Climate Change and Sustainability

How to design low carbon and resilient developments

Practice Note	July 2020

Contents

TOWARDS ZERO CARBON DEVELOPMENT

This practice note provides advice on the implementation of Bristol Local Plan policies for sustainability, climate change and resilience. By following the guidance in this note, developers can ensure their proposals meet local plan requirements for delivering sustainable buildings.

The council has declared a climate emergency and Bristol has committed, in the One City Plan, to becoming carbon neutral and climate resilient by 2030. This requires that we act now to reduce direct and indirect carbon emissions to net zero and prepare and adapt to deal with the projected impacts of climate change. The council is implementing a range of measures, including this practice note, which will secure reduced emissions.

In 2019, we consulted on an update to the Bristol Local Plan[1] and proposed a number of new and revised policies which, if adopted, will ensure that all new development in the city helps us to meet these objectives.

Until a new local plan is adopted, the current Bristol Local Plan's policies expect development proposals in Bristol to deliver energy efficient buildings with reduced emissions. This practice note has been updated to ensure that new development makes the best contribution it can to the city's longer term aims within the requirements of the current local plan policies.

Developers should aim to exceed the requirements of the current local plan policies. Where development proposals go beyond the standards required by the current local plan, the benefits of such an approach can be taken into account as a material consideration when planning applications are decided.

For more information on the city's approach see the One City Climate Strategy.

[1] Local Plan review March 2019. See draft policies CCS1 to CCS5.

1. Introduction

This practice note offers advice on the implementation of Bristol Local Plan policies as they relate to sustainability, climate change and resilience. The relevant strategic policy is set out in policies BCS13-16 of the Bristol Core Strategy.

This version of the practice note has been updated to reflect the changes set out in the then Department for Communities and Local Government (DCLG) written statement to Parliament - Planning update March 2015[2], and should be read in conjunction with the Bristol City Council Note: "Government's Housing Standards Review: Operation of Bristol Local Plan Policies (2015)"[3].

BCS13	**Climate Change** Requires development to both mitigate and adapt to climate change.
BCS14	**Sustainable Energy** Provides criteria for assessing new renewable energy schemes, with a presumption in favour of large-scale renewable energy installations. Requires new development to minimise its energy requirements and then incorporate an element of renewable energy to reduce its CO_2 emissions by a further 20%. Supports the delivery of a district heating network in Bristol.
BCS15	**Sustainable Design and Construction** Requires all development to engage with issues around sustainable design and construction. Requires larger non-residential developments to be assessed against BREEAM, and super major developments to also be assessed using BREEAM Communities. Contains additional policy content relating to refuse storage and broadband provision.
BCS16	**Flood Risk and Water Management** Principally addresses the issues around development in flood risk areas but also requires all development to include water management measures to reduce surface water run-off, including sustainable drainage systems (SUDS).

In order to support the delivery of the Core Strategy, further detailed policy is set out in the Site Allocations and Development Management Policies and the Bristol Central Area Plan. This practice note offers advice on the implementation of these policies in so far as they relate to climate change and sustainability. Where relevant, planning applications should respond directly to key polices, including:

DM15	**Green Infrastructure Provision** Sets out criteria for the provision of certain types of green infrastructure assets and the circumstances when they should be included in development proposals.

2 https://www.gov.uk/government/speeches/planning-update-march-2015
3 http://www.bristol.gov.uk/page/planning-and-building-regulations/planning-advice-and-guidance

DM27	**Layout and Form** Requires development to make efficient use of land, and includes a requirement for development to respond appropriately to local climatic conditions.
DM29	**Design of New Buildings** Requires new buildings to be designed to a high quality standard, and sets requirements relating to solar orientation, adaptability, green infrastructure and the use of high quality, durable and sustainable materials.
BCAP20	**Sustainable design standards in city centre developments** Complements BCS15 by setting a BREEAM standard for development within Bristol City Centre.
BCAP21	**Connection to heat networks in city centre developments** Requires development in the central area that would require heating, to explore opportunities to share or source heat resources with adjoining development or to connect to existing district heating networks.
BCAP25	**Green infrastructure in city centre developments** Sets out a specific requirement for the inclusion of green infrastructure in both the landscaping and as an integral part of building design, to help adapt to the effects of climate change including the impact of overheating and surface water run-off, which is of particular relevance to city centre developments.

Chapter 2 of this practice note addresses general principles around implementation of these policies. Chapters 3 to 6 deal in more detail with individual topics.

The list of policies included in this note is not exhaustive and other sustainability issues are addressed through the broader suite of local plan policies and should be taken into account in planning applications. For example provision of electric vehicle charging points is addressed in policy DM23 of the Site Allocations and Development Management Policies.

2. Applying the Policies

2.1. Submission requirements

Following the adoption of the Core Strategy on 21 June 2011 (and taking into account the written ministerial statement of March 2015), applications for planning permission must be accompanied by the following information:

Policy	Required information	Scale of development
BCS13	Sustainability Statement, including:	All*
BCS14	Energy strategy	All*
BCS15	BREEAM assessment	Major and super-major[4] non-residential
BCS15	BREEAM Communities assessment	Super-major
BCS16	Water management strategy	Minor*
	Standalone Sustainable Drainage Strategy	Major and super-major

*Subject to exceptions set out in part 2.3 of this practice note.

Sustainability Statements are required to address:

- The detailed matters covered by policies BCS14-16;
- The more broad-ranging view of both mitigation and adaptation to climate change offered by policy BCS13; and
- The detailed matters covered by sustainability policies set out in the Site Allocations and Development Management Policies and, where the development is located in central Bristol, the Bristol Central Area Plan.

The Code for Sustainable Homes was withdrawn following the written ministerial statement of March 2015. As such, the requirement set in Policy BCS15 for applications for 'Major' residential development to undertake a Code for Sustainable Homes assessment can no longer be imposed. Nonetheless, it remains imperative that development in Bristol is delivered to a high standard of sustainability ensuring that it remains fit for purpose over its lifetime.

Sustainability Statements and related information should be clear and precise and the measures they propose should be deliverable if they are to satisfy the above policies. Expressions of intent to 'consider' introducing measures will not be sufficient. Where relevant, the measures set out in the Sustainability Statement should also be shown on the application drawings.

2.2. Timing of the requirements

Policy BCS13 requires that measures to mitigate and adapt to climate change are integral to the design of new development. This reflects the fact that certain sustainability measures cannot be retrofitted and, to be effective, measures to mitigate and adapt to climate change such as site-wide renewable energy measures have to be planned into development from the earliest stage as they directly affect the layout and design of development. For example,

[4] The Core Strategy defines major development as development of 10 or more dwellings or development exceeding 1,000m^2 of other floorspace, and super-major development as development of 100 or more dwellings or development exceeding 10,000m^2 of other floorspace

to make the best use of solar for the generation of heat or power, a development will require south-facing roof slopes.

The Sustainability Statement and related drawings must therefore be provided prior to an application being determined. Planning conditions cannot be used to defer the identification of such measures to a later stage when other aspects of the layout and design have already been determined.

Once a satisfactory Sustainability Statement has been received, planning conditions will be used to ensure that the measures set out in that statement are delivered through the final detailed design and on the ground. Appendix 4 of this practice note sets out model conditions that may be used at this stage.

2.3. Exceptions to the requirements

The requirement for a Sustainability Statement only applies to applications for planning permission. It does not apply to applications under any other consent regime, e.g. applications for listed building consent or advertisement consent, applications for certificates of lawfulness or prior approvals under the General Permitted Development Order.

Many of the policy requirements of BCS13-16 cannot readily be applied to the following types of planning application, which will therefore also be exempt from the requirement to produce a Sustainability Statement:

1. “Householder” applications for alterations and extensions to dwelling houses.

2. Alterations and extensions to existing non-residential buildings, including:
   - Extensions of up to 10% additional gross internal floor space, to a maximum of 250m².

3. External works where no additional floor space is being created, such as:
   - New air-conditioning units;
   - New shop fronts;
   - New windows.

4. Applications for planning permission proposing a “change of use” **only** (unless over 1,000m² floor space).

   The exemption for changes of use is only offered to proposals that involve no increase in floor space or subdivision of units. For example:

   - An application that sought only to change the use of a retail unit from a shop to an office, potentially including some external works e.g. a new shopfront would be exempt.
   - An application that sought both to change the use of a retail unit from a shop to an office and also to extend the premises by more than 10% or 250m² would **not** be exempt.
   - An application that proposed the conversion of a house to two flats or the conversion of an office block to multiple units of student housing would **not** be exempt.

5. Applications that are themselves solely for the installation of energy efficiency measures or renewables.

2.4. What does “proportionate to the scale of development” mean?

Policy BCS13 states that Sustainability Statements can be “proportionate to the scale of the development proposed”.

The following key principles apply to **all** Sustainability Statements:

1. Sustainability Statements should address both mitigation and adaptation as set out under policy BCS13.
2. Sustainability Statements should engage with and address the energy requirements of policy BCS14, the water management requirements of policy BCS16 and each of the key issues listed in policy BCS15.
3. In respect of each of these issues, Sustainability Statements should set out what possible measures have been explored, which measures have been adopted and integrated into the design and, where relevant, why it was not feasible to incorporate certain measures into the proposed development.
4. A failure to convincingly address each of these issues will result in a refusal of planning permission.
5. If it is argued that including sufficient measures to meet the energy requirements of policy BCS14 would render the development unviable, then the applicant will be required to submit a full viability assessment[5].

Where the Sustainability Statement can become “proportionate” is in the level of detail required and the different options for measures that have to be taken into account for any given site. The following principles apply:

1. Sustainability Statements for smaller scale developments can be correspondingly brief in their exploration of the different measures that could be included.
2. The scope of different measures that need to be explored can be informed by the size and constraints of the site. For example:
    - The conversion of a single dwelling to two flats where there is limited outdoor space available could be expected to explore the use of water butts and other forms of rainwater harvesting, but would not be expected to consider large-scale approaches to sustainable drainage such as swales and drainage ponds.

    Appendix 3 of this practice note offers guidance on what sustainable energy technologies may be appropriate and should therefore be considered for different scales and types of development.
3. The development will not be expected to deliver, alone, mitigation or adaptation measures of a scope greater than the development itself. For example:
    - An infill development of ten houses or the conversion of an existing building to ten flats might be expected to include site-wide community heating and be future-proofed for connection to a future heat network, but

[5] The basis of the assessment will be an open book appraisal, which will be carried out in accordance with the principles set out in the Royal Institute of Chartered Surveyors Professional Guidance Note “Financial viability in planning” (GN 94/2012).

would not be expected to include the strategic infrastructure needed to expand the heat network on a neighbourhood or larger scale.

An exception to this rule is in respect of water management, where an improvement to the existing levels of surface water runoff will normally be sought.

3. Sustainable Energy

3.1. Overview

Policy BCS14 requires a systematic approach whereby development reduces carbon emissions through the application of the following energy hierarchy:

1. Minimising energy requirements;
2. Incorporating renewable energy sources;
3. Incorporating low-carbon energy sources.

As such, the policy has four main strands:

- To encourage major freestanding renewable and low carbon energy installations;
- To reduce energy demand through the use of energy efficiency and conservation measures, including improvements in fabric efficiency and air permeability and use of passive design principles in new development;
- To secure at least a 20% saving in CO_2 emissions from energy use in new development through on-site generation of renewable energy; and
- To ensure that heating and hot water systems are designed and specified in accordance with the heat hierarchy including, where appropriate, connection to a heat network.

Achieving high levels of energy performance beyond the requirements set by the Building Regulations should be viewed as a major priority in building design, particularly in light of the ‘performance gap’ between design and as-built energy performance that has been identified in recent years[6].

Renewable and low carbon energy generation, storage and distribution is a fast moving and dynamic area, in which innovative and emerging technologies are making good progress towards market entry and commercial viability. As such, the incorporation of innovative technologies and approaches is welcomed provided these are supported by robust evidence of their efficacy.

3.2. Energy strategies

Policy BCS14 states that energy strategies should be submitted with planning applications. These should include a feasibility study for sustainable energy and can form part of the Sustainability Statement required by policy BCS13. Energy strategies will not be sought where a Sustainability Statement is not required (see part 2.3 of this practice note).

3.2.1. Structure of the energy strategy

The energy strategy should show the projected annual energy demand for heat and power from the development together with the associated CO_2 emissions, using the methodology in the current Building Regulations Part L as a baseline[7], then demonstrate how the emissions from energy use in the development will be reduced in accordance with the energy hierarchy as set out in the steps below. An effective energy strategy will combine a **written explanation** of the measures proposed, taking account of site constraints and

---

[6] http://www.zerocarbonhub.org/current-projects/performance-gap

[7] The Core Strategy indicates that the baseline energy demand should be determined on the basis of 2006 Building Regulations Part L standards. The 2006 standard was referenced in the core strategy as these were the regulations current at the time of writing. In determining the baseline energy performance of a development the building regulations that are current at the time of preparing the application should be applied.

opportunities, with **detailed calculations** showing the CO_2 emission savings achieved. The proposed measures should be shown on the **application drawings**, in order to provide certainty that they can be accommodated in the design, and to allow an assessment of how well they have been integrated into the proposed design.

*The energy strategy is only required to address **regulated** emissions. Regulated CO_2 emissions include those which arise from heating and lighting within the development as controlled by Building Regulations. They do not include the emissions resulting from the use of appliances by the occupiers of the development.*

To demonstrate compliance with policy BCS14, an energy strategy must clearly identify the CO_2 emissions of the development for each stage of the energy hierarchy, addressing each of the following steps:

1. Model buildings to comply with current building regulations Part L, and predict regulated CO_2 emissions. For residential development, this is achieved using the Standard Assessment Procedure (SAP)[8]. For non-residential development, this is achieved using a standard model known as SBEM[9].
2. Reduce energy consumption by amending the design to include additional energy efficiency measures to exceed the energy requirements of Building Regulations[10]. This includes, where appropriate, connection to a heat network and the use of CHP.
3. Recalculate the predicted CO_2 emissions to take account of these additional energy efficiency measures – the result being the "residual emissions" for the development referred to in policy BCS14.
4. Consider appropriate renewable energy technologies for the site. Decide on the mix of renewable energy technologies to be used, and calculate the resulting savings in CO_2 emissions, to offset at least 20% of the residual emissions[11].

The applicant should clearly set out in the energy strategy, cross-referenced to the application drawings where appropriate, the measures to be incorporated.

A standard template along with technical guidance for how to demonstrate compliance with Policy BCS14 is set out at Appendix 1 of this practice note. The energy strategy should include a summary of SAP (for residential) or SBEM (for non-residential) calculations to quantify the baseline and residual emissions.

3.2.2. Energy efficiency

Minimising energy use through design needs to be factored in from the beginning of the design process. Bristol City Council strongly encourages the use of fabric and other energy efficiency measures to reduce the requirement for heat and power in line with a 'fabric first' approach, and the application of the energy hierarchy. As set out in section 4.2 of this practice note, this can include consideration of Passivhaus or other standards for residential and non-residential buildings to minimise energy demand.

Designing a shell and then considering how to meet the energy requirements means that opportunities will be lost - for example making use of the orientation of new buildings to

[8] http://www.bre.co.uk/sap2009/
[9] http://www.ncm.bre.co.uk/
[10] This can include savings achieved through the use of CHP systems but not savings from the use of renewable fuel sources to power those CHP systems.
[11] This can include the use of renewable fuel sources to power CHP systems.

take advantage of solar gain. Opportunities for energy efficiency should therefore be maximised at the planning stage.

The Sustainability Statement, with reference to application drawings as appropriate, should demonstrate how the orientation of buildings has been designed to optimise solar gain to support energy efficient design, whilst mitigating against overheating. The built form should also be designed to minimise the number of external heat loss walls.

Where site constraints allow, the application of passive design principles is recommended, as exemplified in the Passivhaus approach; this typically requires buildings to be orientated along an east/west principal axis so that the building faces within 30 degrees of due south. This allows the building to derive maximum benefit from useful solar gains[12].

Once the best possible building orientation has been identified, further measures to consider include:

- Substantial fabric insulation and/or wall thickness, and energy efficient glazing;
- The use and placement of internal thermal mass to create an internal energy buffer;
- Energy efficient building form;
- Appropriate levels of daylighting (e.g. through the use of an atrium or high level windows);
- Good levels of airtightness and appropriate ventilation provided mechanically with heat recovery or naturally;
- Minimising heat loss through thermal bridges;
- Solar shading on south facing glazing to avoid overheating during hotter weather; and
- Tree planting to provide summer shade, whilst allowing solar gain during the winter months.

Where mechanical ventilation is proposed, this should incorporate heat recovery with the facility for a summer bypass.

Where local environmental conditions permit (e.g. noise, air quality), openable windows should be included as they allow building users the opportunity for natural ventilation at quieter times even where mechanical ventilation is also specified

[12] http://www.passivhaus.org.uk/filelibrary/Primers/KN4430_Passivhaus_Designers_Guide_WEB.pdf

Passivhaus as an example for how to minimise energy demand and the 'performance gap'

Passivhaus also known as 'Passive House' is an energy performance standard for new buildings, residential, commercial and industrial. Developed in Germany in the early 1990's the essence of Passivhaus is to reduce fabric and ventilation heat losses to the point where a traditional heating system is no longer necessary. It places a strong emphasis on the use of insulation, eliminating cold bridges and placement of thermal mass.

The adoption of Passivhaus has grown rapidly since 2000 and there are numerous examples of new homes built in northern Europe, including the UK, which achieve the standard, and dispense with primary heating, and require only minimal secondary heating such as a heated towel rail, to maintain a comfortable internal temperature throughout the heating season.

The formal definition of a Passivhaus is "a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air."

Passivhaus minimises the risk of summer overheating. The need for active cooling is diminished by the same principles and through the use of shading and in some cases via the pre-cooling of the supply air. Night-purging and the use of natural cross-ventilation is encouraged during the summer months.

By combining Passivhaus with 'active renewables' such as PV it is possible to construct dwellings with negative energy costs, i.e. where the revenue from energy generated exceeds the energy running cost of the building.

Further information is available here: http://www.passivhaus.org.uk/standard.jsp?id=122

Once energy demand for heating and cooling is reduced to a minimum through building fabric and design, consideration should be given to the efficient and low carbon building services and control systems to further reduce energy demand:

- Selection of heating and cooling systems in accordance with the BCS14 heat hierarchy (see below).
- Responsive heating controls;
- Building management systems linked to temperature, CO_2 and humidity sensors around the building; and
- Intelligent and energy efficient lighting design to incorporate LED lighting in combination with natural lighting.

The applicant should clearly set out in the energy strategy, cross-referenced to the application drawings where appropriate, the measures to be incorporated.

3.2.3. Selection of heating systems

Heating and cooling systems should be selected in accordance with the heat hierarchy set out in policy BCS14.

Applicants should note that the heat hierarchy intentionally excludes non-renewable electrical space and water heating and individual gas boilers.

The decarbonisation of mains electricity as a result of changes in the way electricity is generated and specifically a reduction in coal generation and increase in wind and solar PV generation has closed the gap between the carbon intensity of electricity and gas. The Government expects the carbon intensity of electricity to fall below that of gas by or before 2025. However, non-renewable electric heating remains excluded from the heat hierarchy for the following reasons:

- The continued decarbonisation of mains electricity is not guaranteed and is predicated on:
  - a significant increase in renewable power generating capacity in the UK, to displace fossil fuel generation; and
  - a shift from gas to renewable electric space and hot water heating, specifically heat pumps.
- Demand on the local electricity distribution network is expected to increase significantly over the next decade due to the transition to electric vehicles and the increased use of heat pumps in Bristol which, in combination with heat networks, will be necessary to decarbonise heat. The cumulative impact of developments across the city adopting a heating strategy based on electric resistive heating is to increase demand on the electricity distribution network. It makes the need for costly upgrades to the network more likely and could delay or make the transition to electric vehicles and renewable electric heat more difficult and more expensive.
- Electric resistive heating is relatively inefficient compared to heat pumps and is likely to increase running costs for the end user, with implications for fuel poverty.
- An electric resistive heating system is also likely to mean that development cannot easily connect to a heat network or heat pump based heating system in the future, as it would likely require the entire heating system to be replaced with a 'wet' system at a considerable cost. In most cases a wet heating system will, if designed correctly, allow for a future connection to a heat network.

For certified Passivhaus schemes electric resistive heating is allowable. This is because the space heating requirement is very small and to a large degree addressed through the ventilation system, which helps to avoid peaks in demand. The 'performance gap' between designed and actual energy usage has also been shown to be very small or non-existent in certified Passivhaus buildings. Applicants will be required to show that a scheme is capable of being certified as having met the Passivhaus standard and, in the event that it cannot, will be required to meet BCS14 in full by other means. This includes the selection of the heating and hot water system in accordance with the heat hierarchy.

Combined heat and power

Combined heat and power (CHP) is an efficient way of generating energy, where waste heat from generating electricity is captured and used for space heating in buildings. This can also be combined with cooling for summer months to give combined cooling, heat and power (CCHP).

CHP requires substantial demand for heat and appropriate demand for power to be viable. This can be achieved at varying scales, entirely within a development – for example in a university or hospital site - or used to distribute heat and power to surrounding buildings. Where CHP is proposed only for a single use development – e.g. a hospital – the design should be future proofed to allow connection at a later stage to a larger heat network.

Most CHP systems are gas powered, but other fuels can be used including biomass (wood pellets or wood chip) or waste materials (subject to consideration of air quality). Once the distribution infrastructure is installed, the fuel can be changed later to a lower carbon fuel, and design should allow for this. The location of the energy centre and the infrastructure should be shown on drawings, together with potential future connections to adjacent schemes. In the case of biomass CHP, storage and access routes for delivery and plant maintenance should be shown on drawings and an Air Quality Assessment included with the application.

In energy strategies, the use of gas powered CHP is treated as an **energy efficiency** measure.

If powered by renewable fuels, the use of CHP is treated both as an **energy efficiency** measure and as a **renewable energy** measure.

District heating

Policy BCS14 requires that within Heat Priority Areas (as identified in the Core Strategy), major developments connect to existing heat networks where available. Where a network is not available major developments within Heat Priority Areas should incorporate infrastructure to connect to district heating networks in the future where feasible. Within central Bristol these requirements are further emphasised by policy BCAP21.

Within the Heat Priority Area applicants should:

- Download the Bristol City Council Heat Networks Connection Pack, parts 1 and 2 (available here: https://www.energyservicebristol.co.uk/business/heat-networks/).
- Contact Bristol City Council Energy Services team (info@energyservicebristol.co.uk) to discuss how much heat will be required, and the 'heat-on' date, that is when heat will be required. Energy Services will confirm whether the council will be able to provide a connection by the time the development is occupied, either via a heat network or interim heat plant.

When designing for connection at day one, applicants should:

- Design heating and water systems in accordance with guidance in the CIBSE Heat Networks CP1 Code of Practice and the Connection Pack (Parts 1 and 2) to ensure that the system is designed to reduce flow and return temperatures, minimise heat losses and maximise efficiency of the building/development to which heat is being supplied and the network as a whole.

Where the council confirms that it will be able to provide a connection within one year, heating systems should be designed to enable a future connection to a heat network. In these cases the applicant should:

- Ensure that the development is designed in accordance with the CIBSE and BCC guidance as above and in such a way that connection can be made with minimal disruption.
- Ensure that internal and external connection routes between the development and heat network have been identified, are feasible and safe guarded.
- Ensure that the proposed design of the heating and hot water system including the plant room has been discussed and agreed with Bristol City Council's Energy Services Team.
- Provide contact details of the person(s) responsible for energy provision, for the purpose of engagement over future connection to a network

Where the council cannot provide a connection to a heat network within one year, the development should instead be designed to meet one of the other options on the heat hierarchy set out in policy BCS14.

The effective use of heat networks can contribute significantly to energy efficiency of new development. Appendix 2 sets out the latest position on Bristol's growing heat networks and provides further guidance on the use of heat networks as part of an energy strategy.

3.2.4. Renewable energy generation

The energy strategy should contain sufficient information to demonstrate that feasibility has been fully tested for a range of renewable energy technologies and that a 20% reduction in residual emissions has been achieved. A calculation of the likely energy generated from the renewable technology along with the resultant CO_2 emissions reduction should be provided in the energy strategy. Supporting information should be provided on the likely impacts – for example, in the case of biomass, details of the proposed arrangements for the supply, storage and delivery of fuel. Further detail on the approach to integrating renewables is set out in Appendix 3 of this practice note.

Recognising that the detailed design of the renewables scheme is generally carried out post planning consent, a condition will be imposed requiring the submission of a detailed specification to demonstrate that the proposed technologies have been fully incorporated within the detailed design and are capable of delivering the predicted emissions savings.

3.2.5. Allowable Solutions

Where it can be demonstrated that it is not possible to meet a 20% reduction in residual CO_2 emissions using renewable energy on site, in certain circumstances off-site solutions (Allowable Solutions) may be considered. Whilst no national framework for Allowable Solutions currently exists there are local solutions, for example in the form of either directly linked or near-site provision or through financial contribution to a city wide low carbon energy initiative.

Directly linked and near-site provision

'Directly linked' refers to the provision of renewable energy sources at other sites that are related to the application site. This could apply where, for example, renewable technology could be installed more effectively in terms of cost and / or output at a different site within the estate of the applicant.

'Near-site provision' refers to the provision of renewable energy sources outside but near to the application site. This could apply where, for example, solar panels could be installed on an existing building adjacent to the proposed development. This might be appropriate if, for example, the adjacent building is more favourable in terms of orientation or shading.

In all cases, proposals should be discussed with the Sustainable City team, installations and will need to be genuinely additional, and supported by evidence. Such installations will be secured by condition and will need to be completed prior to the occupation of the new development.

Financial contributions

Applicants should consult the local planning authority with regards to financial contributions as Allowable Solutions.

4. Sustainable Design and Construction

Policy BCS15 deals with the full breadth of sustainable design and construction measures.

4.1. Addressing the issues

As well as energy, which is dealt with in detail by policy BCS14, development is expected to engage with the following issues, all of which should be addressed in the Sustainability Statement. Where a BREEAM assessment is submitted this can form a major part of the Sustainability Statement, but there will also be site-specific opportunities and potential for innovation that go beyond BREEAM.

Waste and recycling

Policies BCS15 and DM32 require that development include storage space for refuse and recyclable materials. For major schemes, clarity will also be sought as to the approach to site waste management during the construction phase in the form of a site waste management plan. The Sustainability Statement should incorporate both of these issues.

Where demolition is proposed, applicants will be asked to maximise the recycling and re-use of demolition materials. A demolition audit should ideally be carried out and submitted with a planning application to identify which materials can be recycled – for example bricks, wooden floors or panelling. The Bristol Wood Recycling Project[13] is a local not-for-profit organisation which collects wood for recycling and can also supply wood for construction projects. Where possible, applicants will be encouraged to specify a percentage of construction materials which are recycled. WRAP[14] can provide assistance with sourcing recycled materials. Where demolition waste is crushed for hardcore, it is best if this can be done on or near site.

Water

The Sustainability Statement should include a water management strategy which should address the following issues as required by policies BCS15 and BCS16:

- Water management – minimising runoff from rainwater.
- Water efficiency – reducing the consumption of drinkable water through the use of measures such as low water use appliances, flow restrictors, spray taps and sensors.

Chapter 5 of this practice note offers further guidance on these issues.

Materials

The Sustainability Statement should set out how sustainability has been taken into account in the selection of materials. A commitment to using materials rated A or B in the BRE Green Guide to Specification[15] would be a good starting point for negotiation.

The web site “GreenSpec”[16] has further useful information on materials, including branded products.

[13] http://www.bwrp.org.uk/
[14] http://www.wrap.org.uk/
[15] http://www.thegreenguide.org.uk/
[16] http://www.greenspec.co.uk/

Flexibility and adaptability

The need for new development to be flexible in its layout and design, as set out in policies BCS15 and BCS21 of the Core Strategy, is further emphasised by policies DM27 and DM29 of the Site Allocations and Development Management DPD.

The Sustainability Statement should set out how the proposed development will be adaptable to potential future changes in use or occupancy. This may include, for example, how the internal dimensions of the development (including floor to ceiling heights) and the proposed provision of building services, access and circulation arrangements will allow for future change of use, reconfiguration or extension.

Consideration should also be given to how a future extension through, for example, a loft conversion or conservatory, could be achieved without compromising the energy efficiency of the building. Integrating Lifetime Homes standards will allow building occupiers to remain in existing homes and reduces the need for specialist provision. In residential developments, including live/work units or space that enables home working can reduce the need to travel. Design and specification that enables the deconstruction and re-use of building elements at a future date can also be considered.

Green Infrastructure

The need for new development to incorporate green infrastructure, as set out in policies BCS9, BCS15 and BCS21 of the Core Strategy, is further emphasised by policies DM15-17 and DM25-29 of the Site Allocations and Development Management DPD.

The Sustainability Statement should demonstrate how opportunities have been sought to incorporate green infrastructure through landscaping and building design. When designing in green infrastructure, opportunities should be taken to maximise multi-functional benefits including:

- Enhancing biodiversity value
- Managing surface water run-off
- Contributing to the mitigation of urban heat island effect (particularly in the city centre and denser urban areas)
- Adapting to future climatic conditions such as increased temperatures and more intense rainfall
- Incorporating food growing and foraging opportunities
- Providing amenity space and contributing to health

The incorporation of green infrastructure in buildings is now common in other UK and international Cities and should be considered in all development. The Sustainability Statement should set out how opportunities to incorporate the following measures have been maximised:

- Green or brown roofs (DM29);
- Living walls / balcony planting (DM29);
- Bird and bat boxes;
- Opportunities for food growing, particularly for dwellings (DM15); and
- Indigenous and nut or fruit bearing trees and bushes specified in landscaping.

The balance between hard and soft landscaping within a development proposal requires careful consideration. Areas of public realm should incorporate adequate soft landscaping and planting in order to contribute to climate change adaptation and minimise overheating. This is particularly important in high density urban environments where the urban heat island effect is most pronounced and where existing green infrastructure is limited, and which are most exposed to climate change impacts.

Given the tight urban grain and high density of development within the city centre and the ambitious levels of growth proposed for the area by the Core Strategy, the opportunities for additional major green infrastructure assets are limited. Therefore, as identified in the Bristol Central Area Plan, the integration of green infrastructure within new development in the city centre should be prioritised in order to enhance and reinforce the area's existing green infrastructure assets and manage risk of surface water flooding and exacerbating the urban heat island effect.

Green Roof Design Considerations

Green and brown roofs and other building integrated green infrastructure can offer a range of benefits including attenuation of surface water run-off, improved micro-climate, energy conservation and carbon reduction, enhanced biodiversity, visual enhancement, amenity and health, noise attenuation, food production, and the extension of roof life. Combining green/brown roofs with solar photovoltaic (PV) panels can enhance the power production of the PV units[17]. Green roof installation can also assist in attaining credits for sustainability standards such as BREEAM.

It is recommended that green/brown roofs are incorporated and designed in such a way as to maximise the benefits that are most relevant to a specific building or location (e.g. the location may be vulnerable to surface water flooding or identified as a potential opportunity to provide brownfield habitats or enhance a wildlife corridor), and to maximise multifunctional benefits.

The level of maintenance required for a green/brown roof will vary, with intensive park-like roofs designed for recreational purposes tending to require a higher level of maintenance. Semi-intensive roofs may require periodic maintenance depending on the planting, and there are examples where very little maintenance is required. Extensive green/brown roofs which are typically designed to provide a visual or biodiversity interest are generally low maintenance[18]. Biodiverse brown roofs would typically require 1-3 visits per year in order to manage the habitat[19].

The provision of living (green/brown) roofs is recommended which feature mounds and troughs with an overall substrate depth of at least 10 cm and mounds which are at least 20 cm high to provide refuges for invertebrates during dry spells. A combination of planted and unplanted (bare) areas is valuable for invertebrates. Features for invertebrates such as log piles, coils of rope, sand piles and stone mounds and areas of wildflower meadow are valuable for biodiversity. Sedum roofs have limited value for wildlife and are not recommended.

Further information on the benefits and design of green roofs can be found at http://www.greenroofcode.co.uk/ and http://www.thegreenroofcentre.co.uk/. The most appropriate specification should be determined in consultation with BCC Bristol City Council's biodiversity, sustainability and flood risk officers.

ICT

Policy BCS15 requires new homes and workplaces to include the provision of high speed broadband access and enable provision of Next Generation broadband. The council's

[17] http://www.greenroofcode.co.uk/
[18] http://livingroofs.org/barrmaintain
[19] http://www.greenroofmaintenanceuk.co.uk/management-packages/biodiverse-brown-roof/

Broadband Connectivity Practice Note (March 2018)[20] sets out what development proposals should do to comply with this policy.

Other measures that can be considered include Internet enabled smart meters that allow building users to track and reduce energy and water consumption, with information sent to workstations, tablets or smartphones. This data can then be combined with other sustainability information including real time public transport information, recycling information, car club booking and community messaging.

4.2. Sustainability Standards

4.2.1. Code for Sustainable Homes

The written ministerial statement of 25th March 2015 revised the Government's national planning policy on the setting of technical standards for new housing within Local Plans. This included the withdrawal of the Code for Sustainable Homes, previously applied to new development in Bristol by policies BCS15 and BCAP20. The council's practice note "Government's Housing Standards Review: Operation of Bristol Local Plan Policies (2015)" [21] sets out the revised sustainable design standards that are applicable to new residential development following the withdrawal of the Code.

4.2.2. BREEAM

Policy BCS15 requires the submission of a BREEAM assessment[22] with all planning applications for major non-residential developments, and **additionally** a BREEAM Communities assessment for super major developments. The implementation of BREEAM Communities for super major developments is designed to support the acquisition of building level certification under BREEAM.

BCS15 sets a requirement for all non-residential development to achieve BREEAM excellent. It is always more effective and less costly to factor sustainability in from the outset. Applicants will be encouraged not to design down to a target BREEAM score but to use it as a starting point, and will be encouraged to innovate. BRE have recognised this, and can now award credits for innovation. If it is considered that this standard cannot feasibly be achieved then detailed evidence should be provided to demonstrate this, and a revised level of certification should be agreed with the planning authority at the pre-application stage. Where viability is cited as a reason for not achieving the standard, a full viability assessment will be required.

A BREEAM pre-assessment should be submitted with the planning application. This helps to demonstrate that the BREEAM assessment has informed the design and provides a level of assurance that the specified measures can be incorporated in the detailed design that follows. The pre-assessment can be submitted as a substantial part of the Sustainability Statement, although additional information including an energy strategy and a water management strategy is also required.

The BREEAM rating will be secured by planning condition which will require post construction certification. To avoid delay, collection of the necessary evidence by the assessor throughout the project is recommended.

---

[20] https://www.bristol.gov.uk/documents/20182/239435/Broadband+Connectivity+practice+note

[21] https://www.bristol.gov.uk/documents/20182/239443/Bristol+Local+Plan+-+Housing+Standards+Review+practice+note_0.pdf

[22] BREEAM UK New Construction or BREEAM UK Non-Domestic Refurbishment and Fit-Out

A BREEAM assessment should be undertaken wherever feasible. Where an applicant is of the view that a BREEAM assessment cannot be applied to a scheme then this should be agreed with the council, seeking input from BRE where necessary[23].

BCS 15 requires a BREEAM Communities assessment to be undertaken for super-major developments. BREEAM Communities is used for very large residential, non-residential and mixed-use developments, and due to the scale at which it is applied has a wider scope to include issues such as community and stakeholder involvement and place making. It is designed to work with the planning process, so that submissions can be made at outline and at reserved matters stages and provides a framework through which the applicant can demonstrate that core planning policies of the NPPF have been addressed. The assessor can be part of the design team, however where this is not the case an external assessor should be appointed in a timely manner to maximise their input. A full list of licenced assessors can be sourced from GreenBookLive[24].

BREEAM Communities comprises 3 steps:

- Step 1: Establishing the principle of development
- Step 2: Determining the layout of the development
- Step 3: Designing the details

Each of these steps comprises a number of assessment topics with associated credits. The applicant should agree with the council which steps and credits are to be considered at which stage of the planning process.

BREEAM Communities is aimed at integrating sustainable design into the master planning process at the site-wide scale. The expectation is therefore that an interim certificate along with an interim report will be submitted with any Outline Planning Application, and final certification is to be secured by way of a planning condition.

4.2.3. Other Sustainability Standards

There are a number of assessment and ratings schemes available that can assist applicants and design teams in integrating sustainability into the design of residential buildings. These include but are not limited to:

- Passivhaus
- Home Quality Mark (HQM)
- Leadership in Energy and Environmental Design (LEED)
- AECB Carbonlite Programme

Current national policy means that Local Authorities cannot require additional technical standards from residential development. However, applicants may elect to apply these standards for a wide range of reasons including:

- To meet Corporate Social Responsibility targets and standards.
- To reduce life-cycle costs of a building including for example energy bills.
- To differentiate themselves in the marketplace.
- To demonstrate the high quality of their homes and give homebuyers confidence in the standards of development and cost-effectiveness of their running.

---

[23] It should be noted that the BREEAM can be used to assess a wide range of developments including new construction, refurbishments and fit-outs, commercial, public multi-residential accommodation and other developments. BREEAM Guidance Note GN10 provides advice on assessing mixed use developments and multiple buildings (or units) of similar function.

[24] http://www.greenbooklive.com/search/scheme.jsp?id=214

- To cater for the growing consumer demand for sustainable products.
- Sustainable development can increase property values.
- To create healthier and more comfortable environments for occupants.
- To reduce maintenance costs.

For infrastructure, landscaping and public realm projects, there is also the CEEQUAL sustainability assessment, rating and awards scheme.

5. Flood Risk and Water Management

Policy BCS16 requires development on sites at risk of flooding to be resilient to flooding through design and layout.

Policy BCS16 also includes requirements that are applicable to all new development, not just development on sites at risk of flooding. This includes a requirement for a water management strategy as part of the Sustainability Statement for minor developments, or a Sustainable Drainage Strategy for major developments. Details of how to undertake an adequate Sustainable Drainage Strategy is set out in the West of England Sustainable Drainage Developers Guide[25]. Guidance for completing the water management strategy is covered in the minor development section of the West of England Guide Bristol Section 2[26].

5.1. Flood Resilience

New development in Bristol should be directed where possible to areas with the lowest risk of flooding, taking into account the impact of climate change. Policy BCS16 requires the application of a Sequential Test (and where required an Exception Test) on the basis of the climate change flood zones as set out in Bristol's Strategic Flood Risk Assessment. The council's Flood Risk Sequential Test Practice Note (August 2013)[27] provides guidance on meeting these requirements.

Flood mitigation measures should be outlined as required in Flood Risk Assessments and/or Sustainable Drainage Strategies submitted with applications for planning permission. These measures can include onsite works, offsite works or a contribution to offsite works secured through planning obligations. Measures can include:

- Green areas set aside for sacrifice to occasional flooding;
- Sustainable Drainage Systems (SuDS);
- Landscaping to divert and retain floodwater in ponds, swales or rills;
- Bunds at the perimeter of development;
- Impermeable boundary walls, fences and gates;
- Sizing rainwater goods to contain high volumes of rainwater;
- Specification of low permeability materials;

Flood resilient design and construction solutions which can be integrated into developments and buildings include:

- Raising the floor levels or ground level of development (note: care is needed with this approach as it may conflict with policies to promote accessibility and active street frontages or increase flood risk elsewhere);
- Flood resilient fittings – e.g. tiling for floors and ground level walls;
- Fixing points for flood shuttering;
- Locating services – e.g. electrical sockets – at a higher than usual position above floor level.

Provision should also be made for safe access to and egress from the development in the event of a flood.

The measures proposed will, in most cases, be assessed in consultation with the Environment Agency.

---

25 https://www.bristol.gov.uk/documents/20182/34524/West+of+England+sustainable+drainage+developer+guide+section+1/

26 https://www.bristol.gov.uk/documents/20182/34524/West%20of%20England%20Sustainable%20Drainage%20Developers%20Guide%20Section%202%20Bristol%20-%20SuDS%20Design%20Guide.pdf

27 https://www.bristol.gov.uk/documents/20182/34524/Flood%20Risk%20Sequential%20Test%20Practice%20Note%20(August%202013).pdf

5.2. Reducing Surface Water Runoff

The Strategic Flood Risk Assessment and Central Area Flood Risk Assessment consider the risk of flooding in the city from watercourses, taking account of the impact of climate change. However, there is also a risk in all city locations of localised flooding caused by rainfall. Climate change means that intense and/or prolonged rainfall and storms are more likely to occur, and this can result in existing drainage failing to cope with the resulting volume of surface water. Policy BCS16 accordingly expects all development to incorporate measures to reduce surface water runoff in order to mitigate this risk, both to new and existing development.

The potential for improvement will vary from site to site depending on existing site conditions (these might range from a Greenfield site, to a site with 100% coverage of building or hard surfaces), local flood risk factors and the nature and extent of the new development. However, the development will be expected to maximise site specific opportunities using water management measures such as sustainable drainage systems. The proposed measures should be set out in the water management strategy submitted as part of the Sustainability Statement for minor development and as part of the Sustainable Drainage Strategy for major development as per the West of England Sustainable Drainage Developers Guide.

For previously developed sites, the total run off and runoff rates should be close to Greenfield runoff rates. Where it is demonstrated that this is not reasonably practicable, a minimum reduction of 30% to existing peak flows will be sought. On Greenfield sites, well-designed development will not exceed the existing Greenfield runoff rates.

In order to reduce runoff rates, measures can include:

- Green roofs, blue roofs and planters;
- Rainwater harvesting;
- Permeable paving;
- Bio-retention;
- Ponds, swales and rills.

These measures can be integrated with landscaping to the development. The West of England SuDS Guide provides further guidance. The Bristol City Council Flood Risk Management Team can also provide information on the various types and applications of SuDS: flood.data@bristol.gov.uk

5.3. Reducing Water Consumption

Reducing the consumption of potable water within buildings and developments is also an important consideration. The processing of water to drinkable quality carries a cost in terms of energy and carbon, so water efficiency can contribute to carbon reduction. It also serves to reduce pressure on the water supply during periods of reduced rainfall and drought, the incidence of which are expected to increase over the lifetime of development constructed today.

Water efficiency measures include:

- Flow restrictors;
- Spray taps;
- Percussion or sensor taps;
- Dual flush WCs;
- Eco showerheads;
- Low water use washing machines and dishwashers;

- Waterless urinals;
- Leak detection.

Using harvested rainwater for washing machines and WCs has a double benefit of reducing runoff and consumption of potable water.

The written ministerial statement of 25th March 2015 on housing standards[28] stated that, where there is an existing plan policy which references the Code for Sustainable Homes, Local Planning Authorities may continue to apply a requirement for a water efficiency standard equivalent to the new national technical standard. This is set through Building Regulations Approved Document G which introduces an optional requirement that dwellings are designed so that their estimated average water consumption is no more than 110 litres per person per day. Therefore, under policy BCAP20 of the Bristol Central Area Plan, which references the Code for Sustainable Homes, major development within Bristol City Centre is expected to achieve a water efficiency standard of no more than 110 litres per person per day as required by Building Regulations Approved Document G.

5.4. West of England Sustainable Drainage Developer Guide

In line with changes to the National Planning Policy Framework (NPPF), Bristol City Council has produced the West of England Sustainable Drainage Developer Guide in partnership with other West of England authorities and Somerset County Council. The NPPF expects all Major Developments, as well as Minor Developments in areas at risk of flooding to utilise Sustainable Drainage (SuDS), and this guide demonstrates the guidance to follow as part of applying for planning permission with respect to flood risk management and incorporating SuDS.

Developments which fall under the above criteria will need to submit the relevant documents to satisfy the Lead Local Flood Authority development checklist and demonstrate that they have provided the most sustainable option for draining of the site.

Discussions with Bristol City Council at any early stage to establish a suitable Sustainable Drainage Strategy is recommended and can help developers to keep capital costs for drainage at a minimum and prevent delays in the planning process. The Flood Risk Management team would welcome discussions regarding flood risk management and drainage concerns and can be contacted at: flood.data@bristol.gov.uk

[28] https://www.gov.uk/government/speeches/planning-update-march-2015

6. Adaptation to Climate Change

Policy BCS13 requires applicants to set out, as part of the Sustainability Statement, how the design and construction of the proposed development will provide adaptation to climate change, as well as mitigation. Adaptation and mitigation measures should be considered together, and adaptation measures chosen which do not increase energy use and so exacerbate climate change – for example by avoiding the use of air conditioning.

To adapt to climate change, development will need to be resilient to more frequent extreme weather events, increases in average and peak summer temperatures and changes in rainfall patterns including periods of lower than average rainfall and drought and increased intensity and duration of rainfall leading to flooding. Changes in average weather and climate also have implications for weather-tightness and general maintenance which need to be considered at the design stage. In the case of applications for healthcare, education, sheltered housing or similar social care purposes, it will be particularly important for applications to demonstrate how comfortable conditions (indoor and outdoor) will be maintained for people in high risk groups vulnerable to high temperatures throughout the anticipated lifespan of the building or development.

Adaptation measures should be based on an assessment of the risks particular to both the specific development and the application site in general, with details of effective adaptations for minimising these risks. In preparing their response, applicants will be encouraged to draw on evidence provided by the UK Climate Impacts Programme[29] on risks from climate change and relate this to the proposed development over its lifetime. Valid and effective adaptations should not be discounted simply because they are either difficult to model e.g. shading from trees, or that they are not required by existing regulations or standards which are focused solely on low carbon targets. As well as making the development resilient in and of itself, solutions that make a contribution towards neighbourhood level resilience will be particularly encouraged.

6.1. Site layouts and approaches to design and construction which provide resilience

Projected changes in average and peak summer temperatures and more extreme weather events as a result of climate change pose a number of risks to development in terms of its ability to provide a comfortable living or working environment, and site layout and building design should respond to this.

Layout

- Buildings with aspects south through to west can be particularly vulnerable to overheating. Site layouts should take this into account and include any necessary mitigation measures required under current and future climate scenarios.
- Higher summer temperatures are exacerbated by the urban heat island effect in high-density development, which limits overnight cooling. Layouts should allow sufficient space between buildings to mitigate this. Street grids with a permeable layout to regulate airflow between blocks should be considered.
- Street trees should be provided of sufficient density and canopy structure to provide shade and to buffer wind.

[29] http://www.ukcip.org.uk/

- Accessible external space should be provided wherever possible, whether private (balconies, courtyards, gardens) or public (landscaped squares, community gardens, greenways).
- External spaces should include an element of shade through measures such as trees, canopies and awnings. Access to these spaces is particularly important during heat waves.

Built form

- Dynamic thermal modelling techniques used together with design standards such as CIBSE TM52 can be used to inform the design and ensure that comfortable internal temperatures can be maintained when external temperatures are high for a long period (with reference to UKCIP projections and changes anticipated during the lifetime of the building).
- Buildings and spaces for people in high-risk groups (e.g. the elderly, those suffering from chronic and severe illness, plus those with an inability to adapt behaviour to keep cool) will need additional measures to keep cool during a heatwave. This is particularly relevant for the following buildings:
    - Care homes and nursing homes;
    - GP surgeries, clinics and hospitals;
    - Nurseries and schools;
    - Social housing/high density/high-rise housing;
    - Temporary accommodation such as bedsits and hostels.

Applicants should consider the following measures to ensure the building is resilient to future climate change.

- The placement of thermal mass to provide a thermal buffer and provide passive cooling.
- Heating systems which can be configured to also provide cooling (e.g. ground source and air source heat pumps) can be considered to avoid the use of air conditioning.
- Living walls and green roofs should be considered in order to cool and shade buildings.
- Tall buildings are more challenging to ventilate, particularly where single aspect accommodation is included. Sufficient internal space should be provided to mitigate this, particularly in relation to floor to ceiling height.
- Openable windows should be provided, and where possible should be designed to be left open for ventilation, and to allow for night time purging without compromising security.
- The use of mechanical ventilation to reduce heat loss in the winter, and provide summer ventilation.
- Opportunities to create external spaces, with appropriate shading and passive cooling suitable for use during heat waves.
- In certain circumstances, provision of a ‘cool room’ may be necessary to accommodate more vulnerable occupants. This can be a room in the ground floor or basement of the north side of the building, or a room with supplementary low-carbon cooling and ventilation systems.

6.2. Conserving water supplies and minimising the risk and impact of flooding

Increased temperatures, changes in rainfall patterns and more frequent extreme weather events pose a number of risks to development in respect of water supplies and flooding:

- Drinking water will be increasingly in short supply;
- Drains may be overwhelmed by extreme rainfall;
- Foul sewers may fail to function properly as we use less water;
- Extensive work may be required to existing sewers;
- Groundwater levels may change;
- Recurring flooding will require investment to improve defences;
- There will be increased risk of surface water flooding.

There are a number of adaptation measures that can help to address these issues. Larger capacity building gutters, downpipes and drainage may be needed to cope with additional rainfall. Effective water management will be essential, and blue amenity space (accommodating water) will play an increasingly important role. Development will have to manage and, where possible, avoid the risk of flooding.

Section 5 of this practice note provides further guidance on these issues.

6.3. Using green infrastructure to minimise and mitigate heating

The incorporation of green infrastructure in development can provide shading and cooling and thereby reduce and mitigate heating of the urban environment, also referred to as the urban heat island effect. Green space can be multi-functional, providing play and amenity space or walking and cycling routes, as well as adaptation to climate change.

Blue infrastructure (water) can also be used to temper the urban heat environment and provide evaporative cooling.

Providing new development with private outdoor space such as gardens provides significant additional opportunities for green infrastructure and urban cooling.

Well-thought-out adaptations to climate change as part of new development, particularly those involving green infrastructure, have the potential to contribute positively to the resilience of the wider area as well as that of the development itself. Ways in which new development can contribute to neighbourhood-level resilience include:

- Improving food security e.g. community orchards and allotments;
- Improving the local microclimate e.g. enhancing the tree network and tempering the urban heat environment;
- Well-adapted public realm e.g. shaded, accessible seating areas including the use of tensile or temporary structures.

6.4. Avoiding responses to climate impacts which lead to increases in emissions

Adaptation and mitigation measures will need to be considered in a complementary way. For example, passive low-carbon means to combat overheating should be specified in preference to active cooling systems wherever possible. Similarly, insulation should be specified that both reduces heating demand and combats overheating risk.

Smart technology can be used to improve not only the energy efficiency of buildings and infrastructure but also provide useful data to increase the comfort conditions for building users e.g. by reporting on thermal performance. This allows for building management systems to respond more rapidly to changes in external conditions.

The resilience of infrastructure networks can be improved through the provision of low-carbon backup supplies, on-site energy generation and recognising the need to design networks that reduce the risk of cascade failure. This will be particularly important in developments such as hospitals or nursing homes.

Appendix 1: Standard template for Energy Strategies

Building regulations set a minimum standard for the energy performance of new buildings. This is expressed as the Target Emission Rate (TER) which is defined as the mass of CO_2 emitted in kilograms per square metre of floor area per year. For dwellings, a second standard, the Target Fabric Energy Efficiency (TFEE) rate also applies. The TFEE rate is expressed as the amount of energy consumed in units of kilowatt-hours per square metre of floor area per year.

For a new building to comply with Building Regulations, the Dwelling Emission Rate (DER) for residential dwellings, and the Building Emission Rate (BER) for buildings other than dwellings, must be equal to or exceed (i.e. be lower than) the Target Emission Rate (TER).

For dwellings the Dwelling Fabric Energy Efficiency (DFEE) must be equal to or exceed (i.e. be lower than) the Target Fabric Energy Efficiency (TFEE) rate.

These calculations are all required as part of the SAP / SBEM procedure for assessing compliance with Building Regulations, and should be used as the basis for demonstrating compliance with the requirements of policy BCS14.

A standard template for setting out these calculations is set out overleaf.

1. Summary table

The summary table should be supported by a written explanation of the measures proposed and a full set of calculations as set out under "Detailed Measures" below. Where relevant, the proposed measures should also be shown on the application drawings.

	Regulated Energy Demand (kW/yr)	**Regulated CO_2 emissions ($kgCO_2$/yr)**	**CO_2 saved**	**% CO_2 reduction**
Baseline energy demand and emissions Building Regulations Part L compliance (equivalent to the Target Emissions Rate TER for new build, or building regulations compliant BER for existing buildings)		A		
Proposed scheme after energy efficiency measures		B	A-B	(A-B)/A x 100
Proposed scheme after energy efficiency measures and CHP (if suitable for the development) or non-renewable district heating – 'residual emissions'		C	B-C	(B-C)/B x 100
Proposed scheme after renewables		D	C-D	(C-D)/C x 100 [THIS MUST BE AT LEAST 20% TO COMPLY WITH BCS14]
Total CO_2 reduction beyond baseline emissions			A-D	(A-D)/A x 100

2. Detailed measures

2.1 Energy efficiency measures

Provide a summary table of U values taken from the SAP /SBEM calculations:

	Part L Values (2013 - or most current)				
Element or System	**Dwellings Lower**	**Dwellings Notional**	**Non Dwellings Lower**	**Non Dwellings Notional**	**Proposed**
Wall	0.30	0.18	0.35	0.26	
Roof	0.20	0.13	0.25	0.18	
Floor	0.25	0.13	0.25	0.22	
Windows /Doors	2.00	1.4	2.2	-	
Permeability	10.00	5.00	10.00	5.00	

Provide a description of the proposed heating system unless it is CHP, connection to district heating or renewable.

2.2 On-site CHP and connection to off-site district heating

Provide information on how the CHP has been sized (e.g. heat demand profile and electricity demand profiles)

CHP size – enter installed capacity (kW_{th}, kW_{e})	
CHP type – manufacturer model	
Annual heat generation (kWh)	
Annual electricity generation (kWh)	
Annual operating hours	
Thermal storage required (litres)	

Evidence that the CHP meets the required air quality standards should be included in the air quality statement.

Where it is proposed to connect to a district heat network, details of the carbon factor used within the calculations should be provided.

2.3 On-site renewables

Set out what renewable energy sources have been incorporated into the proposed development and the resulting estimated annual yield (kWh).

This can include emission savings from the use of renewable fuels to power CHP.

Renewable power – enter the total installed capacity (kW)	
Renewable power – enter the estimated annual yield (kWh) from renewable measures generating electricity (where available apply recognised standard methodologies such as the Microgeneration Certification Scheme (MCS) methodology for Solar PV)	
Renewable heat – enter the total installed capacity (kW)	
Renewable heat – enter the estimated annual yield (kWh) from renewable measures generating heat	

2.4 Allowable solutions

Where the full requirements of policy BCS14 cannot feasibly delivered on-site, and an alternative approach has been agreed with the planning authority, set out any further savings that will be achieved together with a description of the agreed allowable solution.

Additional saving on residual emissions from allowable solutions (kgCO_2 pa)	
Total savings on residual emissions from renewables and allowable solutions (%)	

Appendix 2: District Heating

A heat network, or district heating, is a means of distributing heat and hot water from one or more energy centres through a network of underground pipes. It is also possible that the network supplies electricity or cooling.

Heat networks are recognised by Bristol City Council and the UK government as being important to the UK's future energy strategy, and as having the following benefits:

- Reducing carbon emissions through more efficient heat supply and energy generation and the use of low or zero carbon sources of heat.
- Improving energy security and city resilience through the diversification of energy sources and reducing reliance on imported energy.
- Creating a cost effective supply of heat which can help to reduce levels of fuel poverty and improve business productivity.
- Enabling the use of local energy production and the retention of money within the local economy.

For applicants, heat networks can also reduce development costs through the outsourcing of heating plant and reducing the need for service space.

Heat networks are powered by local 'energy centres'. A number of different energy generation technologies can be connected to the networks ranging from heat-only biomass boilers, to gas and biomass combined heat and power (CHP). There is also potential for this to be supplemented by other sources of low carbon heat, such as waste to energy and capturing waste heat from industrial processes, and water source heat.

Current proposals for heat networks

Bristol City Council has undertaken heat mapping work to determine areas which have the potential to support a viable heat network[30] and continues to expand this mapping as the heat network grows. This work has informed the development of plans to install a number of heat networks across Bristol, in particular the City Centre and Temple and Redcliffe heat networks. Further information on existing and proposed heat networks can be found by visiting http://www.energyservicebristol.co.uk/business/heat-networks/ and by contacting BCC's sustainable city team.

Bristol City Council, as a heat network operator, has committed to offering heat at a fair price and will be a member of the Heat Trust which establishes a common standard in the quality and level of protection given by heat supply contracts.

Connecting to existing and planned networks

Heat networks can also be operated privately. Applicants considering connecting to a privately operated heat network are encouraged to satisfy themselves that the network will provide a fair and affordable service – e.g. through their membership of the Heat Trust, and through their construction in accordance with the CIBSE Heat Networks Code of Practice.

In some instances, where a heat network is planned in the vicinity of a development, but is not – at the time of construction and occupation – outside the development's plant room, temporary heating solutions (e.g. those in shipping containers) can be used as an interim

[30] Please note this does not mean areas outside of those identified in the heat mapping work are not viable for heat networks, as there may be site specific conditions that have not been taken into account in the heat mapping that mean that a network could be viable

solution. Where appropriate, this may be provided by the heat network operator (e.g. Bristol City Council).

In industrial areas such as Avonmouth, opportunities may exist for developments to generate and export waste heat to an existing or future planned network. Where this is the case, it is encouraged that development is designed to allow the supply of heat to existing or future district heating networks.

Depending on the density, heat demand, profile of the heat demand and mix of development, it may not always be appropriate to connect to a heat network[31]. All major development should consider the potential to connect to a network or, if the developer has found none in the vicinity, implement an onsite heat network.

In some circumstances it may be appropriate for smaller developments to connect to an existing heat network. Therefore, where such developments are located close to the network, applicants should work with the council to determine whether a connection is feasible and viable.

Development connecting to a heat network will need to demonstrate in their application that they will meet the connection requirements of the heat network operator – for example the BCC heat network operator requires that developers adhere to the Heat Network Connection Pack Parts 1 and 2[32]. The guidance is designed to ensure that the heat network and the 'secondary system' (inside the development) both operate as efficiently as possible with minimal heat losses and incidental heat gains. Ensuring the heat distribution systems (within buildings) are designed to minimise flow and return temperatures is critical to this.

All BCC operated networks will be designed in line with the Heat Networks: Code of Practice for the UK[33], which sets minimum standards for the design of heat networks, with the aim of ensuring that the network operates effectively and meets client and customer expectations. Unless otherwise agreed with the network operator, developers are encouraged to ensure the designs accord with the CIBSE Code of Practice and particularly sections relating to the network connection and building integrated infrastructure. This will be a requirement for developments proposing to connect to a BCC operated network.

Charges for connecting to heat networks operated by Bristol City Council

Bristol City Council charges developers a fee for connecting to its heat network. Information on the charging structure and costs is set out in the Connection Pack. The connection fee will be no more than 90% of the cost that would have been incurred by the developer to supply heat had a heat network *not* been available (the avoided cost).

Accounting for connection to heat networks in energy strategy calculations

If designed well, heat networks can deliver heat very efficiently and reduce the carbon emissions of a development by making use of low carbon, renewable and waste heat. A lower carbon heat network will reduce residual emissions and subsequently the amount of renewables required to comply with policy BCS14.

Heat networks may be taken into account in the energy calculations where there is an agreement in place to connect the development to the heat network prior to occupation, or

---

[31] The general rule of thumb for heat density in district heating schemes is 50 dwellings per hectare (dph), although some schemes have been viable with lower dph.
[32] Available here: https://www.energyservicebristol.co.uk/business/heat-networks/
[33] http://www.cibse.org/knowledge/cibse-other-publications/cp1-heat-networks-code-of-practice-for-the-uk

where a timetable for future connection is agreed and secured by way of a planning condition.

In energy strategies, district heating is treated as an **energy efficiency** measure when calculating the “residual emissions” for the ‘as designed’ development referred to by policy BCS14.

In order to take the heat network connection into account when calculating the “residual emissions”, the carbon factor associated with the heat supplied by the network should be obtained from Bristol City Council (or the network operator for private networks) and used in carbon emission calculations. This should be accompanied by the assumptions used to derive the carbon factor including estimated heat losses. For private heat networks, the proportion of heat provided by each heat source, the heat efficiency and the type of fuel used should all be provided and, where CHP is used as a heat source, the power efficiency should also be provided.

Appendix 3 Renewable technologies for building and development type

It is crucial that for each project, the effectiveness and appropriateness of renewable and low carbon sources is fully assessed. The energy generating technology selected must fit the use, type and scale of development in order to achieve the greatest reduction in energy consumption and carbon emissions.

The following table identifies the suitability of renewable and low carbon technologies to different types and scales of development, with further design considerations set out in the text that follows. Planning applications should demonstrate that the proposals for renewable energy have factored in this information. In addition to the generic design considerations detailed below, applicants should also be mindful that there may be other site specific factors that could affect the suitability of a technology on a particular site, and should be taken into account when considering which technology is most appropriate, for example listed building status.

In the case of all renewable energy technologies, a planning condition will be imposed requiring the submission of a detailed specification to demonstrate that the proposed technology has been fully incorporated within the detailed design and is capable of delivering the predicted emissions savings.

Technology	**Building characteristics**	**Uses**	**Scale**
Photovoltaic panels	Roof facing east to west (through south) and not overshadowed at any point, flat roof or pitched around 30 to 40 degrees.	All uses. Especially suitable where there is a day-time demand for power, e.g. extensive IT use and / or lighting as in offices, schools, and industrial units. Compatible with Passivhaus approach.	All scales.
Solar thermal	Roof faces east to west (through south), hot water tank needed (not usually compatible with combi boilers).	All uses. Compatible with Passivhaus approach.	All scales. Can be used with other fuel source to pre-heat water and so reduce fuel consumption.
Air source heat pumps	Sited on external walls, or roof space. Relatively space efficient.	Any.	Any, may be used in single units, and to provide ‘community heating’ in low and high rise buildings.

Biomass	Space needed for plant, fuel storage and deliveries. Requires high quality fuel from sustainable source(s).	Mixed use, schools, offices, commercial, residential – especially multi-residential – best where constant energy demand.	Medium to large, viable where heat demand is above 15 kW, can be combined with gas and / or solar for summer / backup use.
Ground source heat pumps	External space for horizontal trench or vertical borehole. Can be designed to provide summer cooling.	Any.	Medium to large.
Combined heat and power	Single energy centre providing heat and power – needs space for access and servicing.	Hospitals, leisure centres, educational buildings, large scale residential and mixed use.	Medium to Large.
District heating	One or more energy centres with heat distribution network.	Residential / mixed use.	Connecting to existing networks: Where an existing network exists, all development should consider the potential to connect to the network. Establishing a new heat network within a development is likely to be viable for large to very large mixed-use developments.

Biomass

Biomass usually refers to a heating and hot water system fired by a wood chip or wood pellet boiler, and biomass can also be used to fuel a CHP system. This is suitable where there is a steady demand for heat, as the system is slow to respond to changes in temperature or use, and biomass boilers are generally most efficient when working at full load. Some systems combine biomass with a gas boiler for backup or for summer use. Biomass is often used in public buildings such as schools, but is less suitable for residential use unless as part of a mixed-use development.

Appropriate storage for the fuel is a critical requirement as is access for fuel deliveries. The location of which, both need to be determined early on, and shown on drawings.

Appearance and volume of storage need to be considered in sensitive locations, and applicants should consider the frequency of deliveries and any potential impact on nearby residents. Arrangements for regular management and maintenance should also be considered.

A secure and sustainable supply of fuel will need to be guaranteed, and in doing so the source and transportation distances should be considered so as to minimise emissions from transport. The Citywide Energy Study includes a map of fuel sources within 40km of Bristol and the Westwoods Woodfuels South West project[34] acts as a broker, connecting woodfuel suppliers with customers and managing the Woodsure quality standard for woodfuel.

The use of biomass has the potential to impact on air quality, and consultation with the Bristol City Council air quality officer should take place to determine whether it is suitable for the location. An Air Quality Assessment should be submitted. The use of high quality assured fuel, specific to the requirements of the boiler is essential to ensure efficient operation and compliance with air quality requirements. Fuel should be supplied according to a recognised quality assurance scheme such as Woodsure[35]. The Biomass Suppliers List (BSL) is administered by Gemserv on behalf of the Department for Business, Energy and Industrial Strategy (BEIS; formerly DECC). It is a list of Renewable Heat Incentive (RHI) eligible woodfuels.

In energy strategies, the use of biomass to power heating, hot water or a CHP system is treated as a **renewable energy** measure.

Ground source heat pumps

Ground source heat pumps extract solar energy from the ground[36] through pipes laid in horizontal trenches or vertical boreholes. The pipes can serve one building, or multiple buildings.

The heat pump is used to raise the temperature of this heat for distribution through the building. Heat pumps are particularly well suited to buildings which are well insulated with low heat loss and good thermal efficiency. They require a low temperature heat distribution system such as under-floor heating, or low temperature radiators to work efficiently.

Vertical borehole systems may be more appropriate to implement at high density, because of the space needed for horizontal systems. In either case the ground over the pipes can be landscaped and used as amenity space. The ground conditions need to be surveyed for suitability, and for constraints such as archaeology. At planning stage a desktop survey is sufficient.

As heat pumps are operated differently to other forms of heating, it is essential that users are provided with appropriate guidance and advice on how to use the system to achieve greatest efficiency and comfort.

In energy strategies, the use of heat pumps is treated as a **renewable energy** measure.

Air source heat pumps

These are fitted to individual buildings and work in a similar way to a refrigeration unit or air conditioning system. In this case the heat pump extracts heat from the air, and raises the temperature of this heat for use in the building. As with ground source heat pumps, air

---

[34] http://www.westwoods.org.uk/
[35] http://woodsure.co.uk
[36] Unlike geothermal systems which extract geothermal heat from ground and usually at a much greater depth.

source heat pumps are particularly well suited to buildings which are well insulated with low heat loss and good thermal efficiency, and require a low temperature heat distribution system such as under-floor heating to work efficiently.

ASHPs are suitable for single residential developments, and can also be installed to provide community heating in low and high rise buildings. ASHP can also be used to provide cooling, especially in buildings with no openable windows.

Air source heat pumps are powered by electricity, and can be combined with other forms of renewable energy including PV and solar thermal.

A key issue is ensuring that heat pumps are correctly sized and controlled. To achieve their full potential heat pumps are operated differently to a gas boiler, therefore it is essential that users are provided with appropriate guidance and advice on how to use the system to achieve maximum efficiency and savings.

In energy strategies, the use of heat pumps is treated as a **renewable energy** measure.

Solar thermal panels

Solar thermal panels provide domestic hot water. In the UK a good quality system will provide 50-60% of the annual hot water demand. They can be combined with other systems (e.g. biomass). Maintenance is generally very low (typically requiring the anti-freeze to be topped up and the pump serviced every 3 to 7 years).

Solar thermal systems are suitable for unshaded roofs which face between south west and south east with a roof pitch of between 30 and 40 degrees. On large developments, the overall layout and orientation should be considered at the earliest stage to maximise opportunities, and reduce pipe runs between solar collectors and hot water storage.

In energy strategies, the use of solar thermal panels is treated as a **renewable energy** measure.

Photovoltaic panels

These generate electricity from the sun, and ideally need to be orientated between south west and south east – because they use light rather than heat they need to be clear of overshadowing from buildings or trees on any part of the system. PV on northerly facing roofs will not be supported.

PV systems are suitable at all scales and for all building types, but are especially useful for buildings where there is high electricity use, even if heating is reduced as far as possible – for example offices and schools.

They can be installed on facades and *brise soleil* (louvres) as well as roofs. PV cells also be integrated into translucent glass panels which can be used in the external building fabric. Fixing systems are available for virtually any roof type. For new build, solar PV can be seamlessly integrated into the roof fabric to improve the product appearance and reduce the cost of roof tiles.

Operation and maintenance costs are low. The panels should come with a 25 year performance warranty. Most inverters now come with a 10 year warranty as standard, though it is recommended that a simple metering system is installed to monitor changing performance patterns. Panels may require periodic cleaning, at 1 to 5 year intervals depending on location.

When designing a building, applicants are encouraged to consider whether opportunities for PV can be maximised through the layout and orientation of buildings.

PV systems are very sensitive to shading. A shadow cast on even a small part of the array can reduce the power output of the whole system, and the total amount of energy generated. When calculating the annual electricity generated for a PV system, applicants should apply the accepted industry standard to calculate the annual yield and account for any shading of the system- the standard estimation method, as set out in the MCS Guide to the Installation of Photovoltaic Systems.

When installed they should be provided with prominent signage and readouts.

In energy strategies, the use of photovoltaic panels is treated as a **renewable energy** measure.

Wind

Generally, wind turbines and building integrated wind turbines are not appropriate for urban areas. This is because wind speeds tend to be lower in built up areas and buildings, trees and other obstructions increase the variability in the flow and direction of the wind which reduces the efficiency and ‘yield’ of the turbine.

Where considered viable, potential noise and flicker need to be considered, and impact on wildlife.

In energy strategies, the use of wind turbines is treated as a **renewable energy** measure.

Appendix 4: Model conditions and advisory notes that may be used to secure compliance with aspects of policies BCS13-16

Other conditions may also be used as appropriate to deal with individual cases.

Sustainable Urban Drainage System (SUDS)

The development hereby approved shall not commence until a Sustainable Drainage Strategy and associated detailed design, management and maintenance plan of surface water drainage for the site using SuDS methods has been submitted to and approved in writing by the Local Planning Authority. The approved drainage system shall be implemented in accordance with the approved Sustainable Drainage Strategy prior to the use of the building commencing and maintained thereafter for the lifetime of the development.

Reason: To prevent the increased risk of flooding by ensuring the provision of a satisfactory means of surface water disposal is incorporated into the design and the build and that the principles of sustainable drainage are incorporated into this proposal and maintained for the lifetime of the proposal.

Energy and Sustainability in accordance with statement

The development hereby approved shall incorporate the energy efficiency measures, renewable energy, sustainable design principles and climate change adaptation measures into the design and construction of the development in full accordance with the energy statement (title, author, date) and sustainability statement (title, author, date) prior to occupation. A total [state total]% reduction in carbon dioxide emissions beyond Part L 2013 Building Regulations in line with the energy hierarchy shall be achieved, and a 20% reduction in carbon dioxide emissions below residual emissions through renewable technologies shall be achieved

Reason: To ensure the development incorporates measures to minimise the effects of, and can adapt to a changing climate in accordance with policies BCS13 (Climate Change), BC14 (sustainable energy), BCS15 (Sustainable design and construction), DM29 (Design of new buildings), BCAP20 (Sustainable design standards), BCAP21 (connection to heat networks).

Renewable energy – where further detail is required

Prior to implementation, details of the proposed PV system including location, dimensions, design/ technical specification together with calculation of annual energy generation (kWh/annum) and associated reduction in residual CO_2 emissions shall be provided within the Energy Statement.

Prior to occupation the following information shall be provided:

- Evidence of the PV system as installed including exact location, technical specification and projected annual energy yield (kWh/year) e.g. a copy of the MCS installer's certificate.
- A calculation showing that the projected annual yield of the installed system is sufficient to reduce residual CO_2 emissions by X%/the percentage shown in the approved Energy Statement.

Reason: To ensure that the development contributes to mitigating and adapting to climate change and to meeting targets to reduce carbon dioxide emissions

Advisory note

The projected annual yield and technical details of the installed system will be provided by the Micro-generation Certification Scheme (MCS) approved installer.

The impact of shading on the annual yield of the installed PV system (the Shading Factor) should be calculated by an MCS approved installer using the Standard Estimation Method presented in the MCS guidance.

BREEAM

Prior to occupation the following information shall be submitted to the local planning authority and approved in writing:

The full BREEAM Post Construction report prepared by the registered BREEAM assessor together with confirmation that this has been submitted to the BRE (including dates/ receipt confirmation email from the BRE) shall be submitted

A letter of confirmation from the BREEAM assessor confirming any known reasons why the building may not be able to achieve the credits and rating indicated in the final BREEAM post construction report.

Within 3 months of first occupation the final post construction BREEAM certificate(s) indicating that a BREEAM 'Excellent' rating has been achieved shall be submitted to the local planning authority and approved in writing.

Reason: To ensure the development is built in a sustainable manner in accordance with BCS15 (Sustainable design and construction), and BCAP20 (Sustainable design standards).

BREEAM communities

Prior to occupation the following information shall be submitted to the local planning authority and approved in writing:

- The full BREEAM communities Post Construction report prepared by the registered BREEAM assessor together with confirmation that this has been submitted to the BRE (including dates/ receipt confirmation email from the BRE) shall be submitted
- A letter of confirmation from the BREEAM assessor confirming any known reasons why the building may not be able to achieve the credits and rating indicated in the final BREEAM communities post construction report.

Within 3 months of first occupation the final post construction BREEAM communities certificate(s) indicating that a BREEAM [‘Excellent’/other] rating has been achieved shall be submitted to the local planning authority and approved in writing.

Reason: To ensure the development is built in a sustainable manner in accordance with BCS15 (Sustainable design and construction), and BCAP20 (Sustainable design standards).