commonly used building materials like ordinary cement, steel, aluminium and zinc have inherently high embodied carbon because of how they are produced. Vice versa, plant-based materials like timber can have less than zero embodied carbon because the tree absorbed carbon dioxide from the atmosphere and this is locked up in the material for as long as it is in use.

Unlike operational energy and carbon, there is currently no mechanism to address embodied carbon in national building regulations or other national legislation for planning and building. Still, embodied carbon is relevant for the net zero goals of the UK and South & Vale because some of materials or products will have been produced here, and all will have been transported within the country or district, and energy will be used during construction.

In the absence of a national regulatory approach to address embodied carbon and without a specific local planning power granted to address it, some local plans have nevertheless taken steps to ensure embodied carbon is not entirely neglected.

Example plans have taken one or both of the following approaches:

- Requirement to assess the building's embodied carbon, reported within the planning application
- Requirement to provide narrative about what steps are being taken to minimise embodied carbon, such as reusing existing buildings, use of lower-carbon materials, or efficient design to reduce material use.

Our review has only identified one adopted and one emerging plan that require a development to achieve a specific numeric target for embodied carbon, whether a limit or a % improvement on a baseline; see B&NES and Bristol examples below. This may be because of a lack of explicitly granted powers, and the 2015 Written Ministerial Statement that directed local plans not to set 'additional technical standards' for the sustainability of housing. It may also simply be because this is an emerging area where local planners do not yet feel confident to set these requirements, robustly justify them at inspection, or interpret whether developers have sufficiently demonstrated compliance.

There is an industry standard method to calculate a building's embodied carbon: the RICS Whole Life Carbon Assessment for the Built Environment[xciv], which builds on the relevant British/European Standard (BS EN 15978). This RICS method splits the building's whole-life embodied carbon into a series of 'modules':

- Modules A1 – A5: 'Cradle to completion stage' (from raw material extraction through to completion of the building)
- Modules B1 – B5: The 'use stage' of the building (such as maintenance, repair, replacement and refurbishment)
- Modules C1-C4: 'End of life stage' (deconstruction, demolition, transport, waste processing, and final disposal).

It is important to note that the RICS / EN15978 approach assumes that any carbon that was sequestered by trees and stored in timber is released during the C1-C4 modules. In reality this may be avoided if the timber is eventually reused. This means that a whole-life carbon assessment may not recognise the full benefit offered by timber buildings, which is that the timber would lock up carbon for most of this century. This is a critical period[xcv] in which we are at risk of reaching tipping points for feedback loops of runaway climate change – such thawing permafrost releasing huge amounts of methane, or large areas of rainforest dying back. It matters not only *how much* carbon is emitted, but *when*.

Therefore it makes sense to set targets that exclude modules C1-C4, to give timber buildings the 'credit' for the carbon they will lock up for many decades. B1 – B5 also include many assumptions about uncertain future actions, therefore may need to be omitted from any planning targets due to a lack of robust justification.

Using the RICS 'modules', other building industry specialist bodies have created benchmarks and 'good practice' targets expressed in kilogrammes of embodied carbon per square metre of floor area:

RIBA Climate Challenge embodied carbon targets[xcvi]: Includes all RICS modules **A1-C4**.			
	Business as usual	2025	2030
Homes	1200 $kgCO_2e/m^2$	<800 $kgCO_2e/m^2$	<625 $kgCO_2e/m^2$
Offices	1400 $kgCO_2e/m^2$	<970 $kgCO_2e/m^2$	<750 $kgCO_2e/m^2$
Schools	1000 $kgCO_2e/m^2$	<675 $kgCO_2e/m^2$	<540 $kgCO_2e/m^2$

LETI Embodied Carbon Primer targets[xcvii]**:** RICS modules **A1-A5 only**.			
	Business as usual	2020	2030
Homes	800 kgCO2e/m^2	500$kgCO_2e/m^2$, (400 including sequestration)	300$kgCO_2e/m^2$ (200 including sequestration)
Office or school	1000 $kgCO_2e/m^2$	600$kgCO_2e/m^2$ (500 including sequestration)	350$kgCO_2e/m^2$ (250 including sequestration).

Bath & North East Somerset Council (see example below) has adopted an embodied carbon policy that requires a target to be met, yet this does not go as far as the LETI standards. However, it forms a highly important example that it is possible to justify such a target.

LETI/RIBA levels of target could still inform supplementary planning guidance, to educate developers and allow planning officers a point of comparison to assess the relative merits of schemes' embodied carbon reports submitted by developers.

If a local plan were to seek to require any of the LETI or RIBA embodied carbon targets, there would be challenges from the development sector consultees and potentially also the inspector. One likely objection is the argument that such a requirement may inhibit the delivery of housing targets.

The separate reports 'Tasks 3 and 4' of this evidence base provide information on the following:

- Feasibility of the proposed targets, with existing materials & techniques
- Achievability of the proposed targets in the kind of development that can be expected in South & Vale's local plan period (e.g. housing type; housing size; other building typologies)
- Whether the proposed target could have an unacceptable impact on costs, considering:
    - Cost of design
    - Cost of alternative materials / construction methods
    - Cost of the embodied carbon assessment.

The LETI and RIBA baselines are derived from a range of existing project data. Their future targets may also be based on case studies that would justify the planning policy, especially on technical feasibility.

Example: New London Plan 2021 (adopted)

Policy SI 2 includes that:

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.

Example: Bath & North East Somerset Council Local Plan Partial Update (adopted, 2023)

Policy SCR8 of requires that large scale development (>50 dwellings or >5000m^2 of commercial floor space) achieves an embodied carbon target of 900 kgCO_2/m^2 for RIBA modules A1 – A5 (upfront embodied carbon). The target only includes the following building elements:

- *Substructure*
- *Superstructure*
- *Finishes*

The policy requirement was selected because it is predicted to be cost neutral, as set out in the evidence study produced by WSP.

There is no last resort option to offset any shortfall of embodied carbon emissions to the required target.

RICS may be able to provide estimates of the typical cost of embodied carbon assessments and the number of professionals who are able to conduct such assessments.

We also note that further evidence is continually emerging on this topic, which could help the planning justification for such targets. For example, in early 2022, the UK Green Building Council[xcviii] found that a real-world large low rise residential development in south-west Cambridgeshire achieved a 20% reduction in embodied carbon reduction at masterplan level compared to a typical baseline, with only a negligible impact on capital costs (0.6%). This was achieved through simple changes such as reducing the area of asphalt in favour of low-carbon permeable paving, and using swales to reduce the need for other drainage infrastructure.

Beyond the assessments conducted within (separate reports) Tasks 3 and 4 of this evidence base, further relevant data could begin to be assembled by the local authority if it firstly adopts a local plan requirement for major developers to simply *report* on their embodied carbon using the RICS methodology, and ideally also any costs associated with steps taken to reduce embodied carbon as a percentage of overall costs. From these, local benchmarks for 'business as usual' and 'best practice' could be derived for inclusion in a subsequent local plan policy or supplementary planning document. This is an important next step for South & Vale if an embodied carbon policy is successfully adopted.

Emerging example: Bristol Local Plan Review (draft 2022)

Policy NZC3 of this draft plan requires that new development will be expected to achieve the following targets as a minimum:

- Residential (4 storeys or fewer) - <625 kgCO_2e/m^2
- Residential (5 storeys or greater) - <800 kgCO_2e/m^2
- Major non-residential schemes - <970 kgCO_2e/m^2

The requirements are based on the RIBA Climate Change targets for 2025 Homes, 2030 Homes and 2025 Offices.

Any shortfall against the embodied carbon targets will be offset at a cost of £373/tCO_2 – the BEIS Green Book 2023 value. Embodied carbon offsetting and target setting at this level has yet to be tested at Examination. Additionally, the £373 price is based on operational emissions and has not been calculated based on embodied carbon, which could be seen as a flaw in the approach.

To conclude: The Joint Local Plan can and should look to set embodied carbon targets, as solely requiring embodied carbon reporting is insufficient to deliver emissions reductions that align with net zero targets locally and nationally. An ambitious target should be set to limit the 'upfront embodied carbon emissions carbon' (modules A1 – A5). Including modules B and C could pose an additional unnecessary risk to policy adoption because these are reliant on many assumptions during the operational and end-of-life stages of a building. Additional requirements such as pre-demolition audits should be set to ensure that retrofit of existing buildings is promoted for new development where appropriate, instead of unnecessary demolition and subsequent embodied carbon emissions. The recommended policy approach is given in 'Policy recommendations'.

Beyond the building: Reducing carbon via the spatial strategy and standalone renewable energy

The local plan's spatial strategy is a vital tool for the minimising the carbon emissions caused by new growth, and potentially even making reductions on both the district's existing annual carbon emissions.

Because this document was produced to support a local plan policy wording review and not the spatial strategy, we do not go into as much depth here as we have done for buildings. However, this is an incredibly important topic in terms of what planning can do to enable the transition to a net zero carbon future. Therefore, for completeness we give an overview here.

The Planning Practice Guidance section on climate[xcix] confirms that location of new development are appropriate carbon reduction measures in local planning, as is deployment of renewable energy: "The distribution … of new development and the potential for servicing sites through sustainable transport solutions, are particularly important considerations".

The key ways in which the spatial strategy can support the net zero carbon transition are:

1. Transport – shaping the spatial pattern of new growth to reduce the use of cars and increase the viability of public transport services
2. Renewable energy – proactively enabling development of generation, storage and distribution
3. Protecting green infrastructure that removes or stores carbon, such as forests, grassland, peatland, or other high-carbon soils
4. Density: this has a smaller impact than points 1 and 2, but higher-density developments generally have smaller sizes per unit, which means less floor space to heat and light. Higher density can also make settlements more walkable by reducing sprawl between destinations.

Allowing growth only where the transport carbon emissions can be minimised

Transport is now the UK's largest emitter of CO_2 – representing 34% of total CO_2 emissions across the UK[20],[c] (compared to homes 26%, commercial/public buildings 8%, industry 15%, and land use 3%). In South & Vale, transport is responsible for 41% of emissions. Moreover, transport carbon emissions have not been reducing much in the past decade before 2020 (unlike the homes and other buildings sectors which have benefitted from reductions in electricity grid carbon). This is because the small increases in vehicle efficiency (and electric vehicles) have been outweighed by an overall increase in miles driven. A switch to electric vehicles is underway but has been slow and it will be many years before EVs make up the majority of new vehicles, let alone the majority of vehicles on the road (as the ban on sales of new fossil fuelled cars and vans has been pushed back to 2035, and the last fossil fuelled cars can be expected to be still in use for at least 14 years[ci] after that).

There is therefore a strong climate justification to devise the spatial strategy to focus the bulk of development in locations where there is a realistic likelihood of low car use, in particular on public transport corridors and walkable urban locations, and to refrain from allocating any sites where driving will be the only realistic option. Walkable sites also enable more efficient land use due to reduced parking area, while growth in urban locations can share existing infrastructure and thus avoid embodied carbon associated with new infrastructure. Where other considerations constrain this approach (such as green belt designations preventing growth around well-served railway stations or bus routes) there may be grounds to review the relative merit of those designations compared to the climate imperative. This should not be done lightly and should be supported by analysis to explore the differences in carbon emissions that would result in growth in different locations.

Transport carbon emissions are largely determined by *where* the development takes place as opposed to what policies are imposed to regulate the quality of each development itself. Once the location is set, it is difficult or impossible for the developer or the local plan to effectively influence the transport habits of the occupants and their associated carbon emissions. Recognising this, emerging local plans are taking steps at a very early stage of plan development to ensure that transport carbon emissions are considered from the outset of spatial strategy design and not as an afterthought.

To avoid locking-in long-term avoidable carbon emissions that come with development in car-dependent locations, spatial strategies can be informed with evidence to show how much carbon could be saved by choosing to direct growth to locations that are inherently conducive to public transport and active travel (see emerging example from Greater Cambridge). This gives a quantifiable value to the carbon savings, thus allowing them to be more fairly weighed alongside other considerations for growth sites such as ecology, landscape or impact on existing residents. However, such spatial carbon assessments can be costly and take significant time (or be delayed as there is a very limited pool of professional expertise to conduct such a study). Therefore the Council(s) must make a decision about whether the benefits of this are worth the cost and potential delay to the adoption of the Joint Local Plan, thus delaying the building-specific carbon reduction policies. This decision will need to include consideration of the proportional amount of growth likely to take place in the plan period and whether it is anticipated that much of this would occur in locations not well connected to public transport and walkable facilities (in the absence of a spatial carbon study).

[20] As percentage of UK emissions, before taking into account sequestration by forests and grassland.

Emerging example: Greater Cambridge Local Plan

In 2020-21, the emerging Greater Cambridge Local Plan was in the early stages of identifying the possible options for its spatial strategy. There were several broad spatial categories reflecting the potential areas where new growth could occur. There was also a range of housing growth numbers (low, medium, high).

Greater Cambridge Shared Planning service commissioned comparative modelling of the carbon emissions of buildings and transport in different types of location: urban, suburban, public transport corridors, new towns, villages.

This modelling used publicly available data on the local area's energy use and emissions of buildings and transport, combined with a locally-specific transport model. It also took into account the different locations' typical densities, home sizes and amount of new infrastructure that would be needed along with housing.

The potential sites being considered for growth were categorised into these different types of location. A range of options were tested, with homes spread in varying proportions across different types of location.

This revealed[cii] a very large difference in carbon emissions in the plan period depending on where homes were built. Importantly, it showed that the carbon emissions difference (between growth in the most versus least car-dependent locations) was just as large as the difference that would be made by applying zero-carbon buildings policies.

Village-led growth had far higher carbon emissions than any other option. Growth on public transport corridors was nearly as low-carbon as urban growth, and both were better than new settlements. Applying a range of carbon reduction policies (for buildings and transport) would halve the total emissions, except in villages because more of their carbon due to transport, which is influenced more by location than policy.

This informed the further refinement of the growth options. The modelling was repeated[ciii] for the refined options. Both were taken into account in the sustainability appraisal[civ]. As a result, the proposed preferred option is led mainly by growth on public transport corridors and urban areas, and does not include significant development in villages (only where they are well connected to existing transport and employment.)

Example: Central Lincolnshire Local Plan Review (adopted 2023)

Central Lincolnshire used the same approach as Greater Cambridge, with same consultant team conducting analysis[cv] to compare the carbon impacts of its various spatial growth options.

Here, the difference between locations was less pronounced. This was partly because the spatial options in Central Lincolnshire were less starkly 'urban' or 'rural' but more blended, and partly because the Lincolnshire growth locations did not include areas with such an unusually high level of cycling and low car use.

Quantifying and protecting the carbon sequestration value of green landscapes

Green infrastructure for carbon sequestration is relevant in South & Vale as an area with a particularly large proportion of green landscape. This green infrastructure has a small but significant effect on reducing both the districts' overall greenhouse gas account. National figures show[cvi] that in South & Vale as of 2021 (2023 data release) forest and grassland remove 6% of the carbon dioxide emissions that the area's other activities cause. This is a proportionally larger achievement than the national picture, where the UK's forest and grassland recapture only 4% of the UK's overall annual CO_2 emissions.

The Pathways to a Zero Carbon Oxfordshire (2021) report explores current future land use and carbon sequestration opportunities. See *Figure 24* for current carbon storage levels across Oxfordshire. The report states that an approximate 23 Mt of carbon is stored in soils and vegetation across Oxfordshire, which increases by 115,000 tonnes each year. It is important to note that this will only be the case if the carbon stored in topsoil is not removed for new developments of housing and infrastructure. Subsequently, it is important for the local plan to closely consider the relationship between site allocations and areas that have high soil carbon content. This data on the distribution of high-carbon soils in South & Vale could justify decisions not to allocate such sites, or to develop development management policies that mitigate and compensate for losses of soil carbon.

There is therefore a strong argument that the site allocations process should be designed to direct new growth away from woodland and grassland – unless a particular greenfield site would give greater carbon savings for other reasons, for example if the site is on a well-served public transport route that would dramatically reduce car use compared to delivering that new growth elsewhere.

Beyond trees and grass, soil can also be a huge store of carbon which can be emitted if the soil is drained or otherwise disturbed – for instance during groundworks or excavation. For example, natural wetland is a rich store of carbon that has been sequestered over many years by plants growing there, and stored thanks to being submerged in water. If drained, wetlands start emitting large amounts of greenhouse gas.

Figure 9.3: Carbon storage in soils and vegetation in Oxfordshire

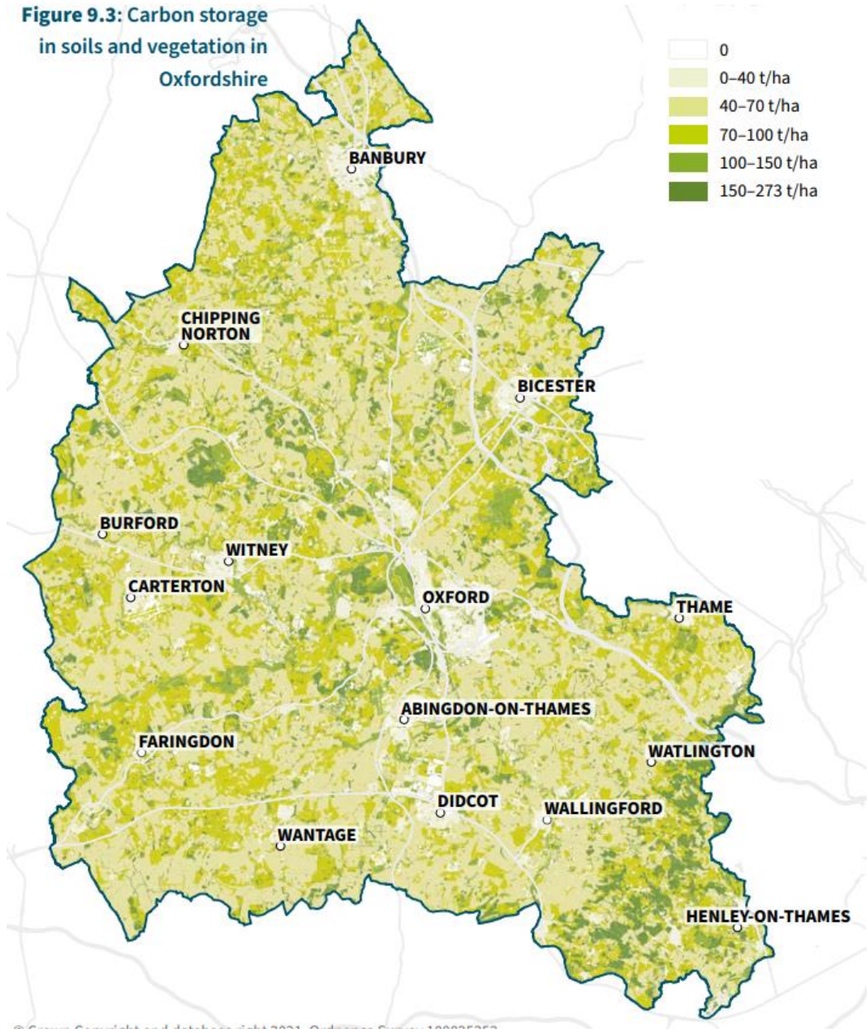


Figure 25: Carbon storage in soils and vegetation in Oxfordshire; Environmental Change Institute (University of Oxford) and Bioregional (2021).

Example: Central Lincolnshire Local Plan Review (adopted, 2023)

This plan was adopted in April 2023.

Aware of the region's widely distributed peatland as well as other green infrastructure, the Central Lincolnshire planning team *commissioned specialists*[cvii] *to map the area's peatland and estimate the potential amount of carbon that is stored, removed, or emitted* by those areas.

It found that while the area of peatland is small, its degraded condition means that it has a meaningful impact on overall emissions (potentially amounting to more climate impact per year than the operational carbon emissions of all the proposed new housing for which the plan must make room). As a result, the emerging plan is proposing Policy S16[cviii] [note: now Policy S17] which will *require assessment and mitigation or compensation of the carbon impacts of development on any carbon sinks including peat*.

However, carbon sinks do not appear to have been a criterion in the sustainability appraisal for site allocations as only 2% of the land was identified peatland and thus not expected to be a common issue confronting many sites.

While not yet adopted and therefore not yet a full legal example, this approach could be relevant to other local plans with substantial amounts of high-carbon soils, woodland, grassland or other natural carbon sinks.

Policy S17 (carbon sinks) includes that:

> "Existing carbon sinks, such as peat soils, must be protected, and where opportunities exist they should be enhanced in order to continue to act as a carbon sink. Where development is proposed on land containing peat soils or other identified carbon sinks, including woodland, trees and scrub; open habitats and farmland; blanket bogs, raised bogs and fens; and rivers, lakes and wetland habitats*, the applicant must submit a proportionate evaluation of the impact of the proposal on either the peat soil's carbon content or any other form of identified carbon sink as relevant and in all cases an appropriate management plan must be submitted."

It also states that: "The demonstration of meaningful carbon sequestration through nature based solutions … will be a material consideration in the decision-making process. Material weight in favour of a proposal will be given where the net situation is demonstrated to be a significant gain in nature based carbon sequestration … Where a proposal will cause harm to an existing nature based carbon sequestration process, weight against such a proposal will be given … with the degree of weight dependent on the scale of net loss." The text refers the reader to the carbon soil mapping, and Natural England report NERR094 to assist in identifying the significance of carbon sinks.

Emerging example: Greater Cambridge Local Plan (First Proposals 2021)

Policy CC/CS will:

- "Support the creation of land and habitats that play a role as carbon sinks and protect existing carbon sinks from development in particular undisturbed or undrained peat".
- "Promote approaches that minimise soil disturbance, compaction and disposal during construction projects".

The details of how this policy will be structured are not yet available.

However, the First Proposals document explains that it is supported by (and will draw on) an evidence base including:

- Net Zero Carbon Study
- Green Infrastructure Opportunity Mapping Report – this took an 'ecosystem services' approach to identify existing and potential green infrastructure, of which one of the ecosystem services is carbon sequestration. This included approximate mapping of soil carbon and above-ground carbon in vegetation.
- Natural England (2021) report on Carbon Sequestration and Storage by Habitat (report NERR094).

It is noted that although many carbon-rich land areas will already be protected by nature conservation policies or designations, this is not true for all existing or potential carbon sinks. The policy is therefore needed because the Net Zero Carbon Study had shown that additional land-based carbon sequestration will still be necessary in the UK's net zero carbon future, even after all possible actions have been taken to reduce carbon emissions at source.

To conclude: Local plan policy should aim to protect areas of land that provide significant annual carbon sequestration services or represent significant natural carbon stores. Through the identification of such areas, local plan policy can look to limit development in these areas or, as a minimum, require that any negative impacts that may result in a carbon release are mitigated and reported on.

Policy recommendations

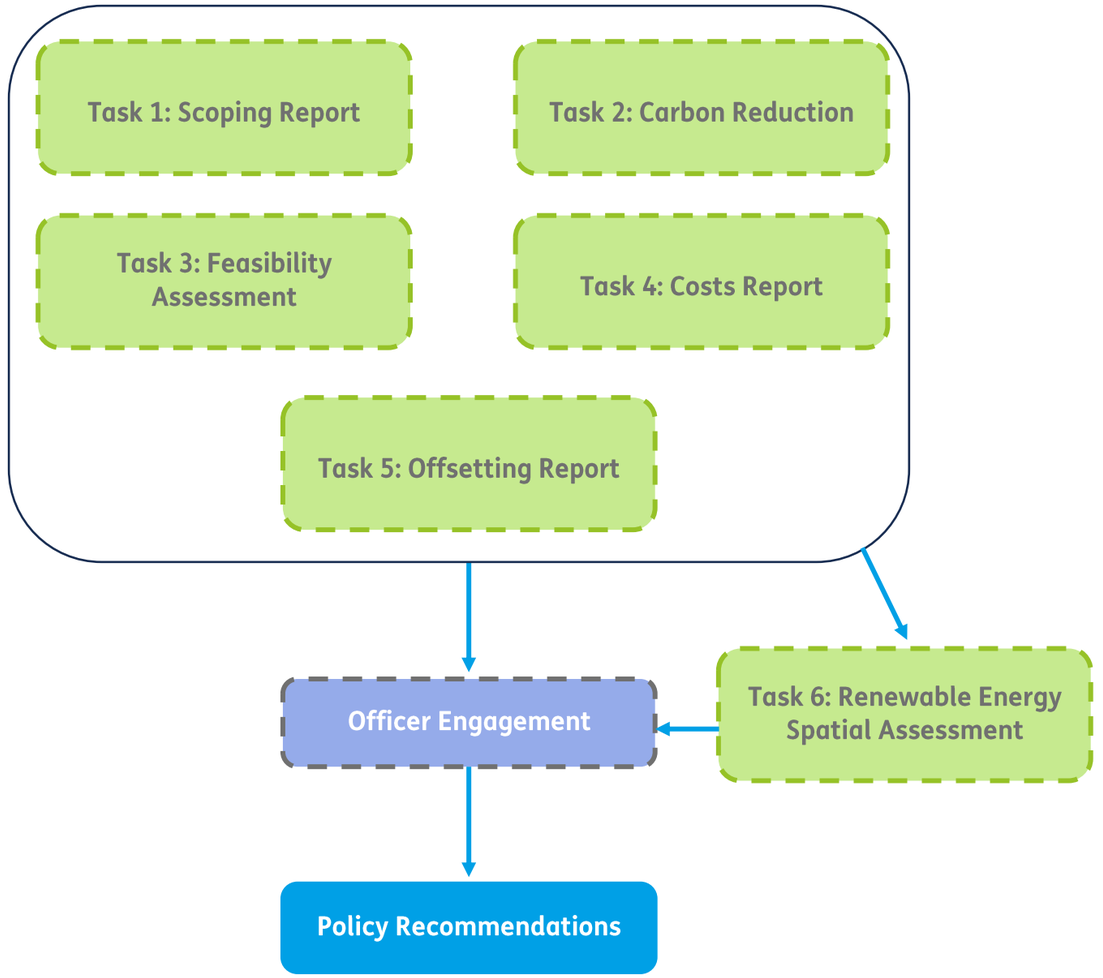
Policy recommendations provided in this report reflect findings emerging from the following elements of the evidence base for the South & Vale Joint Local Plan:

1. **Scoping Report**
2. **Carbon Reduction**
3. **Feasibility Assessment**
4. **Costs Report**
5. **Offsetting Report**

Tasks 1 (Scoping Report) and 2 (Carbon Reduction) set the scene of what the local plan is able to achieve and importantly what it must do within the context of net zero carbon obligations and commitments at both local and national scales. Recommendations given in this section are supported by preceding information throughout this Tasks 1 & 2 report. The exploration of policy examples earlier in this report sets the scene of the ambitious policies that have been adopted and implemented to date elsewhere, which form a baseline that the South & Vale local plan can emulate or work to improve upon.

Tasks 3 (Feasibility Assessment) and 4 (Costs Report) enable specific policy requirements to be tested in their ability to be feasibly and viably deliverable in practice. Results from both these tasks are critical to the success of policy adoption via the examination process, due to the provision of locally-specific cost and feasibility evidence to support the policy's robustness against the examination 'tests of soundness'[21] (especially in 'justification' and 'effectiveness'). Task 5 (Offsetting Report) sets out the recommended approach for offsetting in term of policy integration, implementation of mechanisms and project delivery.

It should be noted that the policy recommendations in this report are not written in a style ready to be immediately placed into the local plan. The policy recommendations should be a reference point from which specific local plan policy wording is created.



[21] National Planning Policy Framework (2021), paragraph 35.

Relevant policy themes

Operational energy

Operational energy is an area of policy development where the local plan can push boundaries and ensure the provision of buildings that are fit for the future, both in terms of reduced energy consumption and holistic integration of design decisions that address climate adaptation.

As already explored in this report, recent examples have detached from the previously typical CO_2 % reduction approach that had been driven by metrics used for Building Regulations compliance, an approach taken by the South Oxfordshire Local Plan. These examples now assess operational energy based on three key metrics:

1. **Space heating demand**

Space heating demand simply represents the thermal energy efficiency of a building, which is primarily controlled by insulation properties of external and internal building elements, air tightness and thermal bridging. Unlike EUI, space heating demand is agnostic to any technology that requires powering within a building; rather the space heat demand metric is a measure of how many units of heat are required to provide sufficient comfort levels for occupants of the building. Whatever technology is used, whether this is a heat pump or gas boiler, will not change the space heating demand value as it is solely based on the fabric efficiency of the building.

2. **Total energy use (Energy Use Intensity)**

This is the total energy consumption of the whole building, measured in kWh/m^2/year. Energy Use Intensity (EUI) takes account of regulated *and* unregulated energy. This is important because the scope of Part L of Building Regulations does not include unregulated energy, meaning any policy based on Part L cannot result in a truly net zero building.

It is a crucial metric because it can essentially prevent inefficient heating technologies (e.g. gas boiler or 'direct electric') from being used in designed buildings that are aiming to achieve policy compliance – setting the right value can therefore implicitly ban inefficient technologies as compliance with an EUI requirement is not possible due to significant energy use inefficiencies. For example, for one unit of energy used, a gas boiler will produce slightly less than one unit of heat (or a direct electric heater will produce one unit of heat), whereas a heat pump will produce three units of heat. Therefore, the heat generation proportion of the final EUI value will be three times less with a heat pump when compared to gas boiler or electric, to produce the same amount of heat. This saves bills for the occupant, and puts less stress on the electrical grid than if the building were to use direct electric heating.

3. **On-site renewable energy generation**

Under this energy-based policy approach (explained in previous section)– instead of a carbon-based approach – with these three key metrics, on site renewable energy generation typically is set at a level that requires equivalent annual on-site generation to match annual total energy use. This final metric therefore provides the final piece in achieving a low energy consumption, energy efficient, net zero energy (and therefore net zero operational carbon) building.

The lower the required EUI limit in policy, the less on-site renewable generation is needed to reach an on-site net zero energy balance. Generation is most easily achieved via rooftop PV.

Key benefits from the approach taken in this theme include:

- A truly operationally net zero building
- Low energy consumption
- Zero fossil fuel use
- Significantly reduced operational costs for residents
- Reduced reliance on grid decarbonisation
- Simple post-occupancy monitoring to understand performance gap
- Potential for decentralised energy networks
- High levels of building comfort for occupants

Embodied carbon

Operational energy policy requirements are gradually becoming more consistently set at levels necessary to align with UK carbon budgets and its eventual 2050 net zero target. However, as operational energy and carbon are reduced, the proportion of embodied carbon becomes larger than ever as a share of the building's lifetime carbon emissions. This means that reductions to embodied carbon will require increased attention going forward.

As explored in the 'Defining net zero' chapter of this report, the definition of net zero is key when considering operational and embodied carbon, since a truly net zero carbon building (over its entire lifetime) would require zero embodied and operational carbon emissions. The vast majority of nominally 'net zero' buildings today only consider operational emissions. In working towards a wholly net zero carbon building, local plan policy would need to address embodied carbon with equal weight, if not more, than operational energy/carbon policy.

A number of local authorities have now implemented embodied carbon policies that require reporting for development above a certain threshold, typically only larger development. However, where viability allows, requirements for embodied carbon targets to be hit should be promoted and integrated into local plans.

Overheating

Similarly to embodied carbon, the link between overheating and operational energy is becoming ever important and must now be put at the forefront of local plan policy, simultaneously with operational energy and embodied carbon policies.

As climate change impacts worsen, particularly more extreme and more variable temperatures, the need for overheating assessments to be undertaken for new buildings is crucial for current and future occupant comfort. In particular, new buildings that meet ambitious space heating demand requirements (previously described) will be at increased risk of overheating due to the ability of the building to retain heat well. Clearly, throughout winter this is a key comfort benefit, yet during summer this can result in the opposite effect if not otherwise mitigated with measures to enhance

ventilation and avoid excess solar gain, in warmer months. It is therefore paramount that overheating risk is sufficiently assessed and integrated into decisions throughout design stages to ensure high fabric efficiency standards are not achieved at the detriment of internal comfort and temperature levels.

In addition to addressing overheating with building-related measures, overheating mitigation measures can also be integrated alongside blue and green infrastructure policies. Benefits here are further intertwined, whereby overheating risks can be mitigated whilst also improving the biodiversity of a site. For example, green roofs, walls and trees are effective at reducing surface temperatures through natural shading and evapotranspiration.

Renewable energy

The UK grid is becoming increasingly powered by renewable energy, primarily through solar and wind technologies. This is a vital part of the UK's carbon reduction trajectory, which will need[22] near-total grid decarbonisation by 2035 and a mix that includes 80% renewables by 2050 while catering for a doubling of electricity demand between 2020 and 2050.

However, it is more important now than ever to ensure that the future energy network is resilient to increasingly variable weather patterns, which will require a balanced mix of generation and storage technologies. Without resilient energy networks at local and national levels, a reliance on fossil fuels will remain when solar and wind power generation is low due to weather constraints.

Partly due to current rise in large-scale renewable energy installations, some local grid substations are at risk of reaching full capacity in coming years without infrastructure reinforcement investments. As the industrial, commercial, domestic and transport sectors continue to electrify (switching from gas, coal and oil) at increasing rates, local policy must support as best it can the development of smart grids and energy sharing networks to relieve pressure on local areas at risk of reaching full grid electricity capacity. On-site energy management systems will play an important role in achieving this, through the provision of battery storage alongside solar PV generation and enabling peak-demand response management systems throughout new buildings. A permissive policy approach towards applications for standalone grid-connected battery storage can also play a role in readying the energy system for the UK's renewable-heavy, electricity-led future.

As local renewable energy generation schemes become more prominent and take up a larger proportion of land, it is also important to ensure that adverse impacts are not inflicted on local communities. Therefore, whilst local policy should support renewable energy generation schemes as much as possible, it should also set criteria that mitigates potential negative impacts, such as addressing community co-benefits and improving biodiversity on-site.

Retrofit

Existing buildings (residential and commercial) currently contribute approximately 1/3 of carbon emissions across the districts. Retrofitting the existing building stock therefore presents a significant opportunity to reduce the districts' carbon deficit. It will often not be possible to retrofit existing buildings to the same level of fabric efficiency required for new buildings. Therefore, policy recommendations should provide a positive approach to reducing emissions in existing buildings through low energy supply, energy efficiency measures and micro renewables whilst recognising this needs to be sensitive to historic and conservation contexts.

[22] Committee on Climate Change (2020), The Sixth Carbon Budget: The UK's path to net zero.

The following policy recommendations have been split up according to development type or policy theme. This mix seeks to best ensure utmost ease of policy implementation, considering the roles of developers/applicants and the Development Management team to respectively demonstrate and assess policy compliance.

This section sets out policy recommendations for:

1. **Net zero (operational energy) new build residential development**
2. **Net zero (operational energy) new build non-residential development**
3. **Overheating in new buildings**
4. **Embodied carbon**
5. **Existing buildings**
6. **Renewable energy**

We assess each of the above policy recommendations based on the following:

- **Links to other policy**
- **Scope for future improvements in next local plan review**
- **Alignment with national policy**
- **Feasibility and costs overview**
- **Implementation considerations**
- **Development industry capability to deliver policies**
- **Development Management capability to assess policies**

A. Net zero (operational energy) new build residential development

All new build residential development to meet the following requirements:

A1. Total energy use	≤ 35 kWh/m²/year
A2. Space heating demand	≤ 15 kWh/m²/year (or <20kWh/m²/year in bungalows only). The use of fossil fuels and connection to the gas grid will not be considered acceptable.
A3. On-site renewable energy	On-site annual renewable energy generation capacity to at least equal predicted annual total energy use. Where an on-site net zero energy balance is not possible[23], it must be demonstrated that the amount of on-site renewable energy generation equates to ≥120 kWh/m²$_{\text{projected building footprint}}$/year. Where a building in a multi-building development cannot individually achieve the requirements of A3, this shortfall is to be made up across other units on-site before energy offsetting (A4) is considered. Large-scale development (50 residential units or more) should demonstrate that opportunities for on-site renewable energy infrastructure (on-site but not on or attached to individual dwellings), such as solar PV canopies on car parks, have been explored.
A4. Energy offsetting	Only in exceptional circumstances and as a last resort where it is demonstrably unfeasible to achieve an on-site net zero energy balance, any annual on-site energy use not matched by on-site annual renewable energy generation is to be offset via S106 financial contribution.
A5. Reduced performance gap	Energy performance predictive calculations of residential units are to be completed using Passivhaus Planning Package (or other method demonstrably proven to produce accurate predictions of total in-use energy, subject to local authority approval of the method). The energy performance of all residential units is to be calculated individually and each should comply with policy elements A1 and A2. In exceptional circumstances (e.g. where a development contains a large number of flatted buildings and limited roof space is available on these buildings), it may be considered acceptable to achieve a site-wide average that complies with policy elements A1 and A2, subject to no individual dwelling exceeding a certain slightly less stringent cap on space heating demand (20 kWh/m²/year). and EUI (45 kWh/m²/year). An assured performance method must be implemented throughout all phases of construction to ensure operational energy in practice performs to predicted levels at the design stage.
A6. Smart energy systems	Proposals should demonstrate how they have considered the difference (in scale and time) of renewable energy generation and the on-site energy demand, with a view to maximising on-site consumption of energy generated on site and minimising the need for wider grid infrastructure reinforcement. Where the on-site renewable energy generation peak is not expected to coincide with sufficient energy demand, resulting in a need to export or waste significant amounts of energy, proposals should demonstrate how they have explored scope for energy storage and/or smart distribution systems. The purpose being to optimise on-site or local consumption of the renewable energy (or waste energy) that is generated by the site. Where appropriate, proposals should demonstrate that they have integrated these to optimise these carbon- and energy-saving benefits and minimise the need for grid reinforcements. This may include smart local grids, energy sharing, energy storage and demand-side response, and/or solutions that combine elements of the above.
A7. Post-occupancy evaluation	Large-scale development (over 50 units) is to monitor and report total energy use and renewable energy generation values on an annual basis. An outline plan for the implementation of this should be submitted with the planning application. The monitored in-use data are to be reported to the local planning authority for 5 years upon occupation.

Policy elements A1, A2 and A3 are to be addressed at design and post-completion stages, to ensure that the development has been built to intended standards. Post-completion resubmission of the original energy statement including energy performance calculations, informed by the relevant tests to systems and fabric, should be required as a condition as part of the planning application process. A5 and A7 compliance should also be demonstrated post-completion through planning condition.

A1 – A7 are to be demonstrated at planning application stage through submission of an energy statement, alongside associated output reports from energy modelling software (e.g. PHPP).

[23] Exceptional circumstances where an on-site net zero energy balance is not achieved may only be found acceptable in some cases, for example with taller flatted buildings (4 storeys or above) or where overshadowing significantly impacts solar PV output.

Links to other policies

These policy recommendations are linked to examples previously explored in the report. A5 specifically is related to the previous section on the energy performance gap.

Policy A2 is linked to C1 and C2 due to the link between improved space heating demand standards and increased overheating risk.

Policies A3 and A6 are linked to the suite of renewable energy policies, as any on-site renewable energy development will form part of the larger energy network of the area. Policy A1 is also linked to wider renewable energy policies, particularly F4 as reduced energy consumption will demand less renewable energy from the grid in cases where an on-site net zero energy balance is not achieved.

Scope for future improvements

Policies A1 and A2 could be further improved (i.e. reduce target values for Energy Use Intensity and space heating demand if found to be feasible and viable) in subsequent local plans, however this may not be feasible across every typology. Improvements to A1 would however make compliance with A3 easier since less renewable energy supply would be needed.

Alignment with national policy

All of these policies are aligned with national policy since their implementation works towards achieving the legally-binding UK target of net zero by 2050, as set out in the Climate Change Act 2008, and carbon budgets subsequently legislated under the aegis of that Act. These associated carbon budgets are linked to the Climate Change Committee's Balanced Pathway to Net Zero report, which in turn is supported by analysis that sets out that all new buildings must be net zero by 2025 have a space heating demand of 15-20 kWh/m²/year.

The Planning and Energy Act 2008 sets out that local standards for energy efficiency in new homes are able to exceed those set in Building Regulations. Detail on why objections in relation to this local planning authority power are invalid is set out in detail previously in this report.

Feasibility and costs overview

Task 3 of this evidence base explores the feasibility of policy requirements. Detached, semi-detached, terraced and flats were all tested as archetypes against metrics set out under A1 – A3. The specific standards set out under A1 – A3 have all been found to be feasible and achievable.

Task 4 of this evidence base explores the costs associated with the policy requirements set out above. To achieve A1 – A3, the following cost uplifts (from Part L 2021) are incurred:

- Detached: 4%
- Semi-detached: 6%
- Terraced: 7%
- Flats: 6%

Implementation considerations

Due to the high ambition of these policies, it is vital that supplementary guidance is provided for the benefit of Development Management officers and the development industry. This is particularly important for A1, A2, A4 and A5 because specific information for policy compliance must be set such as:

- Examples of assured performance
- Acceptable scenarios where exceptional circumstances are valid for A3 and A4
- Methodologies and assumptions for energy performance calculations

Information on the mechanisms of energy offsetting for A4 will need to be included in a planning document that addresses planning obligations.

For A3, renewable energy installations will need to be accompanied with calculations of expected outputs required under the policy by an MCS certifier, which should be set as a planning condition. This is to ensure renewable energy technology has been correctly installed and operates at the predicted output sufficient to deliver an on-site net zero energy balance.

Industry capability

With appropriate engagement with developers operating in the area throughout the local plan process, the local development industry should be well prepared to deliver on these policies. The policies require additional levels of skill to be applied through design and construction phases but do not introduce any new skills not currently known and utilised by developers.

The standard of insulation and glazing typically required to meet the space heating demand requirement (A2) are similar to those set out in the indicative specification for the Future Homes Standard (FHS) (although airtightness is likely to need some improvement compared to the FHS). Additionally, the total energy use intensity limit (A1) is strongly linked to the use of a heat pump, which equally is part of the indicative FHS specification. Therefore, the development industry should be well prepared to deliver on A3, particularly as the South & Vale local plan and the FHS are both likely to be introduced in 2025.

The wider development industry needs to upskill to deliver truly net zero buildings (i.e. on-site net zero energy balance not reliant on offsetting), particularly in terms of predictive energy modelling and high energy performance buildings in-use (rather than just predicted). Delivery of buildings subject to these net zero policies requires quality construction standards to mitigate the performance gap, which the implementation of the A-suite of policies will work towards improving at a larger scale.

Development Management capability

The capability of Development Management officers to accurately assess these policies is reliant on the degree of training and guidance documents available. It is essential that officers have guidance on hand to assess policies against to ensure that compliance is achieved in accordance with methodologies set out in a subsequent guidance document. Specific upskilling of at least one officer on climate change policies to gain a technical understanding will greatly assist the overall ability of the team to assess policy compliance.

Training sessions for Development Management officers on technical processes involved with net zero carbon development can strengthen internal capabilities to assess and scrutinise applications that may have submitted overly-optimistic building performance values for the sake of policy compliance. These may include:

- Understanding of modelling techniques and tools (e.g. PHPP)
- Building elements energy performance values (e.g. U-values)
- Low- and zero-carbon heating and ventilation systems/technologies
- Orientation, form factor and design features for solar PV generation

B. Net zero (operational energy) new build non-residential development

All new build non-residential development to meet the following requirements:

B1. Total energy use	Warehouses: ≤ 35 kWh/m²/year Offices: ≤ 55 kWh/m²/year Schools: ≤ 55 kWh/m²/year Retail: ≤ 35 kWh/m²/year It is accepted that in some circumstances, unregulated energy loads for the specific use of a non-residential building may result in a total energy use that exceeds the limits set out above. In these cases, applicants are required to demonstrate that regulated energy is limited to 30 kWh/m²/year. Unregulated loads must be justified in an energy statement. Other building types not listed are required to demonstrate that regulated energy is limited to 40 kWh/m²/year. Unregulated loads must be justified in an energy statement.
B2. Space heating demand	≤ 15 kWh/m²/year The use of fossil fuels and connection to the gas grid will not be considered acceptable.
B3. On-site renewable energy	On-site annual renewable energy generation capacity to at least equal annual total energy use. Where an on-site net zero energy balance is not possible[24], it must be demonstrated that the amount of on-site renewable energy generation equates to ≥120 kWh/m²$_{\text{projected building footprint}}$/year. Where this is not achieved, it must be demonstrated to the satisfaction of the Council that this is due to unavoidable design issues such as natural lighting and utility space. Where a building in a multi-building development cannot individually achieve the requirements of B3, this shortfall is to be made up across other units on-site before energy offsetting (B4) is considered. Large-scale development (5000m² non-residential floorspace or more) should demonstrate that opportunities for on-site renewable energy infrastructure (on-site but not on or attached to individual buildings), such as solar PV canopies on car parks, have been explored.
B4. Energy offsetting	Only in exceptional circumstances and as a last resort where it is demonstrably unfeasible to achieve an on-site net zero energy balance, any annual on-site energy use not matched by on-site annual renewable energy generation is to be offset via S106 financial contribution.
B5. Reduced performance gap	Energy performance calculations of non-residential units are to be completed using Passivhaus Planning Package, CIBSE TM54, or other method demonstrably proven to produce accurate predictions of total in-use energy (subject to local authority approval of the method). The energy performance of all non-residential units is to be calculated individually and each should comply with policy elements B1 and B2. In exceptional circumstances, it may be considered acceptable to achieve a site-wide average that complies with policy elements B1 and B2. An assured performance method must be implemented throughout all phases of construction to ensure operational energy in practice performs to predicted levels at the design stage.
B6. Smart energy systems	Proposals should demonstrate how they have considered the difference (in scale and time) of renewable energy generation and the on-site energy demand, with a view to maximising on-site consumption of energy generated on site and minimising the need for wider grid infrastructure reinforcement. Where the on-site renewable energy generation peak is not expected to coincide with sufficient energy demand, resulting in a need to export or waste significant amounts of energy, proposals should demonstrate how they have explored scope for energy storage and/or smart distribution systems. The purpose being to optimise on-site or local consumption of the renewable energy (or waste energy) that is generated by the site. Where appropriate, proposals should demonstrate that they have integrated these to optimise these carbon- and energy-saving benefits and minimise the need for grid reinforcements. This may include smart local grids, energy sharing, energy storage and demand-side response, and/or solutions that combine elements of the above.
B7. Post-occupancy evaluation	Large-scale development (5,000m² non-residential floor space or more) is to monitor and report total energy use and renewable energy generation values on an annual basis. These are to be reported to the local planning authority for 5 years upon occupation.

[24] Exceptional circumstances where an on-site net zero energy balance is not achieved may only be found acceptable in some cases, for example with non-residential buildings 3 storeys and above or where a specific use of the building results in a high unregulated energy load (e.g. research lab).

Policy elements B1, B2 and B3 are to be addressed at design and post-completion stages, to ensure that the development has been built to intended standards. Post-completion resubmission of the original energy statement including energy performance calculations, informed by the relevant tests to systems and fabric, should be required as a condition as part of the planning application process. B5 and B7 compliance should also be demonstrated post-completion through planning condition.

B1 – B7 are to be demonstrated at planning application stage through submission of an energy statement, alongside associated output reports from energy modelling software (e.g. PHPP).

Links to other policies

These policy recommendations are linked to examples previously explored in the report. B5 specifically is related to the previous section on the energy performance gap.

Policy B2 is linked to C1 and C2 due to the link between improved space heating demand standards and increased overheating risk.

Policies B3 and B6 are linked to the suite of renewable energy policies, as any on-site renewable energy development will form part of the larger energy network of the area. Policy B1 is also linked to wider renewable energy policies, particularly F4 as reduced energy consumption will demand less renewable energy from the grid in cases where an on-site net zero energy balance is not achieved.

Scope for future improvements

Policies B1 and B2 could be further improved (i.e. reduce target values for Energy Use Intensity and space heating demand if found to be feasible and viable) in subsequent local plans, however this may not be feasible across every typology. Improvements to B1 would however make compliance with B3 easier since less energy supply is needed.

Alignment with national policy

All of these policies are aligned with national policy since their implementation works towards achieving the legally-binding UK target of net zero by 2050, as set out in the Climate Change Act 2008, and carbon budgets subsequently legislated under the aegis of that Act. These associated carbon budgets are linked to the Climate Change Committee's Balanced Pathway to Net Zero in the Sixth Carbon Budget report, which sets out that all new buildings should be zero carbon from 2025, with high levels of energy efficiency and low-carbon heat. It also found that non-residential buildings should phase out high-carbon fossil fuel boilers no later than 2026, and phase out gas boilers in 2030-33, less than 10 years from today (2023), while boilers have a typical lifetime of 15 years. Therefore, new buildings today should not have these, to avoid the need for expensive disruptive retrofit less than 10 years after completion which would also waste embodied carbon (even if the need for 'net zero carbon new builds from 2025' did not already effectively rule out fossil fuel boilers). The policy supports these targets by prohibiting fossil fuel connection and by the EUI targets, which mandate a heating technology similarly efficient to a heat pump (which a fossil boiler cannot meet).

Feasibility and costs overview

Task 3 of this evidence base explores the feasibility of policy requirements. An office, school, warehouse and retail unit were all tested as archetypes against metrics set out under B1 – B3. All archetypes are able to feasibly meet the requirement for B2.

Where each archetype has assumed a generic use, the limits set out for B1 are feasible for all archetypes. An on-site net zero energy balance, as required by B3, is feasible for all archetypes but the office. The office archetype shows a small shortfall to matching total energy use, yet feasibly still achieves a renewable energy output of 120 kWh/$m^2_{\text{projected building footprint}}$/year.

For the retail archetype, the targets for B1 and B3 become not feasible when it is assumed to be a grocery shop (instead of clothes shop) that has a high unregulated energy load. In these cases of high unregulated energy loads for a specific use, it is essential that the regulated energy limit (feasible for all archetypes) for B1 is demonstrated.

Task 4 of this evidence base explores the costs associated with the policy requirements set out above. To achieve B1 – B3, the following cost uplifts (from Part L 2021) are incurred:

- Retail: 8%
- Retail (with residential unit): 5%
- School: 6%
- Office: 5%
- Warehouse: 7%

Implementation considerations

Due to the high ambition of these policies, it is vital that supplementary guidance is provided for the benefit of Development Management officers and the development industry. This is particularly important for B1, B2, B4 and B5 because specific information for policy compliance must be set such as:

- Examples of assured performance
- Acceptable scenarios where exceptional circumstances are valid for B3 and B4
- Methodologies and assumptions for energy performance calculations

Information on the mechanisms of energy offsetting for B4 will need to be included in a planning document that addresses planning obligations.

For B3, renewable energy installations will need to be accompanied with calculations of expected outputs required under the policy by an MCS certifier, which should be set as a planning condition. This is to ensure renewable energy technology has been correctly installed and operates at the predicted output sufficient to deliver an on-site net zero energy balance.

The wider development industry needs to upskill to deliver truly net zero buildings (i.e. on-site net zero energy balance not reliant on offsetting), particularly in terms of predictive energy modelling and high energy performance buildings. Delivery of buildings subject to these net zero policies requires quality construction standards to mitigate the performance gap, which the implementation of the A-suite of policies will work towards improving at a larger scale.

Industry capability

With appropriate engagement with developers operating in the area throughout the local plan process, the local development industry should be well prepared to deliver on these policies. The policies require additional levels of skill to be applied through design and construction phases but do not introduce any new skills not currently known and utilised by developers.

The standard of insulation and glazing efficiency typically required to meet the space heating demand requirement (B2) are similar to those set out in the indicative specification for the Future Homes Standard (FHS). Therefore, the development industry should be well prepared to deliver on B2, particularly as the South & Vale local plan and the FHS are both likely to be introduced in 2025.

Development Management capability

The capability of Development Management officers to accurately assess these policies is reliant on the degree of training and guidance documents available. It is essential that officers have guidance on hand to assess policies against to ensure that compliance is achieved in accordance with methodologies set out in a subsequent guidance document. Specific upskilling of at least one officer on climate change policies to gain a technical understanding will greatly assist the overall ability of the team to assess policy compliance.

Training sessions for Development Management officers on technical processes involved with net zero carbon development can strengthen internal capabilities to assess and scrutinise applications. These may include:

- Understanding of modelling techniques and tools (e.g. PHPP)
- Building elements energy performance values (e.g. U-values)
- Low- and zero-carbon heating and ventilation systems/technologies
- Orientation, form factor and design features for solar PV generation

C. Overheating in new buildings

All new build residential and non-residential buildings must meet the following requirements:

C1. Cooling hierarchy	Demonstrate that overheating risk measures have been selected in accordance with the cooling hierarchy: 1. Minimise internal heat generation through energy efficient design. 2. Reduce the amount of heat entering the building in summer using: a. Building orientation b. Shading c. Albedo d. Fenestration and insulation 3. Manage heat within the building through exposed internal thermal mass and high ceilings. 4. Passive ventilation. 5. Mechanical ventilation. 6. Active cooling measures.
C2. Overheating assessment	Residential development to complete **CIBSE TM59** overheating assessment as their route to compliance with Building Regulations Part O. The simplified Part O route will not be considered acceptable. Non-residential development to complete **CIBSE TM52** overheating assessment (not related to Part O because non-residential buildings are not subject to Part O regulations at present).

Compliance with C1 and C2 should be demonstrated within an energy statement at planning application stage, with supporting output reports from CIBSE assessments.

Links to other policies

Policies C1 and C2 are linked to A1, A2, B1 and B2 due to the link between improved space heating demand standards and increased overheating risk. Overheating policy requirements should be considered holistically with space heating demand requirements since improved air tightness and fabric performance can increase overheating risk without careful design considerations. Additionally, measures to reduce cooling demand through passive overheating measures will also help to keep energy demand low, by avoiding the need for active cooling and excess use of mechanical ventilation.

Scope for future improvements

None as numerical targets are not given.

Alignment with national policy

Part O of Building Regulations requires overheating assessments to be undertaken in residential development, with CIBSE TM59 provided as one route to compliance for residential buildings. Therefore, C1 and C2 are aligned with national policy approaches.

However, Part O does not require that TM59 is completed, as the Simplified Method can be alternatively used. Additionally, CIBSE TM52 is not referenced because Part O does not relate to non-residential buildings.

The Housing Update Written Ministerial Statement (15 December 2021) states that there is no need for local policy to duplicate Part O policy. The cooling hierarchy (C1) is not referenced in Part O and CIBSE assessment are not *required*, therefore C2 neither is a duplicate.

Feasibility and costs overview

No feasibility or cost implications.

Implementation considerations

Specific information on overheating assessments should be set out in supplementary policy guidance.

Although mechanical ventilation is listed down the cooling hierarchy as part of C1, the use of mechanical ventilation with heat recovery (MVHR) should not be viewed negatively as this may assist compliance with operational energy policies. However, MVHR should have the ability to bypass the heat recovery function in periods of warmer weather in order to support the overheating risk mitigation goal.

Industry capability

Overheating assessments are a requirement of Building Regulations Part O (for residential), and is a common measure performed in the design of good-quality non-residential new buildings especially where a BREEAM rating is sought. Therefore, it should not inflict any significant additional burden on the development industry to deliver on C1 and C2.

Development Management capability

The cooling hierarchy is simple to follow and assess to grant policy compliance, assuming some officers have had training carried out and have guidance to refer to. Guidance on how to assess CIBSE overheating assessments will make policy compliance simple to grant or not.

D. Embodied carbon and waste

Residential and non-residential buildings (thresholds given below) must meet the following requirement:

D1. Embodied carbon reporting	All major new residential and non-residential developments are to complete a whole-life carbon assessment in accordance with **RICS Whole Life Carbon Assessment** guidance.
D2. Limiting embodied carbon	Large-scale new residential (50 and above units) and non-residential (5000m^2 commercial floorspace) development to limit embodied carbon (RICS modules A1 – A5) to: Residential (excluding flats) (from 2025): **300 kgCO$_2$e/m^2 GIA** Non-residential and flats (from 2025): **475 kgCO$_2$e/m^2 GIA** Non-residential and flats (from 2030): **350 kgCO$_2$e/m^2 GIA**
D3. Embodied carbon offsetting	Any shortfall to the embodied carbon limits set out in D2 will be offset through a financial contribution reflecting the most up-to-date valuation of carbon from national Government. The embodied carbon price is determined by the 'high scenario' in the *Valuation of energy use and greenhouse gas emissions* (BEIS/DESNZ), currently set at £378/tCO$_2$ (2023). The price should be revised annually.
D4. Building end-of-life	All new buildings are to be designed to enable easy material re-use and disassembly, subsequently reducing the need for end-of-life demolition.
D5. Demolition audits	All major development that contains existing buildings/structures to carry out a pre-redevelopment and/or pre-demolition audit, following a well-established industry best practice method (e.g. BRE).

Information demonstrating compliance with D2 is to be submitted at the planning application stage and post-completion stage (submitted as a planning condition) to verify that as-built embodied carbon quantities remain compliant.

Compliance with D1, D2 and D4 are to be demonstrated within an energy statement. If applicable, output reports for D5 should be submitted alongside an energy statement.

Links to other policies

There are limited links to other policies but opportunities to address embodied carbon and operational energy should be explored holistically to achieve carbon savings across both scopes. Please see examples of embodied carbon policies in previous section.

Scope for future improvements

There is significant scope for future improvements for embodied carbon and waste policies. In particular, standards set for D2 should be lowered in future local plan reviews as embodied carbon policy becomes integrated into local and national policy. As policy is implemented on embodied carbon, industry will become better placed to deliver on ambitious policy requirements and move towards net zero embodied carbon emissions.

Alignment with national policy

Limited alignment with national policy as embodied carbon is not part of Building Regulations currently. However, this is due to a lack of recognition of embodied carbon emissions and their significance.

The industry proposal of Part Z, as an additional document to Building Regulations, is currently going through the parliamentary process and could be integrated before the adoption of the South & Vale local plan. This would require that whole-life carbon reporting is implemented in Building Regulations in 2023 and emissions limits are set from 2027.

The Environmental Audit Committee state that embodied carbon assessments must be undertaken for new development and that if embodied carbon emissions are not actively reduced, the UK will not remain within its carbon budgets nor achieve its 2050 net zero target. There is therefore a clear justification for local authorities to require embodied carbon assessments and limit emissions arising from the construction of new development.

Whilst there is not explicit reference in the NPPF, the reference to low carbon development could readily include embodied carbon as an implicit part of the equation. The case for addressing embodied carbon is justified by the increasing importance of these emissions as the power grid is decarbonised.

Feasibility and costs overview

Alongside testing the feasibility of operational energy policy requirements, Task 3 also explored the feasibility of embodied carbon emissions limits on the tested residential and non-residential archetypes. The limits set out under D2 have been shown to be feasible for all archetypes.

The cost uplifts associated with achieving limits in D2 have been determined in Task 4. The combination of cost uplifts from achieving requirements for A1 – A3 and D2 for residential buildings is:

- Semi-detached: 10%
- Terraced: 9%
- Detached: 6%
- Flats: 12% (*for the 2030 target – hence the initial looser target for this archetype in the policy*).

The combination of cost uplifts from achieving requirements for B1 – B3 and D2 for non-residential buildings is:

- Retail: 12%

- Retail (with residential unit): 9%
- School: 10%
- Office: 7%
- Warehouse: 9%

These cost uplifts only apply for embodied carbon targets set from 2025 and do not account for costs associated with the stepped approach for a stronger target from 2030. The initial looser target from 2025 represents a relatively and easy-to-achieve improvement on the baseline embodied carbon that these archetypes would have with 'business as usual' typical construction (circa 550kg/m^2 according to the modelling in Task 3 and 4). As cost data can quickly become obsolete, it would be appropriate to reassess the costs of the tighter targets closer to 2030.

Implementation considerations

Information and requirements on embodied carbon assessments will need to be set out in supplementary policy guidance to enable developers to sufficiently demonstrate policy compliance. Methodologies and the scope of embodied carbon assessment should be clarified, alongside other potential implications such as third-party verification.

Similarly, acceptable methodologies (i.e. RICS Whole-Life Carbon Assessments guidance) to comply with D5 should be set out in guidance.

Industry capability

The embodied carbon limits set within D2 are challenging to achieve for the development industry yet are still achievable[25], provided responsible and appropriate decision making throughout design stages.

The required embodied carbon limits set within point D2 represent ambitious but achievable targets for developers[26], acting as a backstop to prevent large-scale developments from excessive embodied carbon emissions (embodied carbon emissions of this scale within large-scale development would represent a serious climate impact). The targets from 2030 are more challenging to achieve, yet are still achievable provided responsible and appropriate decision making throughout design stages.

The embodied carbon offsetting required within point D3 will be simple to achieve as it is fulfilled by a payment made to the local authority's offsetting fund in proportion to the embodied carbon figure already calculated under point D2. The amount is easily determined by multiplying the amount of embodied carbon by the financial value per tonne of carbon that is set by the national government, publicly available[cix]. Payment can be made via Section 106 or a unilateral undertaking; developers are familiar with these mechanisms as they are commonly used to make other contributions needed to address the burden placed by the development on public services (e.g. transport, education, allotments, and so on). This mechanism has been used successfully in several local plans for offsetting of operational carbon (see precedents throughout this document).

The expectation set by point D4 (demonstrating ease of future building disassembly for future reuse) and D5 (pre-demolition or pre-redevelopment audit) are both within the industry's current capability in that they are part of the most common environmental certification system used across the industry (BREEAM), with widespread take-up (especially within the non-domestic sector):

- Pre-demolition or pre-redevelopment audits are not uncommon in the development sector, as they are one of the actions that developers often choose to take in order to gain certain credits within the very widespread BREEAM certification (relevant credit: BREEEAM 'Wst 01'[cx]). The industry in London is familiar with these as part of that region's requirement for circular economy statements; as a result many of the major nation-wide built environment consultancies have had exposure to these. Alternatively, these audits are offered as a service by the BRE itself, and by some demolition contractors. Guidance on best practice is available from the BRE[cxi].
- BREEAM credit (Wst 06) requires the applicant to produce "a study to explore the ease of disassembly and the functional adaptation potential" of several different design options, and from that study to "develop recommendations or solutions … during or prior to concept design, that aim to enable and facilitate disassembly and functional adaptation". This would be relevant to the recommended policy point D4. Also, any industry body that is also active within London will also have gained exposure to this concept through the GLA's requirement for circular economy statements, whose guidance[cxii] notes that three of the six 'circular economy principles' are 'building in layers', 'designing for adaptability or flexibility', and 'designing for disassembly'. While such analysis may not be commonplace outside London, it is not unheard of, and this policy is designed to boost the practice by increasing the demand and thus encouraging the Oxfordshire industry to grow its capacity to produce this analysis that will be a vital part of the local and national transition to net zero. Other than the GLA, guidance is available from several sources online including ISO[cxiii] and UKGBC[cxiv,cxv].

Development Management capability

The capability of Development Management officers to accurately assess these policies is reliant on the degree of training and guidance documents available. It is essential that officers have guidance on hand to assess policies against to ensure that compliance is achieved in accordance with methodologies set out in a subsequent guidance document. Specific upskilling of at least one officer on climate change policies to gain a technical understanding will greatly assist the overall ability of the team to assess policy compliance. Officers could familiarise themselves with the following to better understand and assess embodied carbon calculations:

- Different scopes of carbon (e.g. upfront embodied carbon vs. whole-life carbon)
- Knowledge of RICS whole-life carbon assessment guidance
- General understanding of low-carbon materials
- Good practice efficient structural design choices to reduce embodied carbon

[25] As shown in emerging separate reports on feasibility and cost uplift, which identify construction choices that would deliver buildings that meet these targets (and the associated cost uplift), using techniques and products that are commonly available today but represent reasonable changes to the typical higher-carbon conventional construction materials and techniques that would be used in the absence of such targets.

[26] As shown in emerging separate reports on feasibility and cost uplift, which identify construction choices that would deliver buildings that meet these targets (and the associated cost uplift), using techniques and products that are commonly available today but represent reasonable changes to the typical higher-carbon conventional construction materials and techniques that would be used in the absence of such targets.

E. Existing buildings

E1. Energy hierarchy	All works on existing buildings (i.e. conversions, extensions and change of use) are expected to demonstrate that the energy hierarchy and consideration to sustainable construction and design has been applied throughout design decision making. The level of detail expected will be proportional to the scale of the proposal.
E2. Carbon reduction	Development proposals relating to existing buildings that would result in significant improvement to the carbon and/or energy performance of an existing building will be supported, with weight afforded in their favour in proportion to the carbon reduction benefit they bring. All major works on existing buildings (i.e. more than 10 dwellings or 1000m^2 non-residential floorspace) that require planning permission is required to report on the following in SAP (Standard Assessment Procedure) (residential) or Simplified Building Energy Model (SBEM) (non-residential): • % improvement of Dwelling Emissions Rate/Building Emissions Rate over the Target Emissions rate • Primary Energy Rate • Fabric Energy Efficiency rate The purpose of this policy recommendation is to ensure that development involving existing buildings reports on emissions, takes opportunities to reduce emissions, and does not result in excessive emissions. For any work on residential buildings, the use of PAS 2035:2019 specification and guidance (or any superseding guidance) is encouraged.
E3. Heating systems	All major development, where planning permission is required for changes that relate to the heating system, should demonstrate that the feasibility of low- or zero-carbon district heating or individual heating technologies have been explored prior to any replacement of existing gas heating systems.

Links to other policies

No links to other policies.

Scope for future improvements

Limited scope for future improvements as planning policy cannot set strict policy requirements on existing buildings similarly to new buildings.

Alignment with national policy

E2 uses the same methodology as Building Regulations (SAP/SBEM) for new buildings compliance under Part L and is therefore aligned.

Feasibility and costs overview

No feasibility or cost implications.

Implementation considerations

Supplementary guidance on how to apply the energy hierarchy, particularly in the context of existing buildings should be produced. Guidelines should also be set on what is to be expected in planning applications that sufficiently demonstrate compliance with E3.

Industry capability

All three policy elements are well-established in policy presently and are deliverable. E2 aligns with the methodology used for Part L of Building Regulations and is therefore familiar to developers.

Development Management capability

Development Management officers should be well placed to assess policy compliance for these policies. There is likely to be an overlap with policy on existing buildings and heritage assets, which means Development Management officers should collaborate with heritage and conservation teams when assessing policy compliance.

F. Renewable energy

F1. Smart site allocation	Allocate or identify suitable sites for renewable energy that supports a balanced energy system resilient to conditions on an annual basis, which should include storage and not be reliant on one generation technology. This will be explored in Task 6 of this evidence base. Proposals for large-scale renewable energy development (≤ 10MW) are encouraged to choose a site that is well supported by sufficient grid capacity. Support will be given to proposals for standalone electrical grid capacity upgrades, local smart grids, and development of grid-connected energy storage especially if co-located with large-scale renewable energy generation installations.
F2. Energy storage	Support will be given to proposals that form part of the transition to a net zero carbon district and county, which must involve a range of renewable energy storage technologies. This could include energy storage facilities (e.g. battery and thermal storage) and upgraded or new electricity facilities. Proposals for renewable energy generation are encouraged to provide at least an additional 10% of energy storage (e.g. battery storage) of the overall energy generation.
F3. Co-benefits	Proposals for renewable energy generation over 20MW are to provide an option to offer 5% community ownership to the local community (e.g. Parish Council area). Positive weight will be given to schemes led by the community and community energy groups.
	All proposals are to undertake community engagement sessions with the local community to mitigate any potential impacts to the community as a result of the development. The intention of the policy here is to thoroughly engage with the community. Community engagement as per the NPPF is to be demonstrated.
	Large-scale proposals above 10MW are to demonstrate >20% improvement on biodiversity net gain.
	All proposals are to demonstrate how the renewable energy generation site can be restored to its original state following removal of technologies and mitigate any biodiversity loss. Proposals will be subject to a condition requiring the submission of an end-of-life removal scheme within 1 year of the scheme becoming non-operational and the implementation of such a scheme within 1 year of scheme approval. The removal scheme should demonstrate how any biodiversity net gain that has arisen on the site will be protected or enhanced further, and how materials to be removed would, to a practical degree, be re-used or recycled.
F4. Grid reinforcement	All development for renewable energy generation, or development that includes renewable energy generation, is to demonstrate how options for energy storage, smart grids, and energy sharing networks have been explored to reduce the need for grid capacity upgrades.
F5. Refusal of fossil fuels	Any applications for exploration and extraction of fossil fuels will not be supported.
F6. Support for innovative energy generation	Support will be given to innovative renewable energy generation approaches, such as 'agrivoltaics' – the combined use of land for solar PV generation and agriculture. Although these sites may not specifically be identified as suitable in land sensitivity assessments, they should be not refused without an appropriate individual assessment of land suitability based upon the specific innovative use of land.
F7. Protecting infrastructure	Any development should not significantly harm: a. Technical performance of any existing or approved renewable energy facility. b. Potential for optimisation of strategic renewable energy installations. c. Availability of the resource, where the operation is dependent on uninterrupted flow of energy to the installation.
F8. Mitigation of negative impacts	Support will be given to proposals that demonstrate mitigation measures are implemented for: a. Scale, siting and design and impacts on landscape character, visual amenity, biodiversity, flood risk, townscape, heritage, historic landscape and highway/rail safety. b. Impacts on aviation and defence navigation systems/communications. c. Impacts on the amenity of sensitive neighbouring uses (local residents) included issues such as noise, dust, odour, shadow flicker, air quality and traffic.

Compliance with criteria-based policies (F2 – F4) should be demonstrated within a renewable energy statement.

Links to other policies

Due to the requirement for new residential and non-residential buildings to have an on-site net zero energy balance, for which renewable energy generation is crucial, policies F1 and F4 are inherently linked to A1 – A4, A6, B1 – B4 and B6.

Net zero new buildings can reduce additional stresses of new development on grid capacity (F4), particularly if battery storage is integrated on-site. Grid infrastructure reinforcement is critical for net zero development, primarily because as the significant amount of on-site renewable energy generation will be connected to the electricity grid. Therefore, mitigating energy consumption through A1 and B1 reduces stress on the grid.

Offsetting policies A4 and B4 could be benefited by successful implementation of F1, since having sites identified for renewable energy generation reduces time lags for large-scale energy offsetting projects.

These recommendations build upon examples previously set out in this report.

Scope for future improvements

No scope for specific improvement on policies as numerical requirements are primarily not set, but improvements are possible on the delivery and information to support policy development and implementation. For example, a more prescriptive approach on what technologies need to be brought forward could be set, alongside improving co-benefits such as the degree of community engagement and biodiversity net gain levels.

Alignment with national policy

Renewable energy is a key component towards the fulfilment of the Climate Change Act 2008 and associated 2050 net zero target. Therefore, if the UK it to successfully transition to net zero, renewable energy opportunities must be maximised.

National policy requires community engagement to be demonstrated, as per the NPPF, and supports growth of renewable energy generation and specifically requires that sites are allocated to identify suitable areas for installations. Task 6 of this evidence base will fulfil this requirement to enable development of onshore wind schemes. The biodiversity net gain requirement follows the same approach as now applied at national scale, although national policy sets a lower standard of 10%.

Feasibility and costs overview

No feasibility or cost implications.

Implementation considerations

Supplementary guidance is essential to the delivery of these policies to set expectations of what is required from developers to demonstrate policy compliance, particularly F2, F3, and F4.

Requirements for developers on community benefit and engagement should involve South & Vale planning officer participation and members from the local community. Similarly, ecology officers should be heavily involved in assessments to demonstrate biodiversity net gain.

Industry capability

All the policy elements set out involve existing themes within the renewable energy development industry and should be deliverable. Biodiversity net gain has been introduced as a national standard and will therefore be a familiar concept to the industry by the time of policy adoption.

Development Management capability

Due to the wide-ranging potential impacts of renewable energy generation and storage development, technical expertise from various internal officers will be necessary to appropriately assess policy compliance. Input will be needed from officers who have expertise in:

a. Biodiversity/ecology
b. Highways
c. Landscape
d. Heritage/conservation

Policy compliance is likely to be determined on a process of liaison with the renewable energy developer and dependent on the degree of cooperation with council officers, particularly when addressing community-based implications.

Policy implementation and monitoring

Policy adoption is key, yet policy implementation is essential to ensure effective delivery of required standards. It is recommended that the Council put together a group that includes policy officers, development management officers (and conservation/heritage) and building control officers to design an effective monitoring system.

Policy compliance

Adoption of ambitious local plan policies is crucial to work towards a net zero future. However, without reliable implementation and monitoring mechanisms, intended benefits of these policies will not be experienced and their reputation hindered.

Implementation is key to the success of policy delivery in practice and should be treated equally as important to policy development. Therefore, Development Management officers will need to gain an understanding of how the policies are intended to operate in practice and initially be guided through how to assess policy compliance.

To ensure that policies on net zero operational energy, embodied carbon and overheating are delivered as intended, two key stages of assessing compliance are necessary: planning application/design stage and post-completion stage. Submission of data throughout design stages is what will determine policy compliance for the full planning application, yet this must be verified with as-built data to confirm true policy compliance; this only applies for recommended policy components A1 – A3, B1 – B3 and D1 – D2. Pre-commencement and pre-occupation conditions must therefore be set at the planning application stage, which could include:

- Photographic evidence of building fabric, heating systems and ventilation technologies
- Air tightness tests whilst the air barrier remains accessible (to allow improvements to be made if required standards are missed)
- As-built reports for building energy performance, embodied carbon assessments and overheating measures

In cases where standards fall below required levels at the post-completion stage, it is important to have enforcement mechanisms in place to penalise non-compliant applications. This is a difficult issue to deal with as buildings cannot be deconstructed but the council should explore options with the Enforcement team on how to mitigate as-built risks.

Monitoring standards

Understanding how policies work in operation assist the future development of improved policies and informs other local authorities on what is deliverable. The council should develop a reliable monitoring system that enables the collation of policy performance data both for compliance at application stages and once the building is in use. This should be made available in a standardised format for ease of data input for developers and subsequent sharing of data. South & Vale could look to distribute this standardised reporting form to neighbouring authorities to form a regional understanding of policy implementation. Examples of monitoring indicators for new buildings and also renewable energy include:

Indicator	Source	Policy link
Average in-use Energy Use Intensity of new buildings	Development data	A1 and B1
Average on-site renewable energy generation	Development data	A3 and B3
MW capacity of solar PV installed on buildings	Planning portal or MCS data	A3 and E1
MW capacity of solar PV installed as standalone scheme (above 1MW)	DESNZ Renewable Energy Planning Database (REPD) data	F-suite policies
MW capacity of wind turbine installed as standalone scheme (above 1MW)	DESNZ REPD data	F-suite policies
MW capacity of battery storage installed	DESNZ REPD data	F-suite policies, A3 and B3
Annual CO_2 emissions of new build development	Development data	A1, A3, B1 and B3
Number of heat pumps installed	Planning portal or MCS data	A1, B1 and E1
Number of insulation retrofitting measures installed	Planning portal	E-suite policies
Number of listed buildings retrofitted	Planning portal	E-suite policies

As required by policies A7 and B7, Post-Occupancy Evaluation (POE) is key to understanding in practice success of net zero operational energy policy. The primary purpose of undertaking POE is not for policy compliance but to better understand the performance gap between design stage energy performance predictions and the as-built performance of the building. Once the building is in use by occupants, developers cannot be penalised if reported values on energy consumption exceed the policy requirements because operational energy consumption is largely dependent on occupant behaviour.

Due to the influence of occupant behaviour on values reported through POE, there are privacy concerns with residents associated with these exercises. Therefore, developers cannot force residents to participate in POE but should show to the best of their ability that the building performs as intended

with a minimal performance gap with the amount of data available. Implications of this potential risk are that data collection of energy performance may not be possible and future policy iterations are less informed.

Mitigating the performance gap

UK buildings are consistently victim to a performance gap between the energy performance of the building at the design stage and operational performance. The delivery of truly net zero buildings therefore requires rigorous systems to be in place to mitigate such a gap in energy performance, which are explored below.

Often the first point of failure of below-par operational energy performance is at the modelling stage, which in the UK is led by use of inaccurate compliance tools for Building Regulations, SAP and SBEM. Local policy must now move away from the use of SAP as operational energy policies seek to deliver genuinely net zero buildings and instead use robust and proven tools to predict energy performance that can be achieved in practice.

SAP currently underestimates and poorly predicts space heating demand, whilst also neglecting calculations of unregulated energy, which forms a key component of total energy use. It is essentially guaranteed that a significant performance gap will be apparent in any new build that has achieved policy compliance through the use of SAP.

If local policy is to reliably deliver net zero buildings, alternative methodologies must be used to gain an understanding of building energy performance at the design stage. Proven alternatives are available for both residential and non-residential buildings:

- Residential: Passivhaus Planning Package
- Non-residential: CIBSE TM54 with Passivhaus Planning Package or IES-VE

Accurate assessments are equally important for policies on overheating and embodied carbon. For overheating, the simplified method on offer for Part O of Building Regulations is an inaccurate tool, hence why CIBSE overheating assessments should be completed so that more specific and accurate overheating measures specific to the at-risk building can be implemented.

Embodied carbon assessments require reliable and up-to-date data on the carbon content of various materials and products. Accurate data is the key to robust embodied carbon assessments. Since embodied carbon is not a national policy requirement, there is no approved methodology, but the RICS Whole Life Carbon Assessment guidance is generally accepted as the industry standard.

Third party verification

The use of accurate assessment and modelling tools is essential to the eventual performance of building, but human inaccuracies and errors throughout stages remain a risk to exacerbating a performance gap. Therefore, requiring third-party verification mechanisms to assess the accuracy of the approach, inputs and assumptions to modelling and/or assessments can further mitigate performance gap risks. There is currently no recognised collection of third-party verification systems and should therefore be a council-led decision on what would constitute an acceptable third-party verification process demonstrated by a developer. An acceptable third-party verification approach would be the submission of an audit undertaken by a third-party consultancy who are able to undertake the calculations themselves but are independent to the development. Additionally, if the assured performance schemes (as below) are used, this would constitute an effective third-party verification process.

Assured performance

Once accurate modelling and assessments have been completed to the best of abilities, following the processes above, assured performance schemes should be employed as the final element of performance gap mitigation. Building Control at local authorities firstly do not have control over all development sites and even at those where the authority does, regular on-site checks are not always carried out. Management systems to ensure high levels of construction quality are necessary to deliver energy performance standards as predicted.

For example, air tightness and thermal bridging are key components of the net zero operational energy policies recommended in this document. These need to be checked throughout construction phases, meaning that a simple confirmation of insulation thickness is insufficient to assess construction quality.

Acceptable schemes to demonstrate compliance with policies A5 and B5 should be set out in supplementary policy guidance. Several schemes are available and proven to be reputable, as listed below:

- Passivhaus Certification (residential and non-residential)
- AECB Building Standard (residential and non-residential)
- NABERS UK (non-residential)
- Assured Performance Process (residential)
- National Energy Foundation (residential)

Position statement

The following section proposes a position statement that sets out net zero carbon for the local plan, based on the preceding literature review.

1. A Net Zero-Carbon South & Vale is one that:

    - Contributes no more GHG emissions in scopes 1 (direct emissions resulting from activity within South & Vale) and 2 (indirect emissions from energy use)(including all 7 gases named in the Kyoto Protocol) on an annual basis than are removed from the atmosphere by the area's carbon sinks:
        - Including all energy and refrigerant use by buildings and transport,
        - Including natural emissions and removals (e.g. wetlands, forest, grassland) along with other land use,
        - Including all sectors and emissions sources except aviation and shipping
        - Without relying on offset schemes delivered outside the UK, and minimising the use of UK carbon offset credits too.

    - Stays within CO_2 emissions budgets for energy use (including transport) that are consistent with a 1.5˚C climate change pathway to 2100 (as calculated by the Tyndall Centre to be a proportional contribution by South & Vale as part of a globally fair contribution by the UK to the Paris Agreement)

    - Keeps track of its scope 3 emissions (aviation, shipping and embodied carbon of goods, especially building materials), and takes steps to reduce these through resource efficiency, land use, and exerting influence over its supply chain, and finds effective means for the appropriate offsetting of the remainder within the UK.

2. A local plan consistent with a Net Zero-Carbon South & Vale is one that:

    - Has a spatial strategy that seeks to minimise carbon emissions by:
        - Minimising the need to travel
        - Maximising the use of green infrastructure
        - Providing for renewable energy generation

    - Allocates development sites, densities and mix of uses so as to minimise the potential carbon emissions for built environment and transport:
        - In terms of modal shift to active travel and public transport
        - In terms of availability of grid infrastructure to support both electrification of vehicles and the necessary renewable energy generation on buildings linked to the grid
        - Using a cautious estimation of the rate of shift towards electric vehicles

    - Requires the maximum feasible reduction (typically 100%) in scopes 1 and 2 of energy use and carbon emissions from any new development's operation
        - Including both regulated and unregulated energy at the development
        - Calculated using a proven methodology to reliably predict the building's energy use and minimise the energy performance gap
        - To be achieved on site using an energy hierarchy considering passive design, fabric efficiency and zero-carbon heating and disallowing fossil fuel energy use
        - Adopting space heating and energy use intensity targets from relevant green building frameworks that are aligned with science-based carbon targets
        - Taking into account exchanges of energy over the course of a year (with exports of zero-carbon energy counting as negative emissions)
        - With the energy strategy for major developments to include monitoring of energy and carbon emissions for the first 5 years to help create benchmarks

    - Requires new developments to install the sufficient on-site renewable energy generation to match total energy use (in order to meet the aforementioned 100% carbon reduction), and should also:
        - Adopt a guideline metric of renewable energy capacity per square metre of building footprint (to acknowledge that the key factor is roof space for solar panels),
        - Expect that plots below a certain height should be able to become net exporters of zero-carbon energy across the course of a year

    - Requires developer contributions to offset the development's any residual on site renewable energy generation that does not match total energy use, only as a last resort and in exceptional circumstances where this is shown to be unavoidable, and define the 'allowable solutions' for offsetting to include the following:
        - Direct local action funded through setting a price as £/tCO_2 or p/kWh to be charged to the developer, that reflects the actual cost of emissions reduction in South & Vale

    - Prepare structured schemes to deliver these offsets within South & Vale in a measurable and time-bound way (for example, to retrofit existing buildings with insulation or zero carbon heating, to invest in renewable energy in the local area, or to transition existing heat networks to zero-carbon sources)

- Requires developments over a certain size or value to calculate and limit their embodied carbon emissions up to the stage of building completion (RICS methodology stages A1 to A5) and specify steps taken to reduce this through resource efficiency, construction practices and materials selection, making this a material issue in planning. In aid of demonstrating the effectiveness of this:
    - Set embodied carbon limits with industry recognised benchmarks such as set by LETI and RIBA

- Is supported by an infrastructure development plan that explicitly prioritises carbon-reducing infrastructure

- Explicitly encourages and supports renewal and refurbishment proposals that include significant retrofit and improvements to existing building stock, both through policy wording and other planning mechanisms available, such as Local Development Orders

- Identifies and allocates sufficient and suitable space for large scale generation, storage and transmission of renewable energy to support the transition of all buildings and vehicles away from fossil fuels, again identifying suitable sites and using permissive tools, such as Local Development Orders

- Identifies and protects sites in the joint South & Vale authority area that are or could feasibly become carbon sinks (i.e. peatlands and areas suitable for biodiverse native afforestation), and supports the restoration of these, ideally of sufficient size to offset the remainder of unavoidable emissions from sectors that cannot reach zero emissions by 2050.

3. A Net Zero-Carbon Development in South & Vale:

- Contributes net zero GHG emissions in operation in scopes 1 and 2 for all its energy use, consuming only renewable energy from on-site generation OR importing no more grid energy than the amount of renewable energy the home is able to export to the grid over the course of the year. To do this, the home would:
    - Achieve targets for space heating demand and Energy Use Intensity (including unregulated), set by the local authority, or industry benchmarks if better (e.g. RIBA Climate Challenge, LETI Net Zero Operational Carbon and Passivhaus Plus or Premium)
    - Follow an energy hierarchy process in the design that considers orientation, form, fabric renewable heat supply and renewable energy generation
    - Be assessed using a proven methodology that accurately forecasts and minimises actual total energy use of the building (e.g. PHPP), including the performance gap
    - If over a certain size threshold: be monitored for 5 years from first occupation for major developments (with a method built into the energy strategy)
    - Design towards a minimum kWh of renewable generation on site per square metre of building footprint
    - Where there is insufficient on-site renewable energy generation to match the total energy use of the development, offset any residual kWh over the building's lifetime (assumed to be 30 years) through a direct financial contribution determined by a locally-specific set price that covers the cost of achieving the same energy generation within South & Vale
        - This offset payment should go into a structured fund held by the Council to be spent on local schemes with direct and measurable carbon reductions that would otherwise not occur (i.e.. additionality), or invested directly in additional off-site renewable generation (ideally on the roofs of other new builds that have excess space, so as to save land elsewhere and decarbonise the new build growth as a whole).

- Calculates and complies with a limit set for the embodied carbon from construction (major developments only, stages from production through to completion – A1 – A5)

- Does not hinder the site's ability to be an existing carbon sink, or feasibly be converted to a significant carbon sink, if the site is identified to have good potential for this function

- Is sited and equipped to support a pathway towards zero-emissions transport: active travel, public transport or electric vehicles (in that order of preference).

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