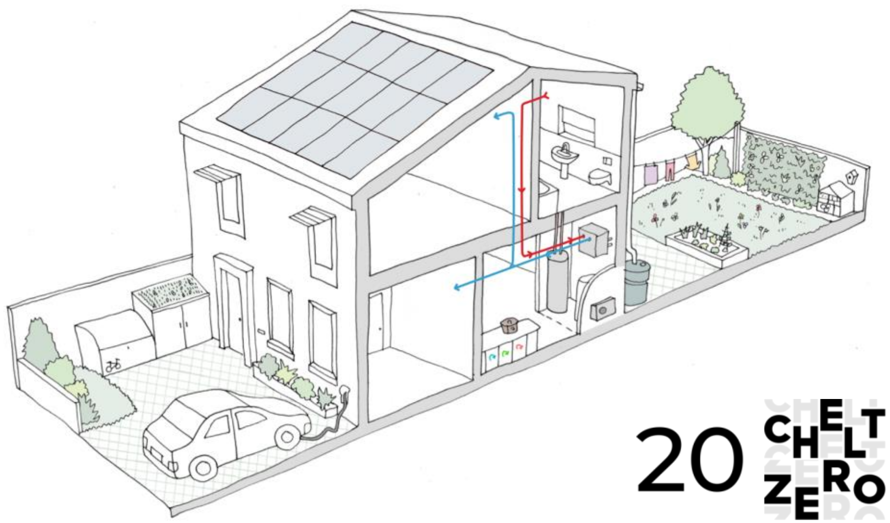
Cheltenham Borough Council



2030 CHELT ZERO

Cheltenham Climate Change SPD

Etude

June 2022 – Rev G

Preface

Planning isn't always the most exciting topic for discussion. Most people wouldn't dive into a chat about local development frameworks in a pub or café, or over dinner with their family. But the planning system is at the heart of the solution to the climate crisis. How do we build new places? How do we renovate older buildings? How do we power them? How do we travel to and from them? How do they support nature? To create a world in which we reach net zero and promote nature, we must answer all those questions and many more.

That's the reason we've produced this supplementary planning document. It's easy to understand and a digestible length. It gives clear guidance for projects ranging from a minor home renovations right through to major development. The document will be at the heart of our planning process. So if you're reading this as an applicant, you'll need to show that you've taken on board the document and incorporated it into your thinking.

We know Cheltenham people want to do the right thing by our precious environment. Together, we know we can do it.

Councillor Alisha Lewis

Councillor Martin Horwood

CHELTENHAM
BOROUGH COUNCIL

20 CHELT ZERO 30

Contents

With thanks to April Grisdale Illustrations for the illustrations created for the One-Page Summaries and Levitt Bernstein Architects for the use of some of their images in the Guidance section

This Climate Change SPD

This Climate Change Supplementary Planning Document (SPD) has been created to communicate Cheltenham Borough Council's ambitions for all buildings within the borough and how they should respond to the climate change and biodiversity crisis.

The SPD is intentionally ambitious. It builds on currently adopted policies with necessity and purpose. Necessity, because it is our responsibility to respond to the climate emergency as we plan for our existing communities and the future generations. Purpose, because we want to communicate the direction of our future policy and use the planning system positively as an enabler for change. The planning process urgently needs to be consistent with a zero carbon future, help limit global temperature rises, mitigate the impacts of climate change and reverse biodiversity loss.

Who is this SPD for?

This SPD is for homeowners, architects, developers or engineers with building projects that require planning permission from Cheltenham Borough Council. This SPD also provides useful guidance for anyone wishing to build to net zero carbon standards, or refurbish or extend their property.

What types of development does this SPD cover?

This SPD covers all types of development: residential and non-residential, new-build and refurbishment and extensions.

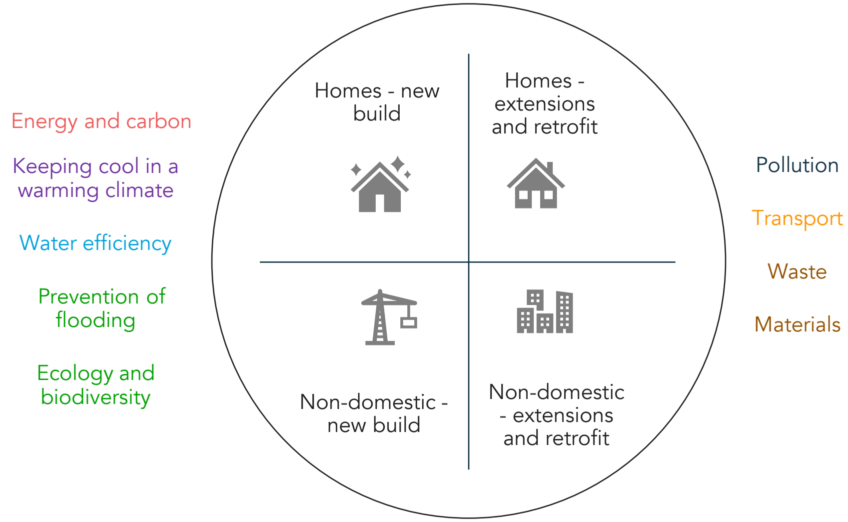
The SPD also covers all scales of development. Development specific guidance is given on topic pages where appropriate.

Planning applications should align with this SPD

The SPD provides guidance on how applicants can successfully integrate a best-practice approach towards climate and biodiversity in their development proposals. How successfully applicants align with the SPD will be a material consideration in the determination of planning applications by the local planning authority.

All buildings should strive to achieve ambitious carbon reductions today.

- **2019** – Cheltenham Borough Council declares a climate emergency
- **2022** – Climate Change SPD published
- **2030** – Cheltenham becomes a net zero carbon council and borough



This SPD covers all development types, at all scales: new-built and retrofit, homes and non-domestic buildings. A broad range of climate change and sustainability issues are addressed.

Climate responsible development: where do we need to be?

The Climate Change Committee's recommendations

The Climate Change Committee is an independent body appointed to advise the government on how to achieve its climate change target of being net zero carbon by 2050 (legislated by the Climate Change Act). Their 2019 report "Net Zero: The UK's contribution to stopping global warming" provides an in-depth analysis of the actions required across different sectors: buildings; industry; power; transport; aviation & shipping; agriculture & land-use; waste; fluorinated gases and greenhouse gas removals. These are summarised on the right.

Emissions from industrial and commercial sources, freight, air travel and land-use and agriculture emissions are shown to be difficult to abate. This makes it imperative that housing, light transport and waste sectors achieve maximum possible reductions.

We all need to work together

All UK local authorities and their inhabitants need to play their part in realising these collective ambitions. Cheltenham Borough Council is committed to working with and supporting others to achieve these aims.

It is important to know where we are going

The guidance in this SPD has been formulated with the objective of delivering sustainable development in a way that is consistent with climate change and biodiversity objectives.

The three overarching objectives needed to respond to climate change in Cheltenham

Reduce carbon emissions to zero + Mitigate against the impacts of climate change + Reduce impact on natural systems and resources

Key conclusions from the Climate Change Committee's "Balanced Pathway" on where we need to be

- Fully decarbonise electricity by 2035 while meeting a 50% increase in demand
- All new homes are zero carbon by 2025 at the latest
- Ultra-efficient new homes and non-domestic buildings
- Low carbon heat to all but the most difficult to treat buildings.
- Ambitious programme of retrofit of existing buildings.
- Complete electrification of small vehicles (100% of new sales by 2030).
- Large reduction in waste, zero biodegradable waste to landfill by 2025, zero all waste to landfill by 2040.
- Significant afforestation and restoration of land, including peatland.
- Greenhouse gas removals will be required to achieve net zero carbon.

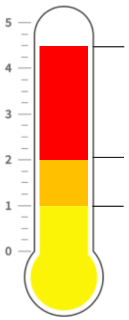
Climate responsible development: how quickly do we need to be there?

Carbon budgets

Climate science shows us that the amount of carbon in the atmosphere is proportional to the global temperature rises that are accelerating climate change and the increasing weather extremes it brings.

The UK has committed to limit global temperature rises to 1.5-2°C through the Paris Agreement and being net zero carbon by 2050. Cheltenham has committed to being net zero carbon by 2030. More than target dates, what is important is the amount of carbon we emit between now and then and not emitting more than our fair share of the global carbon budget. According to the Tyndall Centre, Cheltenham is on track to have consumed its carbon budget by 2027 based on current emissions rates. Therefore we need to reduce carbon emissions sharply (at a rate of approximately 13% per year) if we are to be consistent with Paris Agreement objectives.

In order to help realise the steep emissions reductions we need to see, new development in Cheltenham can and should be built to net zero carbon standards now, and existing buildings should urgently be targeting low and zero carbon retrofit standards.



4-5ºC the temperature rise we are likely to see if we continue on a **business as usual** path

1.5-2ºC The maximum temperature rise above pre-industrial levels the IPCC recommends.

1ºC The global temperature rise already created

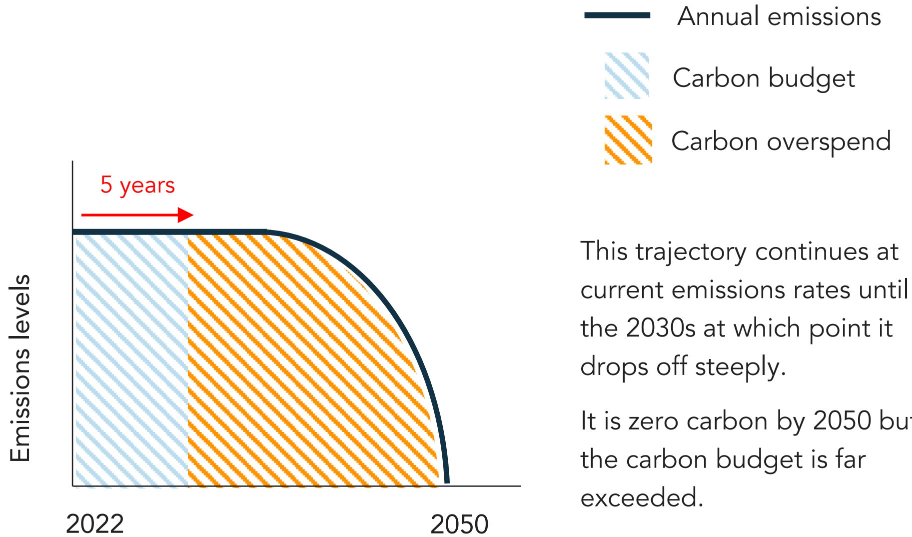
2027

The year we will would exceed Cheltenham's 1.5-2ºC carbon budget at 2017 emissions rates

Cheltenham's carbon budget = 2.0 $MtCO_2$ (from 2022)*

Current emissions rate = 0.39 $MtCO_2$/yr (2019)

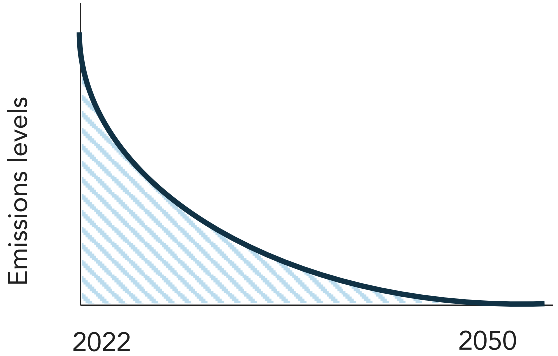
Years left of budget at current emissions rate: **5 years**



Trajectory type A

This trajectory continues at current emissions rates until the 2030s at which point it drops off steeply.

It is zero carbon by 2050 but the carbon budget is far exceeded.



Trajectory type B

This trajectory sees cumulative emissions stay within carbon budget, but a 13% reduction in emissions year on year is required to achieve it.

Aligning development proposals with this SPD

Planning applications should align with this SPD

The SPD provides guidance on how applicants can successfully integrate a best-practice approach towards climate and biodiversity in their development proposals. How successfully applicants align with the SPD will be a material consideration in the determination of planning applications by the local planning authority.

Supporting existing policy

This SPD defines what the Council consider to be a proportionate response to Cheltenham's Joint Core Strategy, Strategic Objective 6 – Meeting the challenges of climate change. The SPD supports implementation of the National Planning Policy Framework (NPPF) 2021 with a local context for Cheltenham. It addresses head on the planning authority's remit to: "help shape places in ways that contribute to radical reductions in greenhouse gas emissions" (para.152), taking a "proactive approach to mitigating and adapting to climate change" (para.153).

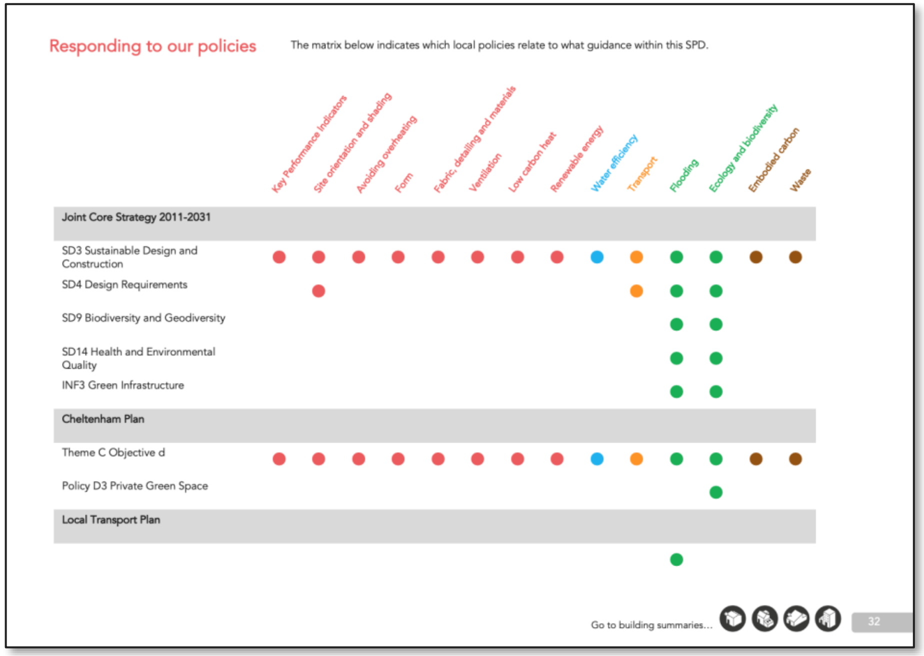
Applicants seeking guidance on how to comply with policies within the Joint Core Strategy 2011-2031, the Cheltenham Plan and the Local Transport Plan can use the policy matrix (p. 32) to locate relevant guidance pages within this SPD.

Key reference documents

Sources of useful further information are provided at the back of this SPD. They are included for reference only and applications do not need to comply with their requirements.

Checklist

A Climate Change Checklist (p. 33) provides the applicant with an easy to digest summary. Applicants will be expected to demonstrate, within their development proposals, how they have integrated in the early stages of design, an acceptable and proportionate response that aligns with the SPD. The Council will consider all planning applications using the SPD as a material consideration in their determination.


Responding to our policies

The matrix below indicates which local policies relate to what guidance within this SPD.

	Key Performance Indicators	Site orientation and shading	Avoiding overheating	Form	Fabric, detailing and materials	Ventilation	Low carbon heat	Renewable energy	Water efficiency	Transport	Flooding	Ecology and biodiversity	Embodied carbon	Waste
Joint Core Strategy 2011-2031														
SD3 Sustainable Design and Construction	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SD4 Design Requirements		●								●	●	●		
SD9 Biodiversity and Geodiversity											●	●		
SD14 Health and Environmental Quality											●	●		
INF3 Green Infrastructure											●	●		
Cheltenham Plan														
Theme C Objective d	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Policy D3 Private Green Space												●		
Local Transport Plan														
											●			

Go to building summaries... 32

Page 32 of this SPD offers a matrix linking the guidance herein to the policies within the Joint Core Strategy 2011-2031, the Cheltenham Plan and the Local Transport Plan.

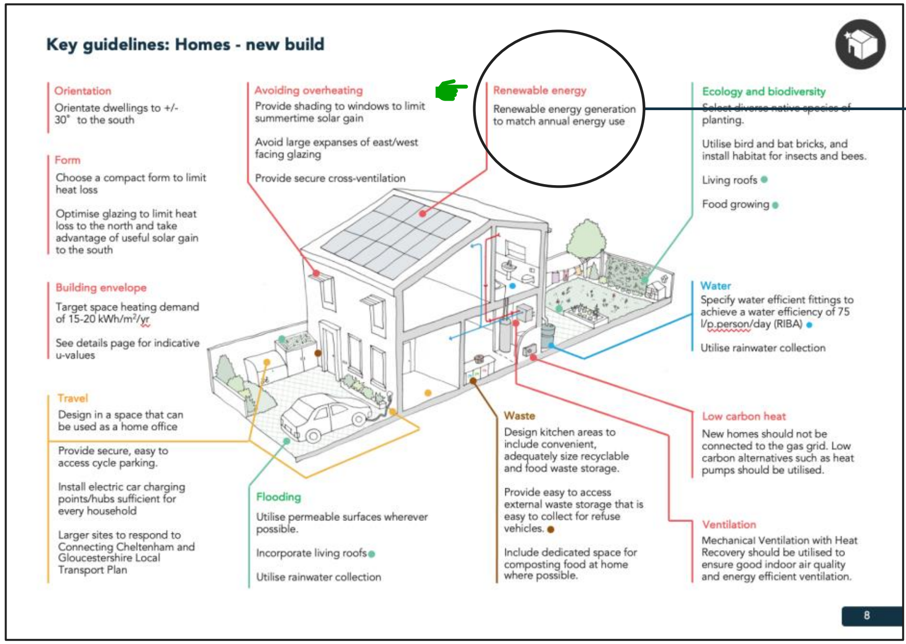
How to use this document

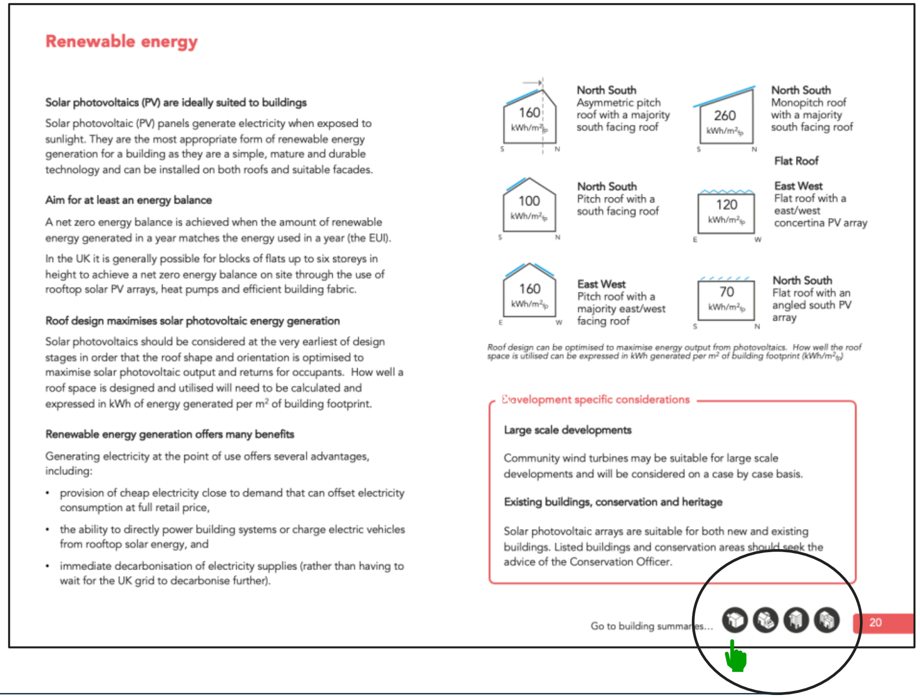
One-page overviews

We are looking for applications to address climate change in an holistic manner. Four one-page overviews, one for each of the four building categories, illustrate key measures for addressing climate.

Detailed guidance pages

Acceptable responses to our climate change policies are given in the Guidance section, pages 13 to 27.





New homes

Extensions and retrofit of existing homes

New non-domestic buildings

Extensions and retrofit of non-domestic buildings

Interactive navigation

Navigate between strategy overviews and detailed guidance pages by clicking linked coloured headings and building icons.

One-page summaries

New homes

Home extensions and refurbishment

New non-domestic buildings

Non-domestic extensions and refurbishment

Key Performance Indicators (KPIs) and recipe for Net Zero carbon buildings

New developments should achieve Net Zero carbon in operation through applying the three core principles outlined below, and by demonstrating the Key Performance Indicators (KPIs) defined by LETI (The London Energy Transformation Initiative) and reproduced on the right.

1 - Energy efficiency

Buildings should use energy efficiently. Space heating demand expresses the amount of energy and building needs for heating and is impacted by site and orientation, window design, form, building fabric, materials and detailing, and ventilation (see pages 14-18).

Energy Use Intensity (EUI) expresses the total amount of energy a building uses (per m^2 per year), and can be measured in-use through the energy meter. It is impacted by the space heating demand, the choice of heating system (p.19), ventilation system (p.18), lighting, cooking, appliances and equipment.

2 - Low carbon heating

All new buildings should be built with a low carbon heating system and must not connect to the gas network.

3 - Renewable energy generation

In new buildings, annual renewable energy generation should be at least equal to the energy use of the building (the EUI) . If this is not possible on-site, it should be demonstrated that the equivalent of 120 $kWh/m^2_{(footprint)}/yr$ of renewable energy is generated across the development.

Demonstrating compliance

For domestic buildings PassivHaus Planning Package (PHPP) offers an accurate means of estimating energy demands. PassivHaus certification is not required but does help to ensure construction quality.

For non-domestic buildings PassivHaus Planning Package (PHPP) or dynamic thermal modelling in accordance CIBSE TM54.

	Housing	Offices	Schools
Space heating demand, $kWh/m^2/yr$	15-20	15-20	15-20
Energy use intensity (EUI), $kWh/m^2/yr$	35	55	65
Renewable energy	Balance EUI OR 120 $kWh/m^2/yr$ footprint	Balance EUI OR 120 $kWh/m^2/yr$ footprint	Balance EUI OR 120 $kWh/m^2/yr$ footprint
Embodied carbon	350 $kgCO_2e/m^2/yr$	300 $kgCO_2e/m^2/yr$	300 $kgCO_2e/m^2/yr$

*Embodied carbon is addressed on page 25.

Above: New developments should seek to achieve the KPIs recommended by LETI, https://www.leti.london/cedg .

LETI also has a Climate Emergency Retrofit Guide: https://www.leti.london/retrofit

Key measures: Homes - new build

New homes should be built to zero carbon standards as defined by LETI and should seek to achieve their KPIs detailed on page 8.

Orientation

Orientate dwellings to +/- 30° to the south if possible.

Form

Choose a compact form to limit heat loss.

Optimise glazing to limit heat loss to the north and take advantage of useful winter solar gain to the south.

Building envelope

Target a space heating demand of less than 15-20 kWh/m²/yr.

See details page for indicative U-values.

Consider impact of increasing high winds.

Transport & Travel

Provide secure, easy to access cycle parking.

Install electric car charging points/hubs sufficient for every household.

Design in a space that can be used as a home office.

(Larger sites to respond to Connecting Cheltenham and Gloucestershire Local Transport Plan).

Avoiding overheating

Provide external shading to windows.

Avoid large areas of east/west facing glazing.

Provide secure cross-ventilation.

Undertake an overheating risk assessment

Utilise trees for further shading.

Renewable energy

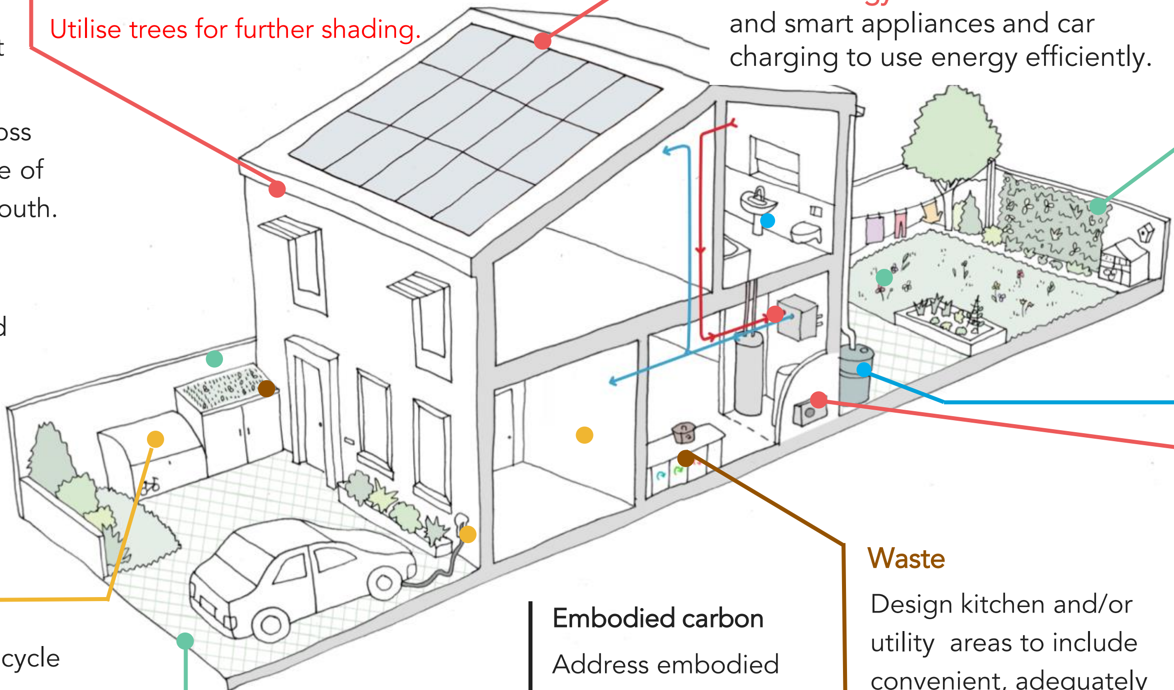
Renewable energy generation to match annual energy use or generate 120kWh/yr per m² of building footprint.

Smart energy - Utilise smart meters and smart appliances and car charging to use energy efficiently.

Ecology and biodiversity

Select diverse native species of planting and include living roofs

Create habitat for mammals (such as hedgehogs, as well as bats) and amphibians and reptiles (such as toads and newts) birds and insects.



Water

Specify water efficient fittings to achieve a water efficiency of 105 l/p.person/day (RIBA).

Utilise rainwater collection.

Low carbon heat

New homes should not be connected to the gas grid.

Low carbon alternatives such as heat pumps should be utilised.

Efficient electric cooking appliances.

Ventilation

Mechanical Ventilation with Heat Recovery should be utilised to ensure good indoor air quality and energy efficient ventilation.

Flooding

Utilise permeable surfaces wherever possible.

Utilise rainwater collection.

Incorporate living roofs.

Embodied carbon

Address embodied carbon, focussing on the structure, by considering different options. Work with the structural engineer to assist this process.

Waste

Design kitchen and/or utility areas to include convenient, adequately sized recyclable and food waste storage.

Provide easy access external waste storage that facilitates efficient collection by refuse vehicles.

Click topic to navigate to detail page

Key measures: Homes - refurbishment and extensions

Refer to new build homes one-page summary for key principles.

All homes will need to decarbonise over the next decade. A decarbonisation plan helps homeowners set their home on a pathway to zero carbon, with clear, staged steps to get there. A Retrofit Designer and Co-ordinator will help to develop a bespoke plan using a 'whole-house' approach using the PAS 2035 standard. Extensions and refurbishment works offer opportunities for improving the environmental performance of a home.

New roof

Keep roof form simple.

Consider how photovoltaics could be integrated at the same time as replacing a roof or adding a loft conversion. Since access arrangements will already be in place, installation may be cheaper.

Replacement windows

High performance new windows should be selected – preferably triple glazing.

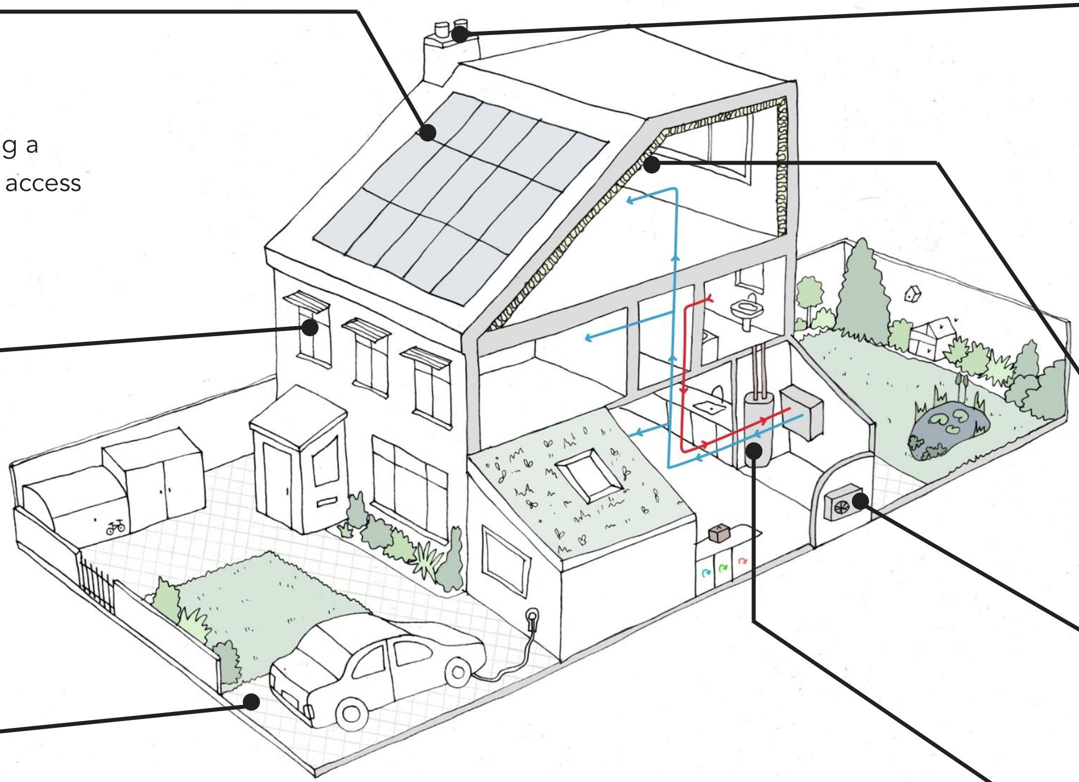
Consider installing Mechanical Ventilation with Heat Recovery at the same time to maintain indoor air quality.

New driveways

New driveways should always be finished with permeable surfaces.

Resurface as little as possible.

Where planting is removed habitat should be replaced elsewhere on-site (e.g. new tree planting and insect habitat).



Chimneys

Chimneys are a source of heat loss. Chimneys can be removed or blocked up – the chimney space must be ventilated from the outside.

Wood burning stoves are a source of local air pollution and should not be installed.

Loft conversions

Insulate roofs well.

Use breathable insulation that has high thermal density and good insulation values.

Replacement heating system

Do not install new gas boilers. Consider a heat pump.

Conservation areas and listed buildings

Heritage buildings and energy efficiency can be successfully integrated.

Early conversations with Conservation Officers are recommended to ensure that the most can be achieved for net zero carbon whilst also ensuring a development meets local conservation design policies.

Replacement kitchen

Insulate the internal wall before installing new kitchen units.

Install efficient electric cooking appliances

Plan space for a utility cupboard that can house hot water storage and a whole house ventilation unit.

Click topic to navigate to detail page

Key measures: Non-domestic – new build

New buildings should be built to the zero carbon standard defined by LETI and should seek to achieve the KPIs on page 8.

Orientation

Orientate dwellings to +/- 30° to the south if possible

Form

Choose a compact form to limit heat loss.

Optimise glazing to limit heat loss to the north and take advantage of useful winter solar gain to the south.

Building envelope

Target a space heating demand of less than 5-20 kWh/m^2/yr.

Consider impact of increasing high winds.

Travel

Provide secure, easy to access cycle parking.

Provide facilities for cyclists, including lockers and showers.

Install electric car charging points/hubs.

Priority parking for car sharers

(Larger sites to respond to Connecting Cheltenham and Gloucestershire Local Transport Plan)

Avoiding overheating

Provide shading to windows to limit summertime solar gain

Avoid large expanses of east/west facing glazing

Provide secure cross-ventilation

Undertake an overheating risk assessment

Renewable energy

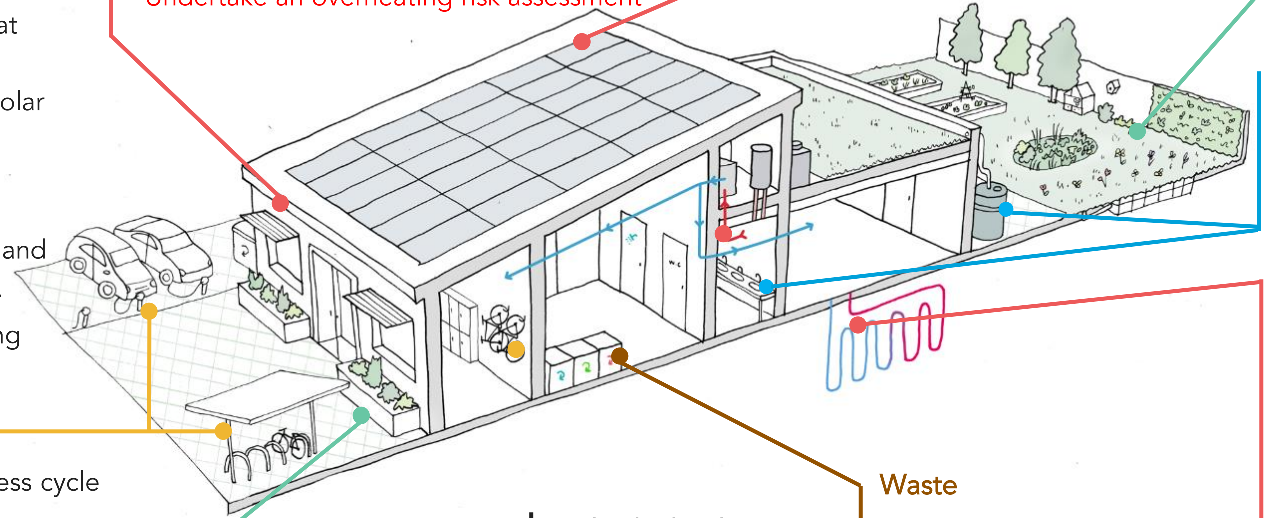
Renewable energy generation to match annual energy use or generate 120kWh/yr per m^2 of building footprint

Roof design should be optimised for renewable energy generation.

Ecology and biodiversity

Select diverse native species of planting and include living roofs

Create habitat for mammals (such as hedgehogs, as well as bats) and amphibians and reptiles (such as toads and newts) birds and insects.



Water

Specify water efficient fittings.

Utilise rainwater collection.

Flooding

Utilise permeable surfaces wherever possible.

Incorporate living roofs and biosolar roofs.

Utilise rainwater collection.

Embodied carbon

Address embodied carbon, focussing on the structure, by considering different options. Work with the structural engineer to assist this process.

Waste

Design convenient, adequately sized and adaptable storage for recyclable waste, food waste, general waste and other relevant waste streams.

Provide easy access for efficient collection by refuse vehicles.

Low carbon heat

New buildings should not be connected to the gas grid. Low carbon alternatives such as heat pumps should be utilised.

Heat pumps can also be used to provide cooling when required.

Efficient electric cooking appliances.

Ventilation

Mechanical Ventilation with Heat Recovery should be utilised to ensure good indoor air quality and energy efficient ventilation.

Key measures: Non-domestic - refurbishment and extensions

All existing buildings will need to decarbonise over the next decade. A decarbonisation plan helps building owners set their building on a pathway to zero carbon, with clear staged steps to get there. A Retrofit Co-ordinator will help to develop a bespoke plan using a 'whole-building' approach.

Photovoltaic panels

Installation of photovoltaic panels should be considered in all cases. Arrays can be installed over existing plant, integrated into existing roofs, alongside green roof and on extensions. They can work efficiently at east and west facing elevations as well as south facing.

Replacement windows

High performance new windows should be selected – preferably triple glazing.

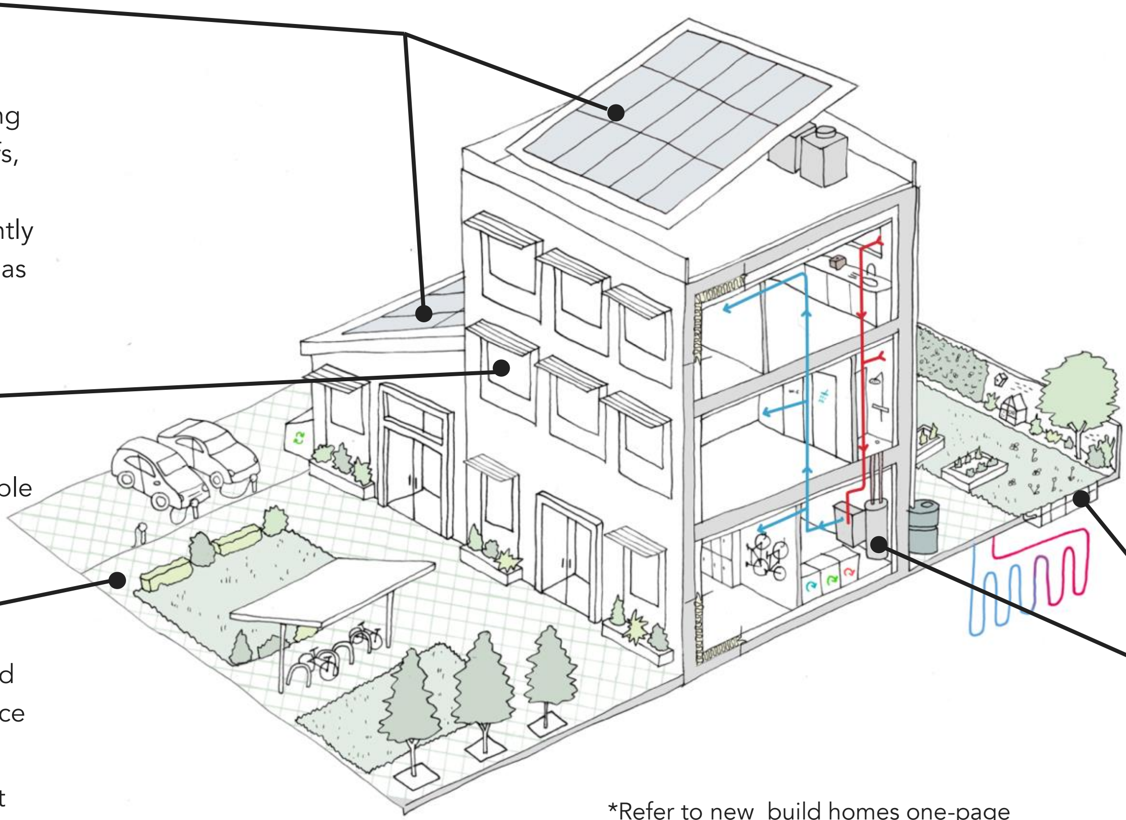
Permeable surfaces

Where new hardstanding is created this should be permeable. Resurface as little as possible.

Where planting is removed habitat should be replaced elsewhere on-site (e.g. new tree planting and insect habitat).

Waste

Upgrade waste storage facilities in line with best practice



*Refer to new build homes one-page summary for key principles.

Conservation areas and listed buildings

Heritage buildings and energy efficiency can be successfully integrated.

Early conversations with Conservation Officers are recommended to ensure that the most can be achieved for net zero carbon whilst also ensuring a development meets local conservation design policies.

Thermal insulation

Thermal insulation should be selected according to the original building construction and materials. Breathable insulation materials will reduce the risk of moisture build up in walls.

Soakaways

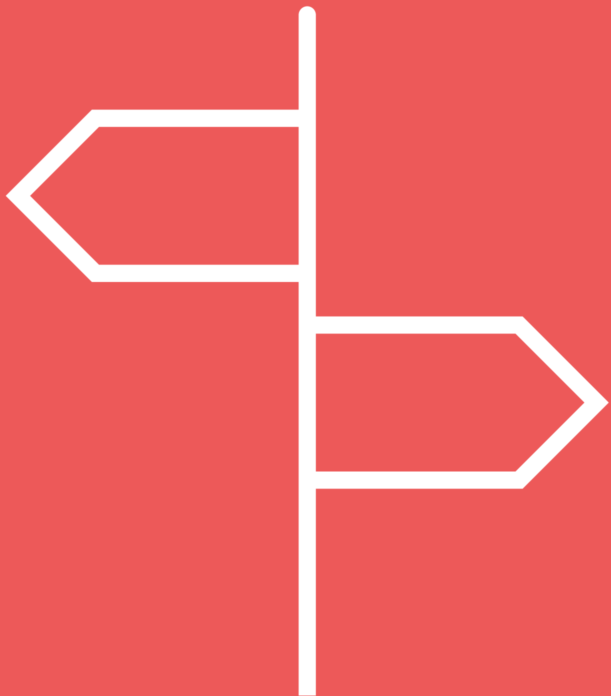
Groundworks should seek solutions to retain water on-site and discharge to the ground where possible, e.g. through rain gardens or soakaways.

Replacement heating system

Do not install new gas boilers. Consider a heat pump.

Embodied carbon

Address embodied carbon in extensions and work to the structure by considering different options and working with a structural engineer.



Guidance

This section gives more detail on the different themes presented in the one-page summaries for each building type in the previous section.

Site and orientation

Choosing a site

Preference should be given to re-use of existing buildings before construction of new buildings. Where new buildings will be constructed, preference should be given to brownfield sites over greenfield sites.

Which direction should the building face?

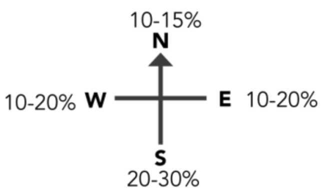
The orientation and massing of the building should be optimised, if possible, to allow useful solar gains and prevent significant overshadowing in winter. Encourage south facing buildings (+/- 30°) with solar shading and prioritise dual aspect. Overshadowing of buildings should be avoided as it reduces the heat gain from the sun in winter.

Overshadowing

Prioritise the south in orientating masterplans, angling the roofs to make the most of PV opportunities to the south. Allow a distance of 1 to 1.5 times the buildings height between buildings to avoid overshadowing and impacting the internal solar gains.

How big should the windows be?

Getting the right glazing-to-wall ratio on each façade is a key feature of energy efficient design. Minimise heat loss to the north (smaller windows) while providing sufficient solar heat gain from the south (larger windows).

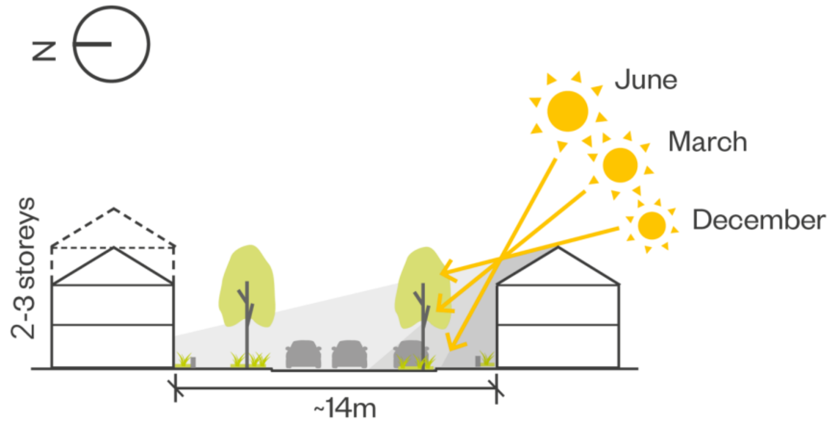


Window Ratio

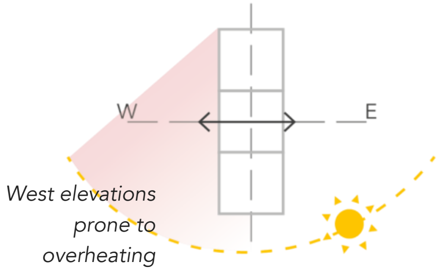
The ratio of windows to external elevation should be in percentage range shown.

Solar Shading

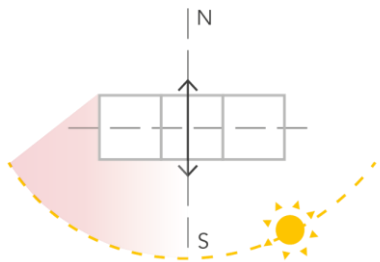
Prioritise occupied spaces with larger windows on the south. It is easier to design fixed shading on south facades to manage overheating risk while allowing heat gains in winter.



Allow a distance of 1-1.5 times the building's height between buildings.
Images: Levitt Bernstein Architects.



Inefficient Design - Avoid east west facing as this can mean the building is prone to overheating



Optimised Design - Ideally south facing allows for solar winter gain

Extensions and refurbishments

These principles are also applicable to new extensions to existing homes or other existing buildings.

For retrofit and refurbishments, consider the principles of window shading (p.23) and window proportions (p.19).

Go to building summaries…

Avoiding overheating

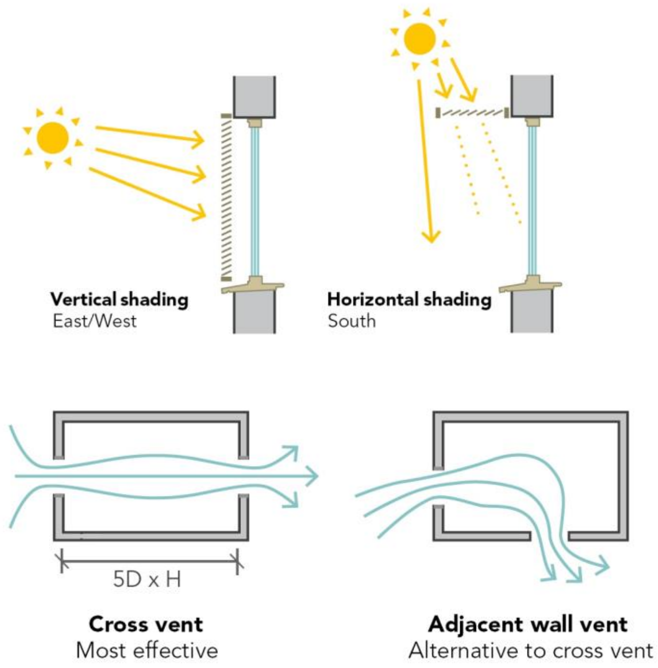
Climate change is already bringing warmer summers with more extreme temperature highs. With this, overheating in buildings is becoming an increasing threat to occupants' health and wellbeing, particularly for vulnerable people. In future years, this is set to become even more of an issue.

All developments are therefore required to demonstrate how the risk of overheating has been sufficiently mitigated through good design.

Design out overheating from the start

Overheating is a known risk and must be reduced through good design. All developments should:

1. Ensure glazing areas are not excessive i.e. not more than 20-25% of facade on south or west façades.
2. Provide appropriate external solar shading. South façades should have horizontal shading over the window and the west façade should ideally have efficient movable shading e.g. shutters. Do not rely on internal blinds – these can be ineffective.
3. Ensure good levels of secure natural ventilation are possible. Design window openings to take advantage of cross-ventilation (from one side to another) and/or stack ventilation (from bottom to top). Avoid fixed panes and maximise opening areas of windows. Side hung windows typically allow more ventilation than top hung.
4. Select a g-value (the solar factor indicating how much heat is transmitted from the sun) for glass of around 0.5 where possible. Avoid reducing it too much as this would also reduce free winter solar gains.
5. Utilise thermal mass in buildings to help dampen temperature swings throughout the day, and work with secure natural ventilation to provide passive night-time cooling
6. Utilise green and blue infrastructure to provide natural cooling to the local environment and reduce the urban heat island effect.



Images: Levitt Bernstein Architects

What you should do

- Use the Good Homes Alliance overheating tool and checklist to demonstrate that the design is at low risk of overheating.
- Demonstrate compliance with the new Part O of the building regulations, Chartered Institute of Building Services Engineers (CIBSE) Technical Memorandum 59 (TM59) for domestic buildings or TM52 for non-domestic buildings.
- Use the Acoustics and Noise Consultants (ANC) Acoustics, Ventilation and Overheating Guide to find a balanced approach to acoustics. daylight and overheating risk.
- Provide a statement describing all ways in which overheating has been addressed on the development or building.

Design and efficient building form

All developments should achieve space heating demands of 15-20 kWh/m^2/yr and achieve a net zero energy balance on-site. Optimising building form can make it easier and cheaper to achieve these targets.

Simple forms are more energy efficient

A simple and compact building is more energy efficiency. Exposed surface area is reduced, in turn reducing the amount of heat that is lost through the walls and roof. A simple shape also reduces the number of junctions and corners in the walls and roof, where it can be difficult to make sure that insulation is continuous, and where extra heat can be lost (thermal bridges). Good design can marry simple form and architectural interest.

Harnessing energy from the sun for heating

Utilise principles of passive solar design to reduce winter heating load, limit summertime overheating and aid natural ventilation.

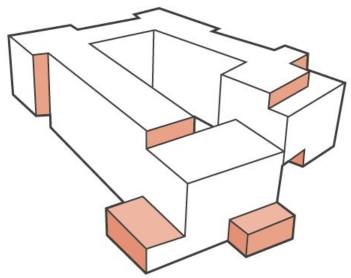
Maximising renewable energy generation

Consider how the building form supports the capture of renewable energy, passive solar gains from the sun, and efficient natural ventilation.

What you should do

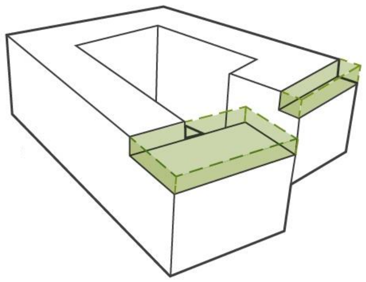
- Keep the form simple and compact.
- Avoid or limit the use of stepped roofs, roof terraces, overhangs and inset balconies as these features will decrease the building's energy efficiency.
- Avoid vertical interruptions to the structure – this will reduce thermal bridging and heat loss.
- Optimise roof design to capture maximum renewable energy.
- Optimise window to wall ratio to balance useful solar gains with heat loss (see page 14).

Less Efficient Form and elevation



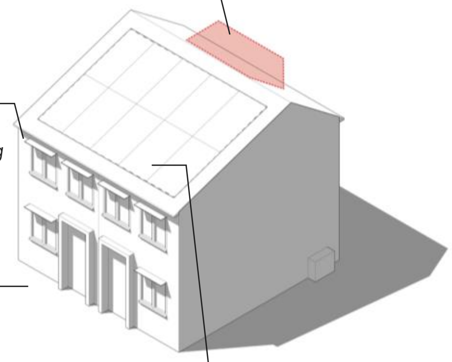
Larger exposed surface area created by step backs and protrusions

Optimised Form



Same building but with a simpler form.

Images: Levitt Bernstein Architects



Go to building summaries…

Building fabric and detailing

Reducing heat loss

All developments should achieve the target space heating demand of 15-20 kWh/m^2/yr, in order to minimise energy required for heating or cooling buildings (p.13).

This will require excellent levels of insulation and airtightness, and minimal thermal bridging. The building fabric specifications listed on the right can be used as a guide. Appropriate specification of material and careful detailing will also be required.

Insulation standards, or U-values (W/m^2.K), are a measure of how well heat passes through an element. The lower the u-value the better the insulator.

Thermal bridging is where a building component allows significantly more heat to travel through it than the materials surrounding it. This can create "cold" spots and sources of heat loss and mould.

Airtightness (m^3/h/m^2) is a measure of the leakiness of a building and how much air passes between different building elements and junctions. This uncontrolled ventilation leads to heat loss.

Thermal mass

Thermal mass also plays a big part in thermal comfort. Thermal mass (such as brick or blockwork) inside the building helps to stabilise internal temperatures throughout the day. Lightweight buildings with little thermal mass will be subject to larger temperature swings.

Sustainable Sourcing

Choose materials that have certification from the Forest Stewardship Council (FSC), the Programme for Endorsement of Forest Certification (PEFC), ISO 14001 (Environmental Standard), BES 6001 Framework for Responsible Sourcing, CARES steel certification.

Indicative u-values to achieve a space heating demand of 15-20 kWh/m^2/yr for new housing and 50 kWh/m^2/yr for retrofit

	New housing	Retrofit	Non-domestic
Roof	0.100 W/m^2.K	0.12 W/m^2.K	There are too many variables in non-domestic buildings to give indicative u-values
Walls	0.10-0.15 W/m^2.K	0.18 W/m^2.K	
Ground floor	0.100 W/m^2.K	0.15 W/m^2.K	
Airtightness	<1.0 m^3/h/m^2	<3.0 m^3/h/m^2	
Thermal bridging	2 kWh/m^2/yr	0.1 W/m.K	
Windows	0.8 W/m^2.K	1.0 W/m^2.K	
Doors	1.0 W/m^2.K	1.0 W/m^2.K	

Notes: U-values are ***indicative*** *of specifications required for a semi-detached house to meet LETI space heating demand targets. Better u-values would be required for detached houses and bungalows. Poorer u-values would be acceptable for flats and terraced houses.*

Refurbishments

Existing buildings can be retrofitted to improve thermal performance. Care should be taken to select the right materials to ensure moisture can pass freely through the building element and not get trapped. More information on this can be found in the Forest of Dean, Cotswold and West Oxfordshire District Councils' Net Zero Carbon Toolkit.

By selecting insulation with some thermal mass (e.g. wood fibre board) temperature variations throughout the day can be moderated.

Ventilation & airtightness

All developments should achieve a space heating demand of 15-20 kWh/m²/yr. To achieve this level it will be necessary to achieve excellent levels of air-tightness and employ Mechanical Ventilation with Heat Recovery (MVHR).

Controlled air flow through good airtightness

The key to energy efficient ventilation in all buildings is being in control of where, when and how air flows through a building. This starts with very good airtightness to limit any uncontrolled infiltration. Trickle vents should be avoided as they do not control infiltration. Practical guidance on how to achieve good levels of airtightness can be found in the Forest of Dean, Cotswold and West Oxfordshire District Councils' Net Zero Carbon Toolkit.

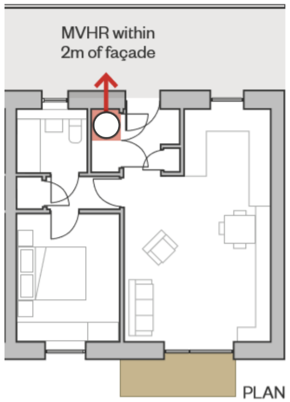
Controlled ventilation with heat recovery

A key component to energy efficient, airtight homes is Mechanical Ventilation with Heat Recovery (MHVR). MVHR is suitable for all building types. Long used in non-domestic buildings, it is increasingly used in homes to ensure good indoor air quality and to remove and replace stale air in an energy efficient manner.

MVHR units supply air into occupied spaces, and extract air from circulation spaces, or kitchen and bathroom spaces in the case of homes, it does this using very little energy and recovers heat energy from outgoing air.

Units should be positioned close to an external wall to prevent heat loss from the ductwork that connects to the outside. These ducts should be accurately fitted with adequate insulation to prevent heat loss, and generally ductwork should avoid having sharp bends which could affect pressure loss and flow.

MVHR units include filters that must be changed regularly (usually at least once per year but check the manufacturer's instructions).



Key requirements for a good MVHR system	
Distance from external wall	<2m
Specific fan power	<0.85 W/l/s
Heat recovery	>90%
Thickness of duct insulation mm	>25mm
Certification	Passivhaus Certified
Maintenance	Easy access for filter replacement.

MVHR systems are an effective way of providing ventilation to airtight homes.
The unit should be located within 2m of the façade (Source: Levitt Bernstein + Etude)

Development specific considerations

Existing buildings

Where airtightness is improved through replacement of windows or doors, mechanical ventilation with heat recovery should be installed to reduce the risk of condensation building up which can lead to damp, mould and poor indoor air quality.

Non-domestic buildings

Natural ventilation should be considered for times when ventilation is required without heating or cooling demands. However, if a building is heated or cooled all through the year, the building should rely on mechanical ventilation in order that opening windows do not conflict with heating or cooling modes.

Low carbon heat

All new buildings should utilise low carbon heat for heating and hot water. No new developments should be connected to the gas grid.

All existing buildings should replace fossil fuel based systems with low carbon heat alternatives as a matter of priority.

Net Zero carbon buildings do not burn fossil fuels for energy. Currently available low carbon alternatives include Air Source Heat Pumps and Direct Electric heating. The electricity needed to power these systems should be met through on-site renewables as far as possible, and the remainder through grid electricity, which is decarbonising quickly.

Heat pumps are the most energy efficient means of heating

Heat pumps can provide both space heating and domestic hot water and can serve individual homes and buildings or communal heating systems. Over the course of their lifetime they will emit just 20% of the carbon a gas boiler would. They are a solution for all building types at all scales.

Direct electric heating

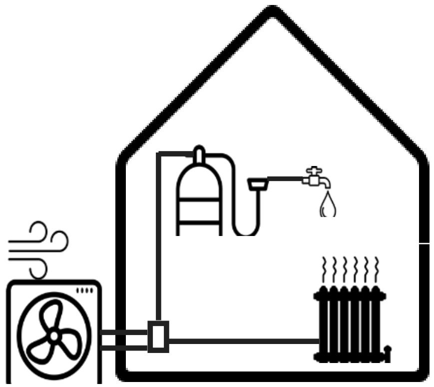
Direct electric heating systems will also emit less carbon than a gas boiler, however it will use around 3x more energy (and carbon) than a heat pump and will cost more to run.

District and communal heating

Communal heating is a viable option where ambient distribution temperatures are used, which is both more energy efficient and reduces risk of overheating.

Where heat networks are proposed, applications will need to be accompanied by:

- An assessment of the advantages of a communal system vs individual systems.
- An accurate assessment of distribution heat losses
- A long term strategy for the sustainable supply of low carbon fuel.



A typical air source heat pump system. The heat pump is located on external wall gathers heat from surrounding air. The heat pump alternates between providing space heating and hot water in the dwellings.

Development specific considerations

Retrofitting heat pumps in existing buildings

Air Source Heat Pumps can be retrofitted into existing buildings if there is a suitable location for the outdoor unit. Heat pumps run best at lower temperatures (around 35-45 °C) and are suited to underfloor heating and larger radiators. However, existing radiators may be sufficient if the building is moderately energy efficient. If the existing building has poor energy efficiency, improvements should also be made to the building fabric, as part of a considered whole house retrofit plan.

If a gas boiler is being replaced during an extension or refurbishment replace with an Air Source Heat Pump.

Other forms of low carbon heat

Wood or other biofuel may be considered on a case by case basis but are generally discouraged due to difficulties of sustainably sourced fuel and negative impacts on air quality and health.

Go to building summaries…

Renewable energy

Electricity demand is set to roughly double by 2050. The UK needs to decarbonise its power supplies in parallel with keeping up with this increasing demand. The provision of renewable energy within new development is therefore a vital contribution. It also provides benefits to occupants such as cheap energy and the ability to charge electric vehicles.

All developments should achieve an energy balance on-site where possible – that is, renewable energy generation should be equal to or greater than the development's energy consumption (or energy use intensity) over the course of a year. If this is not possible, renewable energy generation should target at least 120 $kWh/m^2_{footprint}/yr$.

= Energy Use Intensity OR 120 $kWh/m^2_{f.p.}/yr$

Solar photovoltaics (PV) are ideally suited to buildings

Solar photovoltaic (PV) panels generate electricity when exposed to sunlight. They are the most appropriate form of renewable energy generation for a building as they are a simple, mature and durable technology and can be installed on both roofs and suitable facades.

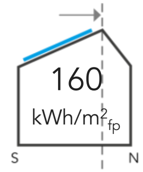
In the UK it is generally possible for blocks of flats up to six storeys in height to achieve a net zero energy balance on site through the use of rooftop solar PV arrays, heat pumps and efficient building fabric.

Use of smart technology to maximise efficient use of energy

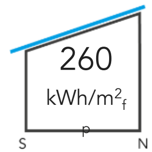
As energy use becomes increasingly electrified and energy generation more diversified, smart technology can help maximise benefits for occupants, the wider community and the electricity grid. Smart meters, appliances and electric car chargers can be set in a way that helps smooth out energy demand, and use energy when its abundant. This will help occupants save money by using more of the renewable energy generated on-site, and import energy from the grid when it's cheaper.

Roof design maximises solar photovoltaic energy generation

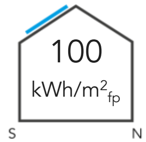
Solar photovoltaics should be considered at the very earliest of design stages in order that the roof shape and orientation is optimised to maximise solar photovoltaic output and returns for occupants.



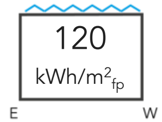
North South
Asymmetric pitch roof with a majority south facing roof



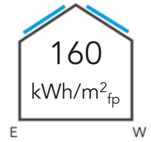
North South
Monopitch roof with a majority south facing roof



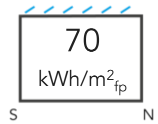
North South
Pitch roof with a south facing roof



East West
Flat roof with a east/west concertina PV array



East West
Pitch roof with a majority east/west facing roof



North South
Flat roof with an angled south PV array

Images: Levitt Bernstein Architects

Roof design can be optimised to maximise energy output from photovoltaics. How well the roof space is utilised can be expressed in kWh generated per m² of building footprint (kWh/m^2_{fp})

Development specific considerations

Large scale developments

Community wind turbines may be suitable for large scale developments and will be considered on a case by case basis.

Existing buildings, conservation and heritage

Solar photovoltaic arrays are suitable for both new and existing buildings. Listed buildings and conservation areas should seek the advice of the Conservation Officer.

Water efficiency and domestic hot water

Water is a precious resource and pressure on water supplies is increasing. Climate change is bringing unpredictable patterns of precipitation putting further stress on resources. It's vital that all buildings use water efficiently.

All developments should exceed the minimum building regulations requirements. For residential buildings, internal water use should achieve the water consumption target of <105 l/p/d.

105
l/p/d

What you should do

- Reduce flow rates - The AECB water standards (opposite) provide clear guidance on sensible flow rates for showers and taps in low energy buildings.
- Reduce distribution losses - All pipework must be insulated and designed to ensure there are no 'dead legs' containing more than 1 litre. Tapping points (e.g. taps, shower connections) should be clustered near the hot water source.
- Insulate to minimise losses from hot water tanks - the standby losses of hot water tanks are highly variable, and can have a significant impact on overall energy use. Target a hot water tank heat loss of less than 1 kWh/day equivalent to 0.75 W/K.
- Install waste water heat recovery systems in shower drains - A simple technology that recovers heat from hot water as it is drained. Vertical systems can recover up to 60% of heat, horizontal systems 25-40%.
- Consider water recycling - This is the process of treating waste water and reusing it, it can be used for large portions of potable water use.
- Choose planting and landscaping schemes that do not rely on irrigation.

Appliance / Fitting	AECB Good Practice Fittings Standard
Showers	6 to 8 l/min measured at installation. Mixer to have separate control of flow and temperature although this can be achieved with a single lever with 2 degrees of freedom (lift to increase flow, rotate to alter temperature). All mixers to have clear indication of hot and cold, and with hot tap or lever position to the left where relevant.
Basin taps	4 to 6 l/min measured at installation (per pillar tap or per mixer outlet). All mixers to have clear indication of hot and cold with hot tap or lever position to the left.
Kitchen sink taps	6 to 8 l/min measured at installation. All mixers to have clear indication of hot and cold with hot tap or lever position to the left.
WCs	≤ 6 l full flush when flushed with the water supply connected. All domestic installations to be dual flush. All valve-flush (as opposed to siphon mechanism). WCs to be fitted with an easily accessible, quarter turn isolating valve with a hand-operated lever. Where a valve-flush WC is installed, the Home User Guide must include information on testing for leaks and subsequent repair.
Baths	≤ 180 litres measured to the centre line of overflow without allowing for the displacement of a person. Note that some product catalogues subtract the volume of an average bather. A shower must also be available. If this is over the bath then it must be suitable for stand-up showering with a suitable screen or curtain.

Refer to the full AECB Water Standard documents Volume 1 and Volume 2 for more information.

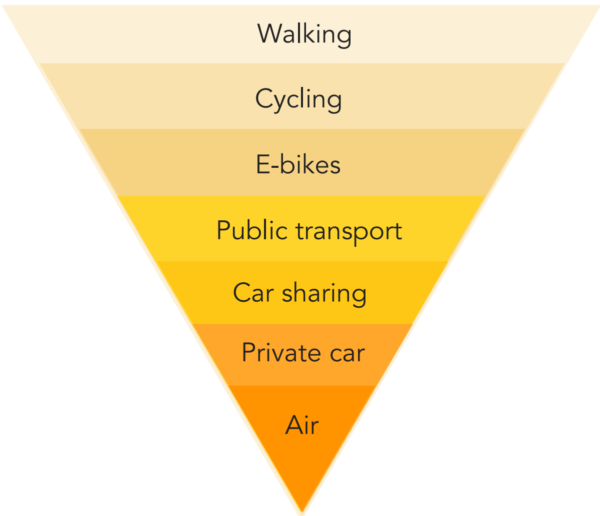
Transport & travel

Transport contributes 24% of Cheltenham's CO_2 emissions - and almost all of these are from road transport. This proportion is growing year on year: as other sectors are decarbonising, emissions from transport have remained static since 2010.

All development proposals are expected to seek betterment over minimum requirements and support shifts in transport and travel behaviour towards the sustainable transport hierarchy below. Proposals should review the wider context of their site and provide strong and continuous links to existing footpaths, cycle routes and public transport nodes.

This has multiple benefits beyond saving energy and carbon: improved local air quality; health and wellbeing benefits from being more active; greater potential for social interactions and facilitating a car free life.

Development proposals should also demonstrate flexibility to respond to changing modal shifts in future years.



The Transport Hierarchy - applications should prioritise the modes of transport in the order they appear in the transport hierarchy, in the design and amenity provided in developments.

What you should do

Small scale sites (single homes, individual buildings) should provide:

- Highly convenient (e.g. front of property), secure, well-lit, covered and inclusive cycle storage in accordance with BREEAM or Code for Sustainable Homes standards as a minimum.
- All parking spaces to be provided with electric car charging points
- The Transport for New Homes checklist should be submitted with each application.

Medium and large scale sites: as above plus development proposals will be required to demonstrate how they will:

- All proposed transport infrastructure should meet LTN 1/201 standards
- Facilities for cyclists, including lockers, showers and changing space should be provided (use Standards for Public Cycle Parking (2021)).
- Enable sustainable travel choices. Integrate high quality travel and transport infrastructure with consideration of and connection to walking, cycling and public transport routes beyond the site.
- Create open and permeable networks of streets and connected networks of green, off-road routes.
- Create direct connections to existing communities and facilities.
- Slow vehicle speeds (20mph) in all residential developments.
- Innovative and future flexible approaches to parking should be sought, including shared parking courts, shared parking between employment and residential uses and electric charging points in all parking spaces.
- Large expanses of surface parking will not be permitted.
- A full and comprehensive Transport Assessment and Travel Plan will be required to support the proposals.

Go to building summaries…

Flooding

A key impact of climate change for Cheltenham will be an increase in the frequency and severity of flood events. Cheltenham is already vulnerable to surface water flooding and has several areas at risk of flooding from the rivers like the Chelt. Overwhelmed drainage systems will also pose an increasing problem. It should be considered that all development, both existing and new, will be at risk of flooding in the future.

Therefore all developments should seek to:

- Ensure new development doesn't increase flood risk onsite or cumulatively elsewhere and to seek betterment over the minimum requirements wherever possible.
- Design buildings, streets and open spaces that are resilient to flooding, utilising flood resilient construction and implementing flood mitigation measures.
- Work with the natural landscape and its features to reduce the risk of flooding (not only on-site but also beyond the site) including Natural Flood Management (NFM) techniques
- Control the flow of water on-site through the use of Sustainable Urban Drainage Systems (SuDS) and take a creative approach to reduce the long-term risk of flooding and enable environments to absorb water.
- Maximise opportunities for betterment of water quality, amenity and biodiversity.
- Follow the drainage hierarchy - all surface water run-off must aim to be discharged as high up the following hierarchy as possible: rainwater re-use; infiltration; hybrid solution combining infiltration and discharge to a surface water body; to a surface water body; to a surface water sewer; to a combined sewer.

Further information

- The SuDS Manual (C753), CIRIA
- Susdrain, Delivering SuDS (including retrofitting SuDS)

Flood risk management hierarchy

Assess	Provide an appropriate flood risk assessment
Avoid	Avoid development in areas of high risk of flooding. Do not increase the risk of flooding on-site or elsewhere.
Control	Incorporate SuDS design
Mitigate	Employ flood resilient construction

What you should do

SuDs should be utilised on every site, considered at every scale and designed in from the beginning of a project.

- Slow the flow – through planting hedgerows, trees, buffer strips.
- Store water – through rainwater harvesting, green roofs, permeable paving, bioretention systems (e.g. rain gardens), trees, swales, ponds, wetlands, detention basins, infiltration basins, soakaways
- Increase infiltration – through improving soil structure, creating permeable surfaces.
- Intercept rainfall - Vegetation, especially tree leaves, intercept rainfall so it doesn't reach the ground.
- Ensure floor levels are more than 600mm above the flood level predicted for a 1:100 year flood event (plus climate change).
- Utilise flood resilient materials and construction methods that allow a building to recover more quickly after a flood.
- Provide safe access and egress routes above the predicted flood level.
- Large areas of impermeable hardstanding should be avoided.

Ecology and biodiversity

All proposals need to protect existing and enhance future biodiversity value. This should be considered with due regard for proportionality and the scale of development, but in all cases high quality, resilient and contextually appropriate ecological and green infrastructure should be the outcome of design.

Connectivity – Provide ecological habitats that build upon existing networks networks and natural capital both on the off the site, create new stepping stones and corridors that increase connectivity allowing wildlife places to forage and shelter and routes along which to travel.

Context – Assess the natural capital in the site. Applications will be assessed on how well existing habitats and features have been preserved and enhanced.

Diversity and complexity - Create diverse, complex and locally appropriate habitats.

Wellbeing - Design multifunctional green infrastructure that supports the health and wellbeing of people through creating space for active travel, recreation, and connection with others and with nature.

Nature recovery - Create habitats that positively enhance biodiversity contributing to the Nature Recovery Network, meet the Gloucestershire Local Nature Recovery Strategy priorities but overall, successfully delivering biodiversity net gain.

Resilience – Design green infrastructure and select species with consideration to their resilience to the effects of climate change and long term sustainability in mind. Planting should not require irrigation.

What you should do

Biodiversity Net Gain (BNG)

Apply the BNG mitigation hierarchy: avoidance; minimisation and compensation. Where BNG cannot be delivered onsite, contact the Gloucestershire Nature and Climate Fund (http://glosnature.com) for support with a suitable off-site strategy as compensation.

Small scale sites (single homes, individual buildings) should show evidence of considerations made, such as:

- Bird & bat boxes / bricks
- Insect habitats
- Ponds
- Grasscrete driveways
- Gaps in fences or hedges for small animals to move between gardens.
- Native trees, shrubs and flowers
- Green roofs

Large scale sites as above, plus:

- Incorporate **Building with Nature** principles, helping to shape multifunctional green infrastructure for people and nature
- Assess the existing ecological value of a site to determine the presence of UK protected and priority habitats and species. Consult the **Gloucestershire Centre for Environmental Records** for local records.
- Protect and enhance existing features for biodiversity, ensuring local baseline and opportunity maps for the Nature Recovery Network are used to plan wider ecological objectives going beyond the site.
- Proposals to include an assessment of existing and proposed natural capital assets on and off-site (www.naturalcapital.gcerdata.com).
- Include blue infrastructure such as ponds, lakes, streams, rivers to enhance biodiversity, manage flood risk and provide amenity.
- Ecological assessments should include the site's ecology at the time of, and 5 years prior to, application for planning.

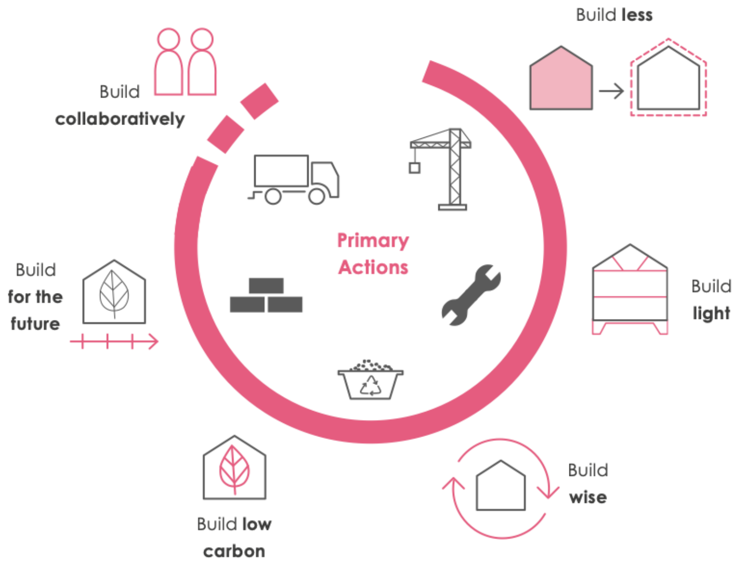
Go to building summaries…

Materials and embodied carbon

Upfront embodied carbon includes the carbon emissions associated with the extraction and processing of materials, energy use in the factories and transport as well as the construction of the building. As buildings decarbonise their energy use, embodied carbon becomes an increasingly significant source of emissions to tackle.

All developments should seek to minimise upfront embodied carbon and monitor progress against the following targets as per LETI guidance .

Office	Residential	Education	Retail
350 $kgCO_2e/m^2/yr$	300 $kgCO_2e/m^2/yr$	300 $kgCO_2e/m^2/yr$	300 $kgCO_2e/m^2/yr$



Primary actions for reducing embodied carbon. Image from LETI.

What you should do

1 **Refurbishment over new build**
Only build new when existing homes cannot be reused or refurbished.

2 **Lean design**
Structural: Design structure for 100% utilisation. Use bespoke loading assumptions, avoid rules of thumb. Reduce spans and overhangs.

Architectural: Use self-finishing internal surfaces. Reduce the quantity of metal studs and frames.

Building services: Target passive measures (e.g. improved fabric) to reduce the amount of services. Reduce long duct runs, specify low Global Warming Potential (GWP) refrigerant (max. 150) and ensure low leakage rate.

3 **Material and product choice**
Prioritise materials that are reused, reclaimed or natural from local areas and sustainable sources and that are durable. If not available use materials with a high recycled content. Use the following material hierarchy to inform material choice particularly for the building structure;

1. Natural materials e.g. timber
2. Concrete and masonry
3. Light gauge/Cold rolled steel
4. Hot rolled steel

Ask manufacturers for Environmental Product Declarations (EPD) and compare the impacts between products in accordance with BS EN 15804

4 **Housing adaptation & flexibility**
Allow for flexibility and consider how a layout may be adapted in the future.

5 **Easy access for maintenance**
Maintained equipment will last longer.

6 **Design for disassembly**
Consider disassembly to allow for reuse at the end of life of the building. Create material passports for elements of the building to improve the ability of disassembled elements to be reused.

Waste

The appropriate management of waste can aid the delivery of cost effective and efficient waste collection services and reduce Cheltenham's impact on climate change.

To reduce this impact effectively, the waste hierarchy principles (prevent, reuse, recycle, recover and environmentally sound disposal) must be applied to three areas of the design and construction process:

1. In the design of recycling storage in both new and existing buildings.
2. In the sourcing and selection of building and construction materials.
3. In the management of waste through the construction process.

Proposals must demonstrate how this will be done (e.g. through a Waste Minimisation Statement).

Key design considerations in minimising waste during occupation

- Provide dedicated, practical and sufficient internal space for sorting and storing of different waste streams: food waste, recyclable waste, garden waste, general waste and other relevant waste streams.
- Provide dedicated, practical and sufficient space outside for storing different waste streams until collection (and keep the off the public highway/pavement).
- Ensure ease of access to external waste storage for residents and building users.
- Enable ease of collection by refuse lorries by providing sufficient access and appropriate areas for turning where necessary.

Sufficient internal storage

Convenient external storage

Ease of collection

What you should do

Apply circular economy principles

In selecting materials, products and systems for a development, there are two considerations. First is how these are sourced, second is how they can be successfully reused, repaired, refurbished and recycled through their serviceable life. Achieving this will lead to a circular economy in construction.

Develop a construction waste management plan

Waste and water consumption should be minimised throughout construction. A plan should both contain target rates for recycling and define processes to manage different waste streams. This plan should also contain a commitment to preventing any biodegradable waste going to landfill.

Integrate recycling storage

In all cases, provide on-site recycling and waste storage where convenience, usability and accessibility (including for residents with reduced mobility), safety, security and functional adaptability are made central design considerations.

Domestic extensions - Consider improving storage space for recyclable waste as part of a kitchen re-design or addition of a utility room.

Non-domestic buildings - Ensure staff, customers, clients and visitors are able to engage in recycling and effective waste management through the provision of clear, well signed, clearly labelled, easily accessible and conveniently located recycling and waste collection facilities.

Where appropriate, specific provision should be made to facilitate the national Deposit Return Scheme (DRS)

Large developments and flats - Consider use of accessible, communal underground waste storage for efficient storage of waste.

Heritage buildings and conservation areas

New development

Designing a new building or development to standards of net zero carbon can be done sensitively within a historic setting: the contemporary becoming a distinct and celebrated feature sitting alongside the traditional.

The architectural drawings for new development should consider form and the materials selected in their design for a building to be acceptable within the context of a sensitive setting.

Early conversations with Conservation Officers are recommended to ensure that the most can be achieved for net zero carbon whilst also ensuring a development meets local conservation design policies.

Retrofitting historic buildings

Changes to the historic environment can be managed and a balance found that meets objectives for both conservation and climate change.

Start a project with an understanding of a building's age, nature and characteristics and the particular features of heritage value and significance that will require conservation. This information is needed in the early stages of design so that a retrofit project can be planned responsibly and sensitively.

Use PAS (Publicly Available Specification) 2035 as a retrofit standard, working with an accredited Retrofit Co-ordinator, to ensure your project can reach its goals for net zero carbon. A Retrofit Co-ordinator will help to develop a bespoke plan using a 'fabric-first' and 'whole-house' approach.

Energy-efficiency measures should be selected to conserve and protect the existing fabric and building features and low-carbon heating and renewable energy generation should be sited to minimise their visual impact on the surrounding setting.

Energy efficiency

Insulation can be added to pitched roofs, rafters and flat roofs: consideration should be given to existing eaves and abutments.

Solid wall, early-cavity wall, timber-frame walls and floors can all be insulated using the correct materials and methods, good detailing and high standards.

The thermal performance of windows can be enhanced through careful restoration, draught proofing and secondary glazing. Where windows need replacing, liaise with the Conservation Officer to ensure this is done sensitively. This is especially important in the case of listed buildings.

When planning energy-efficiency measures, ensure there is adequate ventilation to minimise condensation and reduce risk of damp.

Renewable energy generation and Solar PV

Solar PV should be positioned - in terms of pitch and orientation - to maximise its efficiencies for renewable energy generation. The siting of Solar PV should be well considered to minimise visual impact. In recent years, Solar PV has become an accepted addition within the historic environment as a contrasting feature that serves to illustrate a building's continued life story as it moves into the modern world.

Further guidance

Historic England have produced guidance on a variety of energy efficiency and renewable energy interventions for historic buildings and conservation areas - Historic England, Energy Efficiency and historic buildings.

Local case studies - residential

New-build - Detached PassivHaus, Cheltenham

This detached home is located in a conservation area in Cheltenham. It was built in 2013 and achieved PassivHaus certification. Ultra-energy efficient walls, floor and roof and triple glazing are utilised. Central heating and hot water is provided by Air Source Heat Pumps located inside the building and ducted to outside, so there are no outdoor units. Ventilation is provided with a Mechanical Ventilation with Heat Recovery (MVHR) system, providing clean, filtered air to the interior. A 9.9 kWp photovoltaic array is installed on the roof. Through also using a battery, in the summer months, almost no electricity is imported from the grid, as the photovoltaic panels generate enough energy to power both the home and the electric car. Over the whole year, the home generated as much energy as it used in 2021.

Passivhaus, Cheltenham

Domestic retrofit - 57 Naunton Lane, Cheltenham

This semi-detached Victorian homes has undergone a whole house retrofit, including: internal and external insulation, triple glazing at the back, double glazing at the front, a solar gain conservatory, LED lighting, Air Source Heat Pump and a 1.76 kWp Photovoltaic array on the roof. Excess energy from the solar panels is used to heat hot water.

57 Naunton Lane

Domestic retrofit - Grosmont, 1930s detached house, Cheltenham

Grosmont has improved its energy efficiency through the installation of triple glazing (6x better at keeping the heat in than the original windows), loft insulation and LED lighting. The house is heated by an Air Source Heat Pump, and renewable electricity is generated by a 5.1 kWp solar photovoltaic array. A battery backup system has also been installed, which allows the occupants to more efficiently use energy generated by the photovoltaic panels. Solar thermal hot water tubes also provide a proportion of the hot water needed for the home.

Grosmont, Cheltenham

Local case studies – non-residential

Gloucestershire College, Cheltenham and Gloucester campuses

Gloucestershire College (GC) is nearing completion of an ambitious decarbonisation plan where Ground Source Heat Pumps will become its main system for provide heating and hot water. The systems consist of 40 x 200m vertical boreholes in the car park at each campus. In tandem, solar photovoltaic panels are provided to generate the majority of the electricity required for the new electric heat pump systems. Energy storage systems will store energy generated on-site for use when required: batteries for excess electricity from solar panels; and thermal stores to store heat. Some energy efficiency measures have been implemented in the buildings including insulation on the heating systems, suspended ceilings and roof insulation. The project is expected to see Gloucestershire College reaching net zero ahead of the 2030 target.

Gloucestershire College, Ground Source Heat Pump borehole drilling

Leckhampton Rovers Football Club, Cheltenham

Leckhampton Rovers have undertaken a whole-building retrofit of their sports pavilion at Burrow's Field. They have improved the energy efficiency of the building by insulating the walls, roof and floor and installing LED lighting throughout. The building is heated with an Air Source Heat Pump, and solar hot water heaters heat the water for showers. A 6kWp array of photovoltaic solar panels on the roof provides electricity for the building and any excess electricity is sold to the grid.

In addition, the club has planted 1,200 trees and created a wildlife pond and has plans to install cycle stands, recycling bins, wildflowers around the perimeter and install harvesting rainwater planters around the building.

Leckhampton Rovers Football Club Pavilion

AGD Systems / The Traffic Group, Cheltenham

AGD systems have worked with local charity Severn Wye to reduce their environmental impact. They have installed a 35 kWp photovoltaic system on their roof. Electric vehicle charging points are on-site for staff. Waste reduction initiatives have seen a 75% reduction in waste and zero waste to landfill.

AGD Systems / The Traffic Group

More case studies for new build

Ultra low energy design is fast becoming the new normal

Many self builders and developers are choosing to go beyond building regulations for energy efficiency because it makes sense. Not only can low energy building be cheaper to run, they can be easier and cheaper to maintain and crucially, will not need further expensive retrofit in the future.

Beautiful and efficient homes

Lark Rise in the Chiltern Hills is certified to Passivhaus Plus standards. It is entirely electric, and generates 2.5 times as much energy as it consumes in a year. Careful optimised design has meant that it has a mostly glazed facade, minimal heat demand and stable temperatures over summer months.

Passivhaus/Ultra-low energy can be delivered at scale

Developers are building Passivhaus at scale. Example developments include Springfield Meadows in Oxfordshire, which delivered social and private housing to exemplary standards, including ultra energy efficient fabric with low embodied carbon and nature based solutions to landscaping and SuDS. Other examples include a mixture of houses and flats at Wimbish, Essex (where the average heating costs for the houses are £130/year), Goldsmith Street in Norwich, Agar Grove in Camden and many other developments across the Country.

All types and scales of buildings can be low energy

There are many examples of low energy non-domestic buildings. Oak Meadow Primary School in Wolverhampton was one of the first PassivHaus certified schools in the UK. Large windows allow for useful solar heating in the winter, while external shading limits overheating in the summer. Spaces are ventilated through openable windows and ventilation panels in the summer, and with the mechanical ventilation system with heat recovery in the winter.

Lark Rise, Chiltern Hills.

Passivhaus Plus certified.

(Source: Bere:architects)

Springfield Meadows

(Source: Greencore construction with Bioregional)

Oak Meadow Primary School

(Source: Architype)

More case studies for retrofit

80% House, East London

The 80% house, a regency terrace house in East London, underwent a retrofit for energy efficiency in 2008 with no detriment to the external aesthetic of the house. The house features internal wall insulation, cavity wall insulation at the rear with reclaimed bricks, roof insulation, mechanical ventilation with heat recovery and photovoltaic panels. The house achieved an 80% reduction in carbon emissions.

80% House, East London

(Source: Prewitt Bizeley Architects)

47 Greenleaf Road, Waltham Forest

Waltham Forest Council identified 47 Greenleaf Road for a pilot project for retrofit in the area. It underwent a retrofit for energy efficiency and realised a 54% reduction in energy required for heating. The property features external wall insulation at the side and the rear, internal wall insulation at the front, roof and floor insulation, new double glazing, a mechanical ventilation system with heat recovery. The heating system was replaced with an air source heat pump, and photovoltaic panels were installed.

47 Greenleaf Road

(Source: Waltham Forest Council)

New Court, Trinity College, Cambridge

New Court, Trinity College Cambridge is a Grade I listed building that underwent a sensitive retrofit to improve energy performance and comfort. The retrofit realised an 88% reduction in carbon emissions, and a 75% reduction in energy demand. It features internal wall insulation, low temperature underfloor heating and a new mechanical ventilation system with heat recovery.

New Court, Trinity College Cambridge. Grade I listed

(Source: CIBSE Journal)

Climate Change Checklist

The Council will consider all planning applications using the SPD as a material consideration in their determination. Applicants are expected to implement local guidance and demonstrate alignment with these standards as part of the design and development of their proposals.

Energy efficiency

- ❑ Have you maximised opportunities for natural solar gain and natural ventilation and minimised overheating risk through passive design and attention to building location, orientation and form?
- ❑ Have you designed the fabric of the building to be ultra-low in energy demand, achieving KPIs for space heating demand ($kWh/m^2/yr$) and energy use intensity ($kWh/m^2/yr$)?

Low carbon heat

- ❑ Will the building be fossil-fuel free with low-carbon heat source independent of the gas network?

Renewable energy

- ❑ Has the design and shape of the roof been optimised for maximum output of a photovoltaic array?
- ❑ Does the building achieve a net zero-operational carbon balance and deliver 100% of its entire predicted energy consumption using renewables on-site?

Water

- ❑ For dwellings: have water-efficiency measures been incorporated and will fixtures and fittings be specified to achieve water consumption of <105 l/p/d?

Transport & Travel

Reduced travel:

- ❑ Have you made provision for home working in residential buildings?
- ❑ Is shared mobility encouraged within your transport plans for non-domestic buildings?

Active travel:

- ❑ Have you enabled sustainable travel choices with connections for cycling, walking and public transport, providing cycle parking and facilities to levels that sufficiently meets the needs of building occupants irrespective of age or ability?

Low-carbon transport infrastructure:

- ❑ Have you provided active charging infrastructure for electric vehicles, meeting standards and sufficient for the needs of building occupants?

Prevention of Flooding

- ❑ Have you carried out a flood risk assessment to ensure your development avoids areas at high risk of flooding?
- ❑ Have measures to reduce flood risk been included in your proposals and are these designed using nature-based solutions and methods of sustainable urban drainage?

Ecology and biodiversity

- ❑ Do you know what ecology and biodiversity are on your site and beyond it, and have you taken steps to both preserve what is already there and enhance ecological value in the future?

Embodied carbon

- ❑ Have you minimised embodied carbon in the design of the building and in the selection of materials for its construction?
- ❑ Do your assessments of embodied carbon meet LETI targets and take full account of all construction elements including substructure, superstructure, mechanical, electrical and plumbing, products and finishes?

Waste

- ❑ Do you provide adequate space, both inside and outside the building, for waste recycling and storage?
- ❑ Have you incorporated targets and site management processes to minimise water consumption through construction and minimise and recycle waste, reducing waste going to landfill?

Responding to our policies

The matrix below indicates which local policies relate to what guidance within this SPD.

	Key Performance Indicators	Site orientation and shading	Avoiding overheating	Form	Fabric, detailing and materials	Ventilation	Low carbon heat	Renewable energy	Water efficiency	Transport	Flooding	Ecology and biodiversity	Embodied carbon	Waste
Joint Core Strategy 2011-2031														
SD3 Sustainable Design and Construction	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SD4 Design Requirements		●								●	●	●		
SD9 Biodiversity and Geodiversity											●	●		
SD14 Health and Environmental Quality											●	●		
INF3 Green Infrastructure											●	●		
Cheltenham Plan														
Theme C Objective d	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Policy D3 Private Green Space												●		
Gloucestershire Local Transport Plan (2020-2041)														
										●	●	●		●
Gloucestershire Waste Core Strategy														
Policy WCS2 – Waste Reduction														●

Further information

The Net Zero Carbon Toolkit, Cotswold District Council, West Oxfordshire District Council and the Forest of Dean District Council. October 2021.

https://www.cotswold.gov.uk/media/05couqdd/net-zero-carbon-toolkit.pdf

Historic England: Energy Efficiency and Old Buildings, https://historicengland.org.uk/advice/technical-advice/energy-efficiency-and-historic-buildings/

Bath and North East Somerset, Energy efficiency, retrofitting, and sustainable construction Supplementary Planning Document - https://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/Sustainable-and-Retrofitting/scrf_adoption_draft_spd.pdf

Transport for New Homes checklist - https://www.transportfornewhomes.org.uk/wp-content/uploads/2019/10/checklist.pdf.

Standards for Public Cycle Parking, June 2021 - https://2z30i71k4m1tu9odh1fx8yq1-wpengine.netdna-ssl.com/wp-content/uploads/2021/06/05132-Cycle-Parking-and-Security-Standards-June-2021-REV-6.pdf

Building with Nature - (www.buildingwithnature.org.uk).

Gloucestershire Centre for Environmental Records, (www.gcer.co.uk)

The Growth Hub – Tools, resources and advice to help businesses get to net zero. https://www.thegrowthhub.biz/netzero

Glossary

Air Source Heat Pumps (ASHP) – an electric heating system that gathers ambient heat from surroundings to efficiently heat a dwelling.

Air-tightness – A measure of how much air naturally leaks out of or into a building, through gaps around doors, windows, keyholes etc. Usually measured in $m^3/m^2/hr$ @ 50Pa.

Building fabric – a term used to describe collectively the walls, roof, floor, windows and doors of a building.

Carbon budgets – a term used to state remaining carbon emissions, or share of carbon emissions, that can be emitted before the amount of cumulative emissions exceeds that aligned with a given atmospheric temperature change.

Carbon footprint – the amount of carbon emitted by a person or organisation in a given timeframe.

Carbon offsets – a way of balancing emissions in one area by reducing emissions in another or by sequestration of carbon*.

Climate resilience – enabling a building, dwelling, geographical area or organisation to adapt to the changing climate.

CO_2 – carbon dioxide, a greenhouse gas.

Coefficient of Performance (CoP) - a measure of efficiency usually used when describing heat pumps. The CoP is the amount of useful heat (or coolth) produces from every kilowatt of electricity used. E.g. a heat pump with a CoP of 3 produces 3 kW heat for every 1 kW of electricity it uses.

Communal heating system – a multi dwelling heating system.

Energy efficiency – the relative amount of energy a building or system uses to achieve a certain aim (e.g. maintain a specific internal temperature)

Fabric Efficiency – a measure of how effective a building's fabric is at retaining heat or staying cool.

Greenhouse gas – a gas that retains heat in the atmosphere, e.g. carbon dioxide (CO_2) and methane (CH_4).

ktCO_2 – kiloton of CO_2, a measure of the amount of carbon dioxide emitted or offset.

kWh – kilowatt hour, a measure of the amount of energy used or generated in one hour.

Leaky building – A building with a low level of air-tightness.

Mechanical Ventilation with Heat Recovery (MVHR) – a form of building ventilation that recovers heat from stale air before it is vented outside the building and uses it to warm incoming fresh air.

Net Zero Carbon – where the amount greenhouse gases emitted by an organisation are equivalent to the emissions either: i) sequestered or offset , ii) displaced by production of renewable energy.

Renewable energy – energy from a renewable source e.g. wind or solar.

Space heating demand (SHD) – the amount of heat energy required to heat a space. SHD is a reflection of building fabric efficiency and is usually expressed in $kWh/m^2/yr$.

***Sequestration** – the storing of carbon in land based assets.

Solar photovoltaic (PV) – a form of renewable electricity generation from solar energy well suited to buildings and urban environments. Can be stated in installed capacity (kW), annual generation (kWh/yr) or annual generation per m^2 of building footprint ($kWh/m^2/yr$)

Waste Water Heat Recovery (WWHR) – A proprietary system fitted to the outlets from sinks, showers and baths, which collects heat from the waste water and transfers it to the cold water feeding a hot water store.

Whole House Retrofit – where a building is retrofitted for energy efficiency in an holistic manner, and many different fabric elements and systems are considered at once.