

Sheffield Development Framework **Climate Change and Design** Supplementary Planning Document and Practice Guide

Adopted March 2011



Sheffield *where everyone matters*



Cover Pictures from left to right:

Green roof, West One, Sheffield
(Courtesy of The Green Roof Centre)

Solar panels, Furnival Building, Sheffield Hallam University
(Courtesy of Solar UK)

Green homes, Norfolk Park, Sheffield

Brise soleil, Information Commons, The University of Sheffield
(Courtesy of The University of Sheffield)

Biomass boiler, Sheffield

Sheffield Development Framework

Climate Change and Design

Supplementary Planning Document and Practice Guide

Adopted by the City Council March 2011

*Development Services
Sheffield City Council
Howden House
1 Union Street
Sheffield
S1 2SH*

Availability of this document

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- telephone (0114 205 3075, or
- email sdf@sheffield.gov.uk
- write to:

SDF Team
Development Services
Sheffield City Council
Howden House
1 Union Street
Sheffield
S1 2SH

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SUPPLEMENTARY PLANNING DOCUMENT

1 PURPOSE AND SCOPE OF SUPPLEMENTARY PLANNING DOCUMENTS (SPDs)

- 1.1 A Supplementary Planning Document (SPD) is a part of a local planning authority's Local Development Framework – in Sheffield's case, the Sheffield Development Framework (SDF).
- 1.2 Local Development Frameworks contain two types of document, Development Plan Documents (DPDs) and Supplementary Planning Documents (SPDs).
- 1.3 Development Plan Documents contain the principal spatial and other planning policies. They are subject to independent examination by a Planning Inspector and they carry statutory weight. In the case of the Sheffield Development Framework the DPDs are:
 - the Core Strategy (adopted 4 March 2009)
 - the forthcoming City Policies and Sites document.
- 1.4 Supplementary Planning Documents (SPDs) provide greater detail on the policies in the DPDs where it does not need to go through the statutory examination process. They are, therefore, non-statutory documents. SPDs should always be read alongside the Development Plan Documents that they supplement. Although they do not carry the statutory status of Development Plan Documents, they are material considerations in making planning decisions. They must also be subject to community involvement as specified in legislation.
- 1.5 A Background Report on the guidelines in this SPD has also been produced, providing further justification and explanation for the guidelines.

2 WHAT THE DEVELOPMENT PLAN DOCUMENTS SAY

- 2.1** The issues of climate change mitigation and adaptation, renewable energy and carbon reduction, and flooding are covered in the Core Strategy in Chapter 11 (Global Environment and Natural Resources).
- 2.2** Policy CS63, Responses to Climate Change, covers general principles for mitigating and adapting to climate change. These include locating development sustainably, designing developments to be energy efficient, and locating and designing development to eliminate unacceptable flood risk.
- 2.3** Policy CS64, Climate Change, Resources and Sustainable Design of Developments, sets out the policy requirements for ensuring buildings are as sustainable as possible. It covers the reduction of emissions from new developments in the first section, and the sustainable use of resources in new developments in the second section. The supporting text to policy CS64 sets out the requirements for all new developments of 5 or more dwellings (including apartments) to achieve Code for Sustainable Homes Level 3 (or equivalent) as a minimum, and all non-residential developments over 500sqm to achieve a BREEAM (Building Research Establishment Environmental Assessment Method) rating of very good (or equivalent) as a minimum.
- 2.4** Renewable Energy and Carbon Reduction are covered under policy CS65, which sets targets for renewable energy capacity in Sheffield for 2010 (in excess of 12MW) and 2021 (in excess of 60MW). The policy also sets out potential locations for the development of larger-scale wind generation, and encourages connection to the City Centre District Heating Scheme, and shared energy schemes.
- 2.5** Policy CS65 also sets a requirement for significant new-build developments and conversions (size thresholds as in paragraph 2.3) to provide a minimum of 10% of their predicted energy needs from decentralised renewable or low carbon energy, and to generate further renewable or low carbon energy or incorporate design measures sufficient to reduce the development's overall predicted carbon dioxide emissions by 20%. This carbon reduction requirement can include the energy generated to satisfy the 10% energy requirement. These requirements must be met unless it can be shown not to be feasible and viable. Where it is not feasible to meet the requirements, a contribution towards an off-site carbon reduction scheme may be acceptable.
- 2.6** Flooding is covered in policy CS67 Flood Risk Management. The first part of the policy deals with reducing the extent and impact of flooding, and the second part covers overriding cases for developing in a zone with a high probability of flooding. Key parts of the policy include requiring the use of Sustainable Drainage Systems or sustainable drainage techniques on all sites where feasible and practicable, ensuring safe access to and from an area with a low probability of flooding, and not permitting housing in areas with a high probability of flooding before 2016/17.

3 WHY MORE GUIDANCE IS NEEDED

- 3.1** The policies discussed in section 2 cover some issues which are relatively new to planning. This SPD is needed to help applicants understand what they must achieve to obtain planning permission. This actually involves only a few more specific guidelines, expanding upon particular parts of the policies and supporting text:
- green roofs (CS64/CS67)
 - reducing carbon emissions (CS65)
 - the definition of a 'conversion' (CS64 and CS65)
 - decommissioning renewable/low carbon energy generating infrastructure (CS65)
- 3.2** However, what many developers will need to satisfy the Core Strategy on design for sustainability is not more policy guidelines but information about the range of ways in which they could satisfy the targets in the policies. The choice of means of satisfying the targets will be a matter for each developer and the Council does not wish to prescribe any particular approach beyond what is already required by the Core Strategy. So a Practice Guide on Climate Change and Design has been prepared, which provides further guidance on various ways of achieving the requirements of the related Core Strategy policies.

4 GUIDELINE CC1 Green Roofs

Introduction

- 4.1** Core Strategy policy CS64 deals specifically with climate change, resources and sustainable design. Paragraph 11.8 of the supporting text to this policy refers to the contribution of green roofs as a method of reducing surface water run-off, and highlights the link with policy CS67, which deals with flood risk management, including sustainable drainage techniques.
- 4.2** Green roofs have a number of benefits, which support various Core Strategy policies, as follows. They can reduce and attenuate surface water run-off (see policy CS67(a)), help to improve air quality by absorbing particulate matter (policy CS66), and improve biodiversity by creating habitats (policy CS63(j)). Green roofs can also help to minimise the relative heating of urban areas (policy CS63(k)), and can reduce the need for heating and cooling within buildings, therefore reducing carbon emissions (policies CS63(d) and CS64). The topography of Sheffield means that roofs in the valleys are highly visible, and well designed and constructed green roofs can make a striking visual improvement, helping to strengthen Sheffield's unique greenness (policy CS74).
- 4.3** There are also two relevant objectives within the Core Strategy. S11.1 states 'Developments laid out, designed and constructed to minimise carbon emissions and other harmful impacts on the climate and local environment, to reduce obsolescence, to use energy efficiently, and to work with natural processes throughout the lifetime of the building'. The inclusion of green roofs on new developments helps to meet this objective. S11.3 states 'The impact of flooding decreased by reducing surface water run-off; not developing in locations where flood risk is unacceptable, but where development cannot be avoided and the probability of flooding is high, implementing appropriate mitigation measures'. Green roofs can help to achieve this objective, by reducing surface water run-off.
- 4.4** Sheffield has a strong track record of securing green roofs and has the highest number of green roofs of any UK city except for London. To date, planning permission has been granted for approximately 100 developments which include green roofs; approximately 40 of these have been completed and several others are under construction.
- 4.5** Seven significant green roofs have been constructed within 1 mile of the City Centre, and planning permission has been granted for several more including developments on The Moor.
- 4.6** Notable in Sheffield is the development of green roofs which have high wildlife value, and the green roof on Sharrow School has been designated as a Local Nature Reserve by Natural England. A number of other green roofs have been designed specifically to reduce run-off from the site and some to provide additional space for building users.
- 4.7** Developments of many different types have been constructed with green roofs, including individual houses, apartment buildings, offices, educational buildings, a warehouse, community buildings and a large supermarket.

Guideline CC1

Provided they are compatible with other design and conservation considerations, and where viable, green roofs will be required on all larger developments, and encouraged on all other developments. The green roof should cover at least 80% of the total roof area.

Definitions

'Green roofs' – roofs on which plants are grown. Modern green roofs involve re-creating natural environments using a multi-layered system, and can take various forms.

'Larger developments' – 10 or more dwellings, or more than 1,000 sq m gross internal floorspace.

Reasons for the Guideline

- 4.8 Sheffield is an Air Quality Management Area, and green roofs will help improve air quality, by reducing the amount of airborne particulate materials.
- 4.9 Areas of the city are prone to flooding, and this problem is exacerbated by the increasing quantity of hard surfacing. In addition, climate change is anticipated to make the problem worse. Green roofs will reduce the amount of surface water run-off and delay the time over which it occurs.
- 4.10 Green roofs will help to offset the effect of development, providing alternative areas of habitat, increasing the ability of wildlife to survive within the urban area. Brownfield land is amongst the most ecologically diverse land in Sheffield but the amount of brownfield land is decreasing as development takes place. There is also a net loss of other features of wildlife value within the urban area. As the effects of climate change become more apparent, the character of habitat areas will change, placing wildlife under further stress and green roofs will help to compensate for this.
- 4.11 Sheffield is known to be exhibiting the effects of an urban heat island, where the difference in temperature between the urban area and the surrounding countryside is growing. Health problems and increased energy consumption from air conditioning are predicted as a result. Green roofs significantly reduce summer air temperatures at roof level and keep buildings cooler.
- 4.12 In the most densely developed areas of Sheffield, up to 47% of land is covered by roofs. Significant improvement in visual quality for both residents and workers will result from the use of green roofs as an essential compliment to the increasingly high standards which are now expected in other aspects of urban design.
- 4.13 Requiring green roofs on large developments will increase the environmental and ecological value of the built environment. Green roofs on large and medium developments could also potentially be used for recreation purposes, thus increasing the amount of open space in the city. However, it is important that the purpose of the green roof is clear, to avoid conflicts between, for instance, biodiversity and recreational uses.

- 4.14** The guideline provides for instances where green roofs are not compatible with other design or conservation considerations, acknowledging that they may not be appropriate on every development over the size threshold. Although a green roof can technically be installed on any pitch of roof, it becomes more difficult and expensive the steeper the pitch.
- 4.15** The size threshold for this guideline is in line with the threshold for major developments, as defined in the Development Management Procedure Order (2010). Green roofs on developments over this size threshold are more likely to be feasible and viable than on smaller schemes with less roof area. It is accepted that incorporating green roofs on individual houses may be less feasible than on a building containing apartments, but the use of green roofs should still be considered for developments of individual houses.
- 4.16** It would be unreasonable to require 100% green roof coverage, as roofs often have areas that would be impractical to cover, such as plant or vents. 80% allows for these areas, and ensures that green roof coverage is not merely confined to a small area of the roof. Where it is not possible to achieve 80% coverage for financial or technical reasons, developers will be encouraged to consider a smaller amount if appropriate.

Making it happen

- 4.17** The main method of achieving green roofs on new developments will be through the process of development management. It is possible that there will be instances where a developer can prove it is not financially viable to provide a green roof. In such a case, the Council would need to see evidence to prove this.
- 4.18** Green roofs can last double the length of time of a normal roof, but they do need some maintenance. Provision for maintenance should be made using a planning condition, as part of the development management process.
- 4.19** Although green roofs result in additional construction cost, this will in most cases be more than offset when 'whole life costs' are taken into account, due to reduced need for drainage infrastructure, reduced energy consumption for cooling and extended roof life.
- 4.20** In instances where the design of a building means it is not physically possible to incorporate both a green roof and roof-mounted renewable/low carbon energy, the priority will be to ensure the requirements of Core Strategy policies CS64 and CS65 are met. However, other options for achieving the policy requirements and incorporating a green roof should be explored.

Other information

Core Strategy, Sheffield City Council, March 2009.

More information and guidance on green roofs can be found at www.livingroofs.org.

The Council's Sustainability Toolkit also contains guidance on green roofs, which can be found at <http://www.sheffield.gov.uk/in-your-area/housing-services/environmental-sustainability/sustainable-housing/green-roofs>.

Case Studies

For case studies and information about green roofs in Sheffield, go to the Green Roof Centre's website - <http://www.thegreenroofcentre.co.uk/pages/casestudies.html>

The 2011 Code of Best Practice - http://www.thegreenroofcentre.co.uk/green_roof_code

5 GUIDELINE CC2 Reducing Carbon Emissions

Introduction

- 5.1** This guideline is needed to help with the implementation of policy CS65 (see paragraphs 2.4 and 2.5), following changes to the Building Regulations Part L (Conservation of Fuel and Power) from October 2010, to tighten up the carbon reduction requirements. The revisions place much higher standards on development, roughly averaging a 25% reduction in carbon emissions beyond the requirement in the 2006 Building Regulations, across different types of development.
- 5.2** Subparagraph (b) of policy CS65 requires a 20% carbon reduction for developments of 5 or more dwellings, or more than 500 sq m gross internal floorspace. However, requiring a 20% reduction beyond that required by the new Building Regulations Part L would not normally be viable in the current economic climate for the majority of developments. Compliance with part (b) of Policy CS65 will, therefore, not be required for the duration of this Supplementary Planning Document.
- 5.3** Where it is not feasible to achieve part (a) of the policy, and additional carbon reductions will be provided instead, evidence will be required to show this. The amount of energy that would be needed to satisfy part (a) if it was feasible to do so will need to be converted into carbon emissions, to show how the Building Regulations requirement has been exceeded.
- 5.4** Towards the end of 2011, a review will be undertaken to determine whether it is appropriate to raise the standards beyond the Buildings Regulations through the Core Strategy policy, and if so, by how much. This will take account of any changes in the economic climate and in the costs of the technology. This means that, although the application of the 20% figure is relaxed in the short-term on viability grounds, the policy is not abandoned.
- 5.5** In terms of carbon reduction, the 2010 Building Regulations requirements on average equate to a slightly higher level than would have been achieved by the previous 2006 Building Regulations plus the additional 20% reduction required by CS65 (b). Therefore, developments will be performing slightly better in terms of carbon reductions under the 2010 Building Regulations than with the previous approach.
- 5.6** Part (a) of policy CS65 relates to predicted energy needs, and will still be applied as set out in the policy. However, further provision is needed where this is not feasible.
- 5.7** In addition to carbon reduction, part (a) of the policy requires that significant developments provide a minimum of 10% of their predicted energy needs from decentralised renewable or low carbon energy unless it is not feasible or viable, and any developments exceeding this 10% requirement will be particularly welcomed.
- 5.8** The requirement for a minimum of 10% decentralised renewable or low carbon energy is currently fixed in the Core Strategy, but a review of the document could begin in 2013, which would provide an opportunity to increase the requirement as appropriate.
- 5.9** Policy CS65 supports the Council's drive to increase the amount of decentralised energy generation in the city, by encouraging connection to the City Centre District

Heating Scheme, shared energy schemes in new developments, and by setting a specific requirement for significant developments to generate a proportion of their own energy needs from renewable or low carbon sources.

Guideline CC2

Where it is not feasible to achieve the requirements of part (a) of Core Strategy policy CS65, and a contribution towards an off-site carbon reduction scheme would not be possible, an equivalent reduction in carbon emissions should be achieved by improving on the requirements of the Building Regulations Part L (Conservation of Fuel and Power), unless it is not viable to do so.

Definitions

'Not feasible' – not physically possible on the site.

'Not viable' – not financially possible.

Reasons for the Guideline

- 5.10** There is a balance to be struck between ensuring carbon is reduced, and not placing excessive demands on developers. This is already recognised in policy CS65, which relaxes its targets where they can be shown not to be feasible and viable. Viability would become a very significant issue if further reductions are sought.
- 5.11** Part (a) of policy CS65 follows from national policy in encouraging decentralised and renewable or low-carbon energy. The policy also allows for a contribution towards off-site schemes where it is not possible to incorporate it into the development. However, the scope for spending such money on schemes that would genuinely add to the generation of low-carbon energy (and not simply subsidise something that would happen anyway) may sometimes be limited. In such cases the development should still contribute to an equivalent reduction in carbon emissions but through design measures on-site.

Making it happen

- 5.12** This guideline will be implemented through the development management process. Where carbon reductions beyond those required by the Building Regulations are proposed, evidence will be required to show this.
- 5.13** If the review shows that it is viable to require carbon reductions beyond the Building Regulations standards, Guideline DES2 will be amended to reflect this. A mechanism may be introduced to require developer contributions where the requirements cannot feasibly be met on-site, but it is viable to provide a contribution towards an off-site carbon reduction scheme (see Policy CS65).

Other information

Planning Policy Statement: Planning and Climate Change, Supplement to Planning Policy Statement 1, Communities and Local Government, 2007.

Core Strategy, Sheffield City Council, March 2009.

Additional notes

Note that 10% of predicted energy needs is not necessarily the same as half of 20% of predicted carbon emissions. This is because they are measuring different things; kWh/year, and kg/CO₂/year or tonnes/CO₂/year.

6 GUIDELINE CC3 The Definition of a ‘Conversion’

Introduction

- 6.1** Policy CS64 applies to new developments and ‘conversions’, but the term ‘conversions’ is not defined. Paragraph 11.12 of the supporting text to policy CS65 sets out the types of developments that have to comply with parts (a) and (b) of the policy itself, and also applies to both new-build developments and ‘conversions’. The lack of definition can lead to uncertainty about the implementation of both of these policies. Therefore the following guideline is needed to define the term ‘conversions’.

Guideline CC3

For the purposes of interpreting policies CS64 and CS65, a ‘conversion’ is any change to a building involving significant physical works to the fabric of the building such as the removal or reinstatement of walls or the creation of additional floorspace.

Reasons for the Guideline

- 6.2** In some instances, the purpose a building is used for can change, without needing any significant physical changes to take place. This would be a change of use, but not a conversion. The requirements of CS64 and CS65 would not need to be met in such situations.
- 6.3** The above definition also recognises that a conversion is not necessarily a change of use. For instance, it includes the subdivision of a residential property into self-contained dwellings, even though this is within the same use class.
- 6.4** Although the guideline provides assistance in determining whether a development constitutes a conversion, it is not possible to set out a precise rule that can be followed. Therefore, all proposals for developments that are not new-build will need to be considered to determine whether they are conversions, for the purposes of implementing CS64 and CS65.

Making it happen

- 6.5** This guideline is not specifically about making something happen; its purpose is to assist with the implementation of CS65 and to provide clarity for applicants and officers on what the term ‘conversions’ means.
- 6.6** When taking a decision regarding the significance of the physical works, regard must be given to whether it will be possible for the standards in Policy CS65 to be achieved as part of the works.

Other information

Core Strategy, Sheffield City Council, March 2009.

Practical examples

Examples of conversions:

Warehouse/mill building (B2) to residential (C3 or C4)
Large single dwelling (C3) to flats (C3 or C4)
Barn/farm building (sui generis) to residential (C3 or C4)

Examples of changes of use unlikely to include significant physical works:

Shop (A1) to estate agent (A2)
Shop (A1) to restaurant/café (A3)
Restaurant/café (A3) to drinking establishment (A4)

7 GUIDELINE CC4 Decommissioning Renewable/Low carbon Energy Infrastructure

Introduction

- 7.1 It is important to consider the future of a site used for renewable or low carbon energy generation beyond the useful life of the installation. If the installation is no longer functioning, it needs to be removed and the site restored. Decommissioning generally relates to wind turbines, but it can be an issue for other types of renewable or low-carbon energy generation, such as biomass plants. Planning Policy Statement 25: Renewable Energy notes that the visual impact of wind turbines can be temporary, if provision is made for the future decommissioning of the turbines.

Guideline CC4

Where permission is granted for larger-scale renewable or low carbon energy generating infrastructure, provision must be made for the removal of the facilities and reinstatement of the site if or when it is decommissioned.

Strategies for decommissioning must be submitted at the planning application stage, and should take account of any proposed after-uses of the site. Issues to be addressed include restorative measures, the removal of ancillary infrastructure, and landscaping. It may be appropriate to allow some parts of the infrastructure to remain as part of the strategy.

Definitions

'Decommissioning' – the process of removing renewable or low carbon energy generating infrastructure, and restoring and reinstating the site.

'Larger-scale renewable or low-carbon energy generating infrastructure' – stand-alone, grid-connected developments generating energy from renewable or low carbon sources.

'Ancillary infrastructure' – additional equipment such as sub-stations, access roads and anemometry masts.

Reasons for the Guideline

- 7.2 Decommissioning needs to be addressed at the planning application stage, to ensure a satisfactory strategy can be achieved. If any after-uses are proposed for the site, it is important to consider them to ensure the decommissioning supports the uses.
- 7.3 It is also important that developers show that funding will be available for decommissioning, to ensure that it will be possible when the project ceases. The components of a renewable/low carbon energy generating system can have scrap value, which can help to cover the costs of restoring a site.

- 7.4** Some parts of the infrastructure may be retained after decommissioning, for instance leaving access tracks as part of a walking route. Infrastructure may also be left if doing so would minimise disturbance to the site, such as leaving and covering the concrete base.

Making it happen

- 7.5** A strategy for decommissioning will be secured through the process of development management, and must be submitted with the planning application. A planning condition will be used to secure the strategy. The implementation of the strategy will be triggered by the expiry of the consent or in the event of the project ceasing to operate for a specified period. The Council will monitor applications for large-scale renewable/low carbon energy installations to ensure it is aware of expired consents or projects ceasing to operate.
- 7.6** The specified period after which decommissioning must commence will depend on the type and scale of installation, and possibly its location. The period will need to be agreed with the local planning authority for each application.
- 7.7** Developers must demonstrate that funding to implement the decommissioning strategy will be available when required. The decommissioning strategy must be linked to the development rather than the developer, so that if the ownership changes during the life of the project, the new owner will still be responsible for decommissioning.

Other information

Planning Policy Statement 22: Renewable Energy, Office of the Deputy Prime Minister, 2004.

Core Strategy, Sheffield City Council, March 2009.

PRACTICE GUIDE

1 Introduction

- 1.1** This practice guide supports the implementation of Core Strategy policies CS63-67, and Guidelines CC1 and CC2 in the Climate Change and Design Supplementary Planning Document. These policies and guidelines relate to environmental sustainability. The purpose of the guide is to provide information and advice on ways to achieve the requirements of the policies and guidelines, and design environmentally sustainable buildings. The practice guide covers a number of environmental sustainability topics and issues which have arisen since the adoption of the Core Strategy.
- 1.2** The practice guide follows the structure of the Core Strategy policies and is designed to be read alongside them. It contains a mixture of advice, case studies and references. It is issued only to help developers needing more information about options for satisfying the policies, not as a set of requirements.
- 1.3** It is important to note that the policies are interrelated, and should be considered together as part of a holistic approach to designing for environmental sustainability.
- 1.4** Guidance on the wider principles of sustainable development, including transport and the economy, can be found on the Council's website, at <http://www.sheffield.gov.uk/sustainability>.

2 CS63 Responses to Climate Change

The policy

Policy CS63

Action to reduce the city's impact on climate change will include:

- a. giving priority to development in the City Centre and other areas that are well served by sustainable forms of transport; and
- b. promoting higher densities of development in locations that are well served by sustainable forms of transport; and
- c. promoting routes that encourage walking, cycling and the use of public transport; and
- d. designing development to increase energy efficiency and reduce energy consumption and carbon emissions; and
- e. promoting developments that generate renewable energy; and
- f. reducing the volume of waste disposed of in landfill sites and generating energy from waste.

Action to adapt to expected climate change will include:

- g. locating and designing development to eliminate unacceptable flood risk
- h. giving preference to development of previously developed land where this is sustainably located
- i. adopting sustainable drainage systems
- j. encouraging environments that promote biodiversity, including the city's Green Network
- k. designing development to minimise the relative heating of urban areas.

- 2.1** The policy distinguishes between reducing the city's impact on climate change (mitigation) and adaptation, and it is important to consider both when designing for environmental sustainability. Mitigation involves reducing the emission of greenhouse gases, notably carbon dioxide, and adaptation ensures that buildings can still function in the future when the climate is expected to be significantly different.

The Energy Hierarchy

- 2.2** Parts (d) and (e) of the policy relate to energy efficiency and energy generation. These are key issues to be considered when designing an environmentally sustainable building. When thinking about designing an energy strategy for a building or scheme, it is suggested that developers follow the principles of the Energy Hierarchy, as shown in Figure 1:

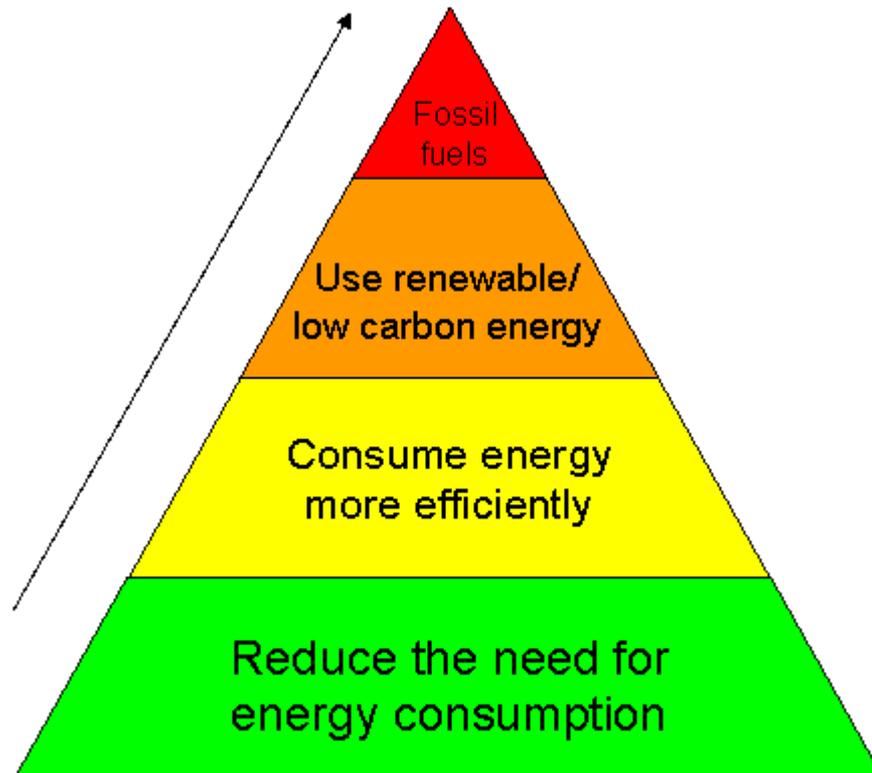


Figure 1. The Energy Hierarchy

- 2.3** An energy strategy should follow the hierarchy from the bottom up. The first part is addressed by how a building is located, oriented or designed to reduce energy consumption. This could include using natural light and ventilation, or insulating a building well to minimise heat loss. Once the energy consumption has been reduced, the remaining energy consumption should be designed to be as efficient as possible. This might include designing control and maintenance systems to optimise efficient energy consumption, or installing energy efficient light fittings.
- 2.4** The last two (least preferred) parts of the hierarchy address the generation of energy, prioritising the use of renewable or low carbon energy, with fossil fuels the last option to be considered.
- 2.5** The first two sections of the Energy Hierarchy relate to parts (a) and (b) of policy CS64, which are concerned with energy efficiency and making the best use of natural resources such as solar energy, natural ventilation and natural light. Part (b) of policy CS65 requires a reduction in carbon dioxide emissions, and is related to the first part of the energy hierarchy. Where energy consumption is reduced, carbon dioxide emissions are also reduced.
- 2.6** The third section relates to part (a) of policy CS65, which sets a requirement for significant developments to produce 10% of their predicted energy needs from renewable or low carbon sources.

Climate change adaptation

2.7 Sheffield's Local Climate Impact Profile (2009) assessed changes to Sheffield's climate over the last 10 years, and considered likely future impacts. Some of the key trends from the last 10 years were:

- Increasing average annual temperatures – the warmest years, warmest month and highest temperature have all been recorded since 1990
- An increase in the number of days when temperatures exceed 30°C
- Fewer days of lying snow
- Reducing differences between the seasons.

2.8 Figure 2 shows the mean annual temperatures (30 year averages) recorded at Weston Park weather station.

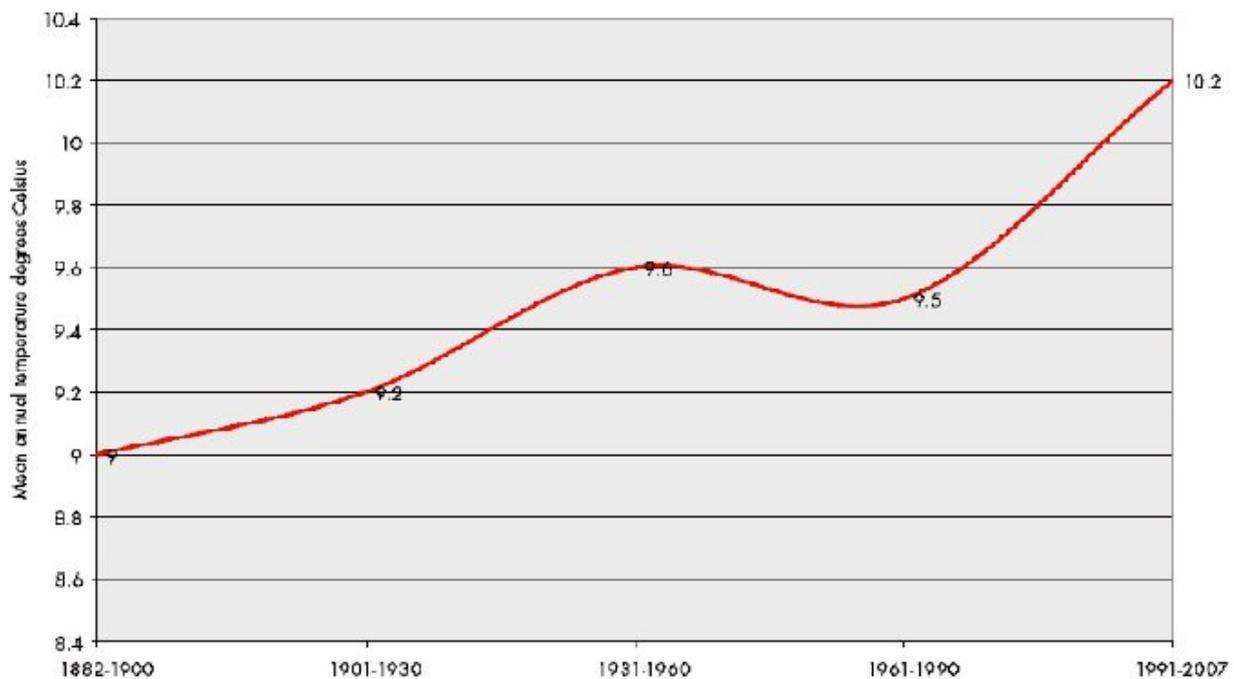


Figure 2 . Mean annual temperatures (30 year averages) at Weston Park weather station (Source: Sheffield's Local Climate Impact Profile, 2009)

2.9 The Yorkshire and Humber Regional Adaptation Study: Weathering the Storm (2009) sets out the key changes that may occur in the region by 2050. These include:

- Annual average daily temperatures rising, by almost 2°C.
- Extreme hot temperatures increasing, with summer temperatures more regularly reaching 34°C.
- A reduction in annual rainfall of up to 6%, less in upland areas.
- Increased winter rainfall and decreased summer rainfall.
- Reductions in the number of days of frost and snow.

- 2.10** It is important to plan developments with these changes to the climate in mind, to ensure that they continue to function in the future. The first issue to consider when designing for adaptation is the scale of the development. For the purposes of this document, developments are considered at neighbourhood and building scale. Guidance is given on designing for increased temperatures, and increased rainfall and storm events, as these impacts are most likely to require specific design solutions.

Neighbourhood scale

- 2.11** A neighbourhood-scale development might include a mix of uses such as housing, shops, and schools. In designing a neighbourhood, it is important to consider the spaces between buildings and the areas of public realm.

Designing for increased temperatures

The Urban Heat Island (UHI) Effect

When designing for increasing temperatures, it is important to understand the urban heat island (UHI) effect (see policy CS63, part (k)).

A UHI occurs where an urban area is significantly warmer than the rural area around it, sometimes by up to 4-6°C. In Sheffield, the difference is currently around 2°C. This is caused by:

- Buildings and roads acting like giant storage heaters, absorbing heat during the day and releasing it at night.
- Decreased plant and tree cover leading to decreased evaporation (evaporation uses heat so removes it from the air), and decreased reflection of heat.
- The blockage of wind by buildings.
- Human activity, including vehicles and industry.
- Air pollution, which can cause a localised greenhouse effect.

UHIs are **not** a direct result of climate change, but that the intensity and frequency of UHI events may increase as the climate changes.

- 2.12** Increased temperatures as a result of climate change and the UHI could have a number of impacts for Sheffield:
- Increased magnitude and duration of heat waves, leading to uncomfortable living conditions and potentially increased mortality.
 - Increased energy requirements for cooling.
 - Changes to local wind patterns, leading to wind and fog.
- 2.13** Areas of public realm and spaces between buildings provide an opportunity to help manage the effects of increasing temperatures, and provide cooling benefits.
- Green infrastructure (see Core Strategy policy CS73, The Strategic Green Network)

- Urban green spaces can cool air temperatures by as much as 1 to 2 degrees Celsius⁽¹⁾.
- Trees may be sited in open spaces to create areas of shading to provide cooler places on hot, sunny days.
- Trees can also be sited in front of buildings to provide cooling inside them where appropriate, particularly on glazed south elevations. Deciduous trees are best for this, as they allow increased light and some heat in during winter.
- Planting trees can provide further cooling benefits through evapotranspiration, which occurs when plants secrete water out through their leaves, which draws heat as it evaporates, cooling the air around the plants. One single tree with a crown of 30ft can evapotranspire up to 40 litres of water a day, equivalent to removing all the heat produced by a small space heater in four hours⁽²⁾.
- Low water-use planting works best as it reduces the need for watering.

All the above measures also have benefits for the city's biodiversity, and help to improve air quality.

- Water
 - Designing in water features such as ponds, fountains and roadside swales can help to cool urban areas.
- Design and materials
 - Buildings and streets may be orientated to ensure air flow and reduce excessive solar gain in buildings.
 - Light coloured materials that reflect rather than absorb heat may be chosen for areas of public realm, although glare should be avoided.

Designing for increased rainfall, flooding events and storms

2.14 Climate change is likely to lead to more frequent heavy rainfall and flooding. This is reflected in the requirements of Core Strategy Policy CS67, Flood Risk Management. Design features that should be considered are:

- Sustainable Drainage Systems (SUDS) – see CS67(b)
 - Well-designed SUDS provide a way of managing surface water run-off, reducing and slowing down the flow of water.
 - They can take many forms, but common techniques include permeable paving, green roofs, swales, soakaways and ponds.
- For more detail, see the chapter on Policy CS67 Flood Risk Management (p. 43).

1 Natural England (2009), No Charge? Valuing the Natural Environment, available at <http://naturalengland.etraderstores.com/NaturalEnglandShop/NE220>

2 Heat Island Group (1999), <http://eetd.lbl.gov/HeatIsland/Vegetation/Evapotranspiration.html>

- Using open spaces for flood storage – see CS67(f)-(i)
 - Open spaces such as parks or shared spaces within a development can be designed to store water in times of heavy rainfall and release it slowly to reduce the risk of flooding downstream. An example of this is the grass arena at Manor Fields Park, which doubles as a storage area for water in heavy rainfall.
- Avoiding flooding – (a requirement of national policy, which underpins policy CS67)
 - Locating development sequentially, directing it towards areas with a lower probability of flooding first.

Building scale

2.15 Developments at a building scale, such as dwellings or commercial units, can be made resilient to a range of different climate conditions.

Designing for increased temperatures

2.16 Although air conditioning may seem an obvious solution to keeping buildings cool, it increases energy consumption and therefore carbon emissions, making buildings more expensive to run and contributing to climate change. Also, air conditioning can heat the areas around buildings, contributing to the Urban Heat Island effect.

2.17 To ensure that buildings do not overheat, the following design features may be considered:

- Orientation and glazing
- Shading

These design features are explored in more detail in chapter 3, as they relate to reducing the need for energy consumption.

- Materials
 - Light coloured materials are best for reflecting heat.
 - Green roofs also help to cool buildings and urban areas through evapotranspiration (see p. 6).

Designing for increased rainfall, flooding and storms

2.18 It is important that buildings are resilient to storms and rainfall, and where necessary, flooding. For information on designing for increased rainfall and flooding, see section 6. As well as increased rainfall, storms can bring extremely windy weather. Strategic planting of shrubs and trees can help protect buildings from wind.

3 CS64 Climate Change, Resources and Sustainable Design of Developments

The policy

Policy CS64

All new buildings and conversions of existing buildings must be designed to reduce emissions of greenhouse gases and function in a changing climate. All developments will be required to:

- a. achieve a high standard of energy efficiency; and
- b. make the best use of solar energy passive heating and cooling, natural light, and natural ventilation; and
- c. minimise the impact on existing renewable energy installations, and produce renewable energy to compensate for any loss in generation from existing installations as a result of the development.

All new buildings and conversions of existing buildings must be designed to use resources sustainably. This includes, but is not limited to:

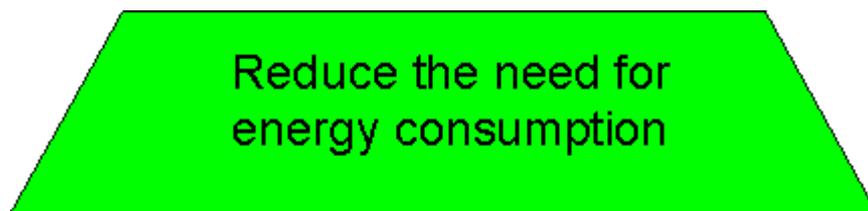
- d. minimising water consumption and maximising water re-cycling;
- e. re-using existing buildings and vacant floors wherever possible;
- f. designing buildings flexibly from the outset to allow a wide variety of possible uses;
- g. using sustainable materials wherever possible and making the most sustainable use of other materials;
- h. minimising waste and promoting recycling, during both construction and occupation.

- 3.1** Policy CS64 is in two parts. The first part covers reducing carbon emissions from development and the second part covers the sustainable use of resources. All the criteria apply to all developments, although the extent to which they can be achieved depends on the type, scale and location of development.
- 3.2** Paragraph 11.7 in the Core Strategy explains that residential developments of 5 or more dwellings must achieve Code for Sustainable Homes Level 3 as a minimum, to show compliance with the policy. Non-residential developments of more than 500 sq m gross internal floorspace must achieve a Building Research Establishment Environmental Assessment Method (BREEAM) rating of 'very good' as a minimum. These standards are explored in more detail in paragraphs 3.38 to 3.53.
- 3.3** Paragraph 11.9 states that a sustainability statement is required for developments of 5 or more dwellings, or more than 500sqm. For smaller developments above the threshold this may be incorporated as a sustainability section within a Design and Access Statement, or, particularly for larger developments, it may be a separate statement. This should include information about meeting Code for Sustainable Homes and/or BREEAM requirements. Developments below the threshold still need to provide some information about how they will meet the policy requirements, but this should be proportionate to the scale of the development.

- 3.4** Parts (a) and (b) of the policy are concerned with energy efficiency and passive design. Passive design is a way of designing a building to ensure the internal environment is comfortable, whilst minimising the consumption of energy. It involves using the sun and wind to heat and cool parts of a building, as well as maximising natural light. Passive design fits into the first part of the Energy Hierarchy on page 3 and should be the starting point of an energy strategy.

Passive Design

The first level of the Energy Hierarchy



The first level of the Energy Hierarchy

Orientation, layout and glazing

- 3.5** Making the best use of solar energy to heat and illuminate buildings is called passive solar gain, and is achieved through orientation, layout and glazing. Using natural sources of heat and light reduces the need to consume energy, decreases carbon emissions, and reduces the running costs for a building's occupiers. In an ordinary UK home, around 14% of space heating costs comes from solar energy through windows and walls⁽³⁾.

Residential development

- 3.6** On sites where a north-south axis is possible, the orientation of dwellings as shown in the indicative plan in Figure 3 will maximise heating in the morning and evening, when it is most needed. This also helps to minimise overshadowing between buildings due to the angle of the shadows created by the sun's path. The habitable rooms (such as living rooms and bedrooms) would need to be on the west elevation, to maximise light and heating later in the day.

3 Solar Energy, The National Energy Foundation, 2001

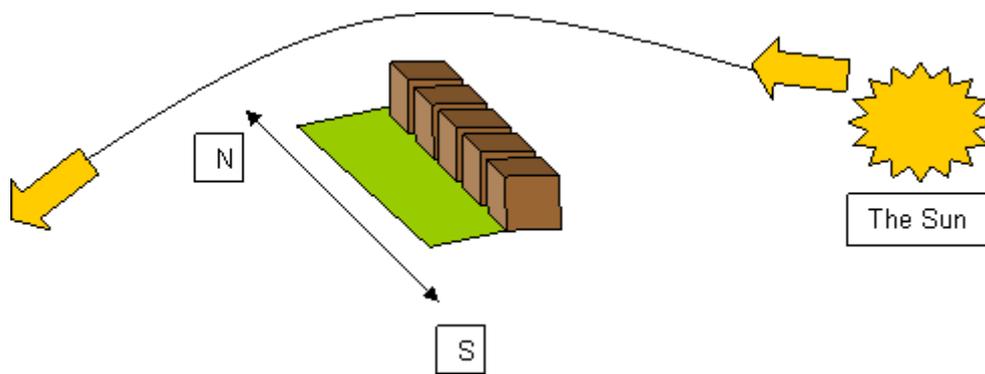


Figure 3. Orientating dwellings on a north-south axis

- 3.7** On sites where an east-west axis is possible, orientation of dwellings as shown on the indicative plan in Figure 4 will maximise solar gain on the south elevation. Habitable rooms are best located on this elevation, with other rooms such as kitchens and bathrooms on the north elevation. Orientating dwellings this way will maximise heating and from the sun in winter, but it is important to consider whether there will be excessive solar gain in summer. If this is likely to be the case, then shading options such as louvres or planting should be designed in (see 3.9 below).

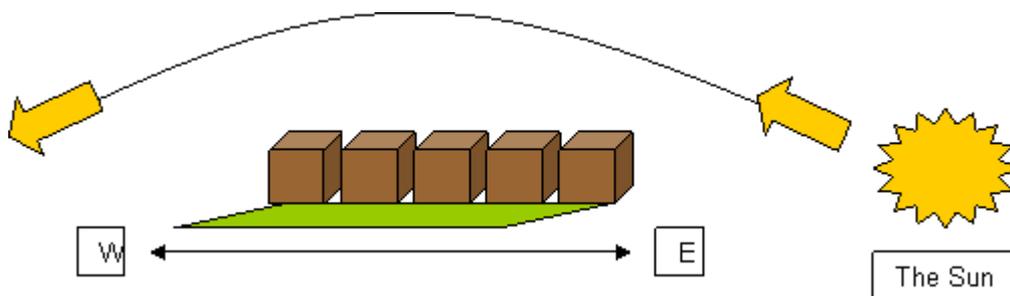


Figure 4. Orientating dwellings on an east-west axis

Non-residential development

- 3.8** Orientating a development that is not for residential use requires a different approach. Commercial properties are usually occupied during the day, and often need to minimise solar gain because their uses produce heat (such as through the use of computers and other electrical equipment). They suit an east-west axis, with glazing on the north elevation to maximise light and prevent excessive heat gain, which can still be an issue in winter. Figure 5 shows the optimum orientation for commercial developments.

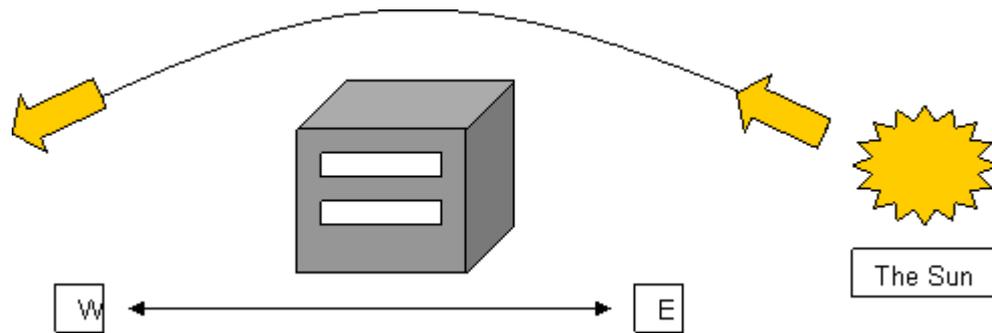


Figure 5. Orientating a non-residential development

Shading

3.9 It is not always possible to orientate buildings ideally, so where there is a risk of overheating in the summer, shading features may be included:

- Trees can help to shade glazing.

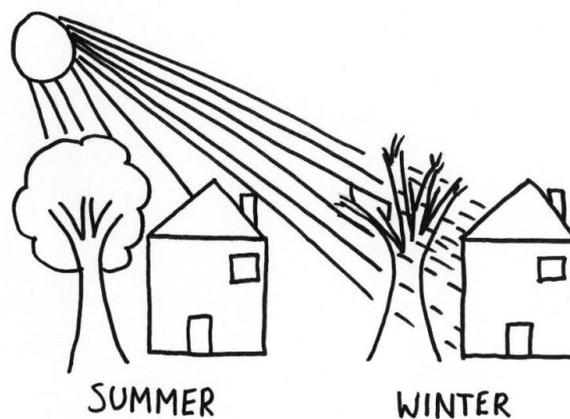


Figure 6. Using trees for shading

- Louvres or brise soleil can provide design solutions for shading, and can be fixed or moveable.



Figure 7a. Loughborough Magistrates Court



Figure 7b. M&S, Derby

(Photographs courtesy of Kingfisher Louvre Systems
http://www.kingfisherlouvres.com/single_bank_louvres.html)



Figure 8. Brise soleil, Tonbridge Police Station
(Photograph courtesy of Kingfisher Louvre Systems:
http://www.kingfisherlouvres.com/brise_soleil.html)

Thermal mass

3.10 Thermal mass is another important component of passive design, and involves using the materials of a building to moderate temperatures within it. Materials with a high thermal mass absorb heat during the day and release it during the night, helping to regulate the temperature. A high thermal mass construction could be a brick and block wall with a plaster finish. A timber framed wall has a lower thermal mass.

Thermal mass should not be confused with insulation and U-values. Thermal mass is a passive design feature, not a method of insulation. It can reduce the cooling load of a building in summer and the heating load in winter, therefore reducing carbon emissions.

Summer

- 3.11** In the summer, thermal mass helps to prevent buildings from overheating, by absorbing heat from the sun and from the occupiers, rather than letting it heat the interior of the building. For instance, in a commercial building, peak internal temperature is usually in the afternoon due to the sun and heat gains from office equipment, lighting and the occupants. When the occupants have departed and the heat gain diminishes, the external temperature is decreasing, and heat is released from the thermal mass of the building. The absorption of heat can reduce the need for air conditioning, and therefore reduce energy consumption and carbon emissions.

Winter

- 3.12** Thermal mass can also play an important part in temperature regulation in winter. It works the same way as during the summer, absorbing heat during the day and releasing it at night. This prevents the building getting so cold over night, therefore reducing the load on the heating system in getting the building back up the required temperature.
- 3.13** Figure 9 illustrates how a dwelling can be designed to maximise the benefits of thermal mass all year round.

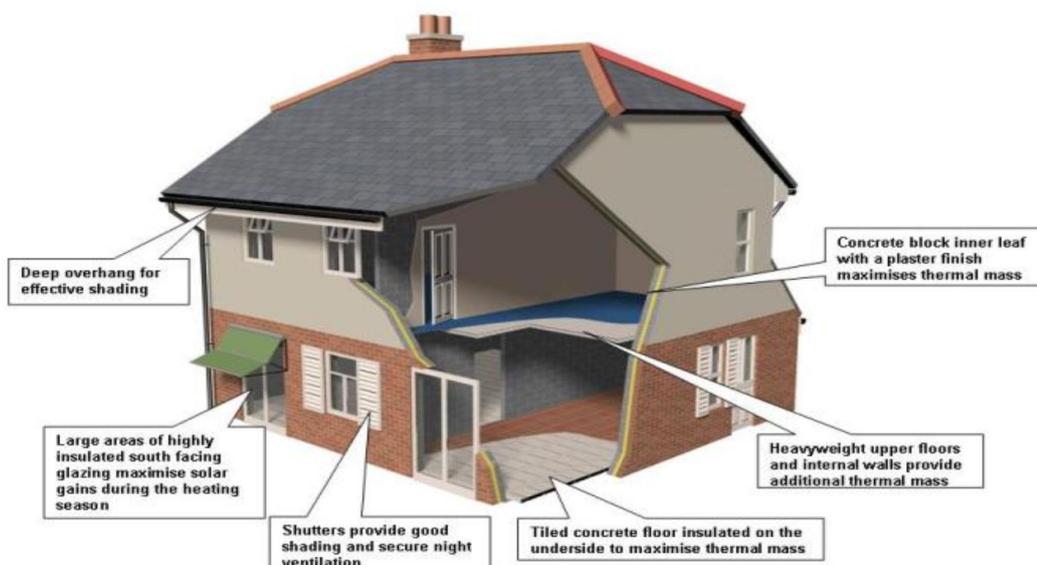


Figure 9 . Exploiting thermal mass on a year-round basis

(Source:

www.sustainableconcrete.org.uk/sustainable_design_constructio/thermal_mass.aspx)

Natural ventilation

3.14 Natural ventilation involves supply and removing air through a building using natural means. This reduces the need to mechanically ventilate a building, and reduces energy consumption. However, it is important to consider that the ventilation level is dependent the speed and/or temperature of the wind and is therefore variable. The two main types of natural ventilation are *wind driven* and *passive stack*.

Wind driven ventilation

3.15 Wind driven ventilation can be created by taking advantage of the natural pressure differences that occur when air flows over a building, as shown in Figure 10.

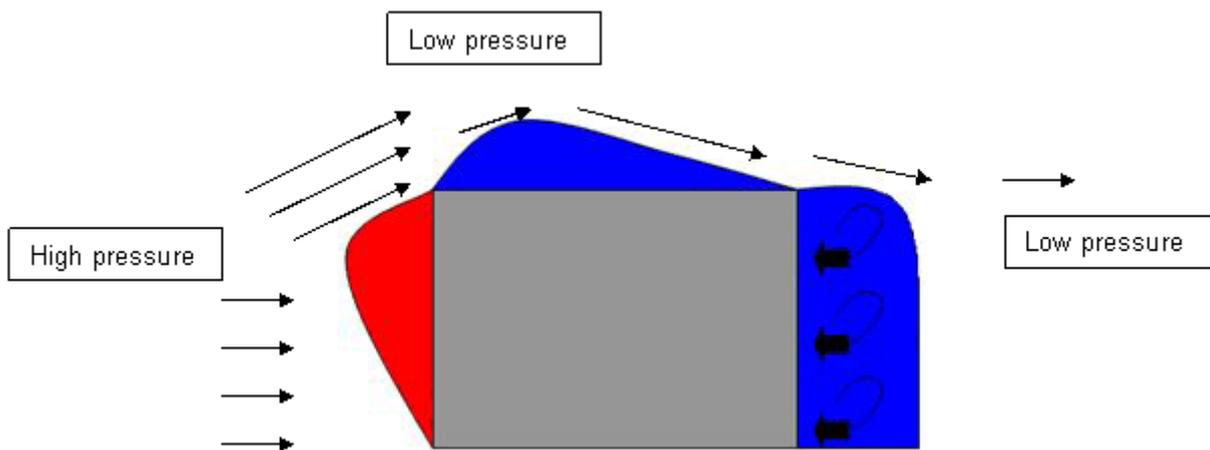


Figure 10. Wind driven ventilation

3.16 By placing ventilation openings as shown by the bold arrows on the right of the above figure, air will be drawn into the building providing natural ventilation.

Passive stack ventilation

3.17 Passive stack ventilation is driven by differences in internal and external temperatures, and is achieved by placing ventilation openings at different heights. It is based on the 'stack' effect whereby warm air naturally rises and is replaced with cooler air entering at a lower level. In order to make a passive stack approach work, vents should be placed in rooms which require fresh air to replace moisture-laden or odorous air. Ducts draw the warm air up and out of the building, and ventilation openings (such as trickle vents in winter or open windows in summer) draw in fresh air from 'dry' rooms. Figure 11 illustrates this approach.

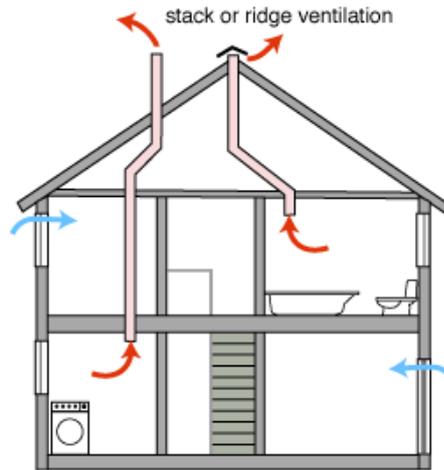
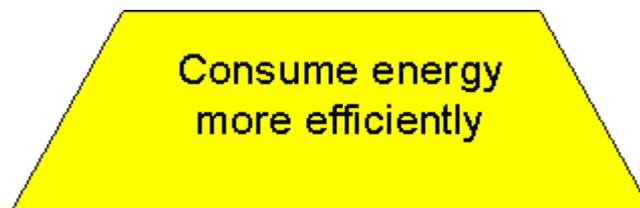


Figure 11. Passive stack ventilation
(Source: www.greenspec.co.uk/whole-house-ventilation.php)

Energy Efficiency

- 3.18** Where energy is needed within buildings, it should be used as efficiently as possible. This means not wasting energy or using more than is required, and it fits into the second level of the Energy Hierarchy. The following section explains how to ensure buildings are energy efficient.



The second level of the Energy Hierarchy

Thermal insulation/U-values

- 3.19** Thermal insulation is an important way of improving energy efficiency, by reducing the heat losses through the fabric of the building. The thermal insulating properties of building elements or structures are compared using U-values.

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

$$\mathbf{W/(m^2K)}$$

The lower the U-value, the less heat is transferred through it.
A U-value of 0.3 loses heat at half the rate of a U-value of 0.6.

- 3.20** The Building Regulations set maximum permissible U-values which all new buildings must comply with. However, U-values can be improved upon by increasing the thickness of insulating materials. This will help to increase energy efficiency and decrease carbon emissions.

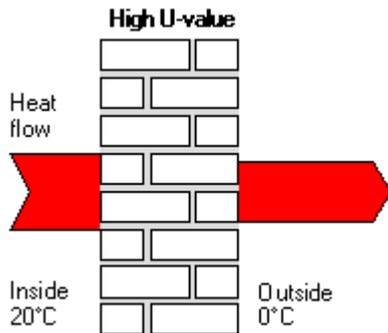


Figure 12 . High U-value

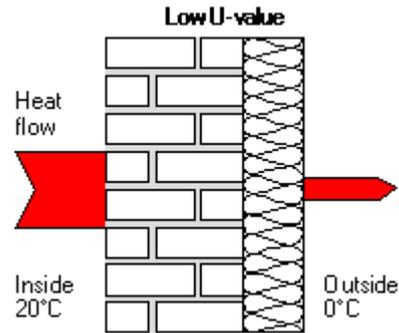


Figure 13 . Low U-value

(Source: www.builddeskonline.com/sw56126.asp)

- 3.21** Another important aspect to consider when insulating a building is thermal bridging. This is where heat is lost through a material that is more conductive than the surrounding materials, such as a metal fastener or concrete beam, or where a floor meets an external wall. This can also occur at windows and doors. Thermal bridges can significantly increase heat losses, and can lead to problems with damp when warm, moist air condenses on a cooler surface. A common source of thermal bridging is through reinforced concrete slab balconies, which cut through the thermal insulation layer and cause a thermal outflow.

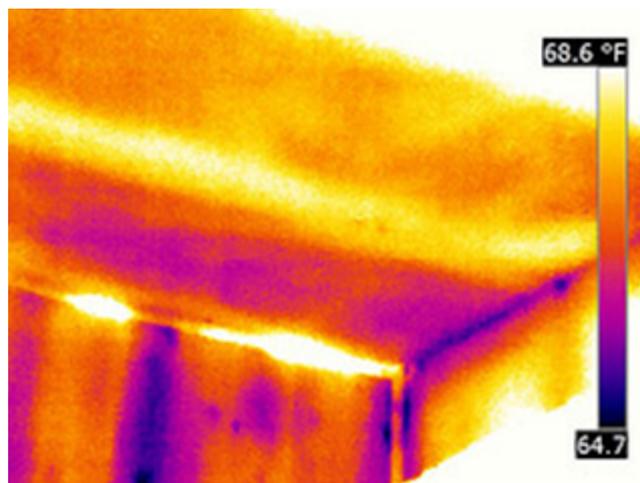


Figure 14. Thermal image showing thermal bridges at the junctions of walls and floors
(Source: http://www.flickr.com/photos/pcw_1333/4457268155/in/photostream)

- 3.22** The solution for the problem of thermal bridging depends on the type of building being constructed, but general principles include eliminating penetrations in the structure, through the design and construction of a building, and using heat transfer-resistant materials.

Airtightness

3.23 Making a building airtight helps to improve its energy efficiency, by reducing drafts and therefore reducing the need to artificially control the temperature within the building. Air can pass into and out of buildings in a number of places, such as through gaps in the envelope around windows and doors. Figure 15 shows the common places in a dwelling where air can escape or enter.

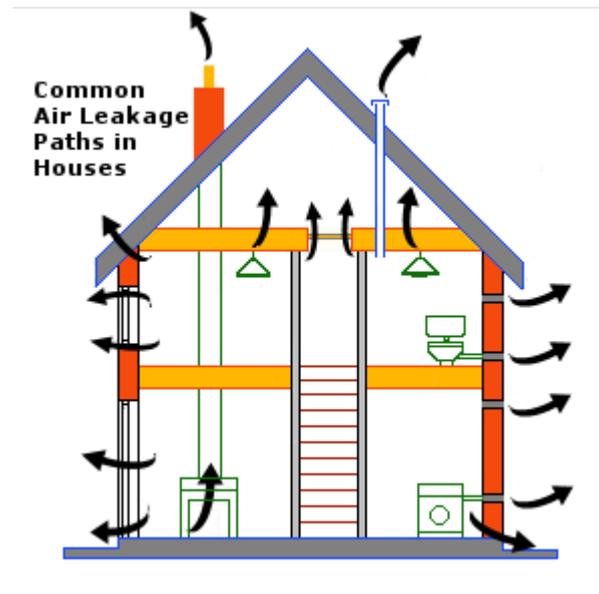


Figure 15. Common air leakage paths
(Source: <http://www.airtightbuilding.com/>)

Air leakage is measured as the rate of leakage per m^2 of external envelope per hour at an artificial pressure differential through the envelope of 50 Pa. i.e. $\text{x m}^3/\text{hr}/\text{m}^2@50\text{Pa}$.

3.24 Air leakage can be reduced through careful construction practices, to ensure gaps in the fabric are minimised. Measures include:

- Ensuring gaps around window and door frames are properly sealed.
- Draughtstripping external windows and doors (other than kitchens and bathrooms unless other ventilation measures are included).
- Sealing holes around services passing through the external walls including water pipes, gas pipes, boiler flues and electrical cables.
- Choosing airtight light fittings or sealing gaps around light fittings and ceiling pull cords.
- Sealing the joint between the ceiling and the external wall.
- Sealing the joint between the drylining and the skirting board.

3.25 Part (c) of policy CS64 is about ensuring that the impact of new developments on existing renewable energy installations is minimised. For example, care should be taken to avoid new buildings overshadowing existing solar panels, or interfering with wind patterns near to building-mounted turbines. In instances where this is unavoidable,

the new development will be required to produce extra energy to compensate from the loss in generation from the existing development.

- 3.26** The second section of the policy deals with the sustainable use of resources, to help minimise the impact of new buildings and conversions on the environment.

Minimising water consumption and maximising water recycling

- 3.27** The UK's population is growing, and this is placing an increasing demand on the water supply. The demand is forecast to increase further, as climate change leads to warmer temperatures and more periods of drought. Therefore it is important that developments minimise water consumption and maximise water recycling.

- 3.28** There is a wide range of water efficiency measures that can be implemented, and examples include:

- Installing flow restrictors to tapware
- Install aerated showers which use less water but increase perceived flow rate
- Low-flush/dual flush WCs
- Taps with water-brakes that require additional force to be turned on more than a specified amount
- Low volume baths

- 3.29** In addition to specifying water efficient fixtures, water consumption can be reduced further by recycling.

Rainwater harvesting

- 3.30** Rainwater harvesting involves collecting water from a roof and storing it to be used for purposes such as flushing toilets and filling washing machines. This can reduce average consumption from 150l/person/day to 80l/person/day, depending on rainfall and roof area. Rainwater harvesting reduces reliance on mains water, and can provide up to 50% of water requirements which reduces water supply costs. In addition, it helps to reduce surface water run-off. The following figures show how rainwater harvesting typically works in residential and commercial buildings.

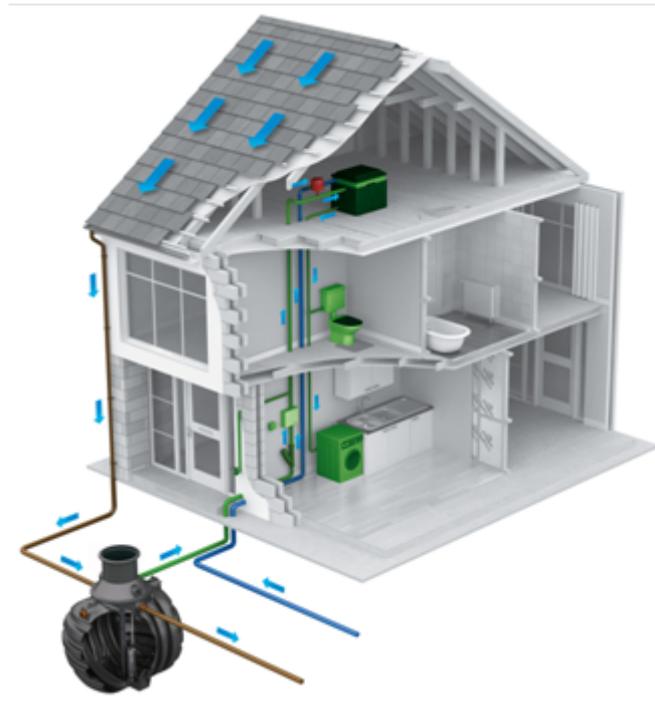


Figure 16. Typical residential rainwater harvesting system
(Source: <http://www.kingspanwater.com/>)

- 3.31** The rainwater harvesting system collects water from the roof and it passes through a filter system where debris is removed. It is stored in a tank before being pumped out for use in toilets, garden taps and washing machines. A pressure switch and flow controller turns the pump on and off as required. The supply can be topped up from the mains if required. Any excess water from the tank is discharged through an overflow to the drain.



Figure 17. Typical commercial rainwater harvesting system
(Source: <http://www.kingspanwater.com/>)

- 3.32** Commercial rainwater harvesting systems are usually larger and more sophisticated versions of residential systems, but work in a similar way.
- 3.33** Rainwater harvesting and green roofs can be compatible, but if a green roof is installed, less water can be collected. Also, organic material from the roof can cause discolouration of the water.

Greywater recycling

- 3.34** Greywater recycling involves collecting waste water from baths, hand basins and washing machines which is then most commonly used for watering gardens or flushing toilets. This saves water, but it is important to ensure that common contaminants such as soap, salt and grease are removed. A sand filter can be used to reduce the amount of chemicals in the water. Figure 18 shows how much water can be saved through greywater recycling.

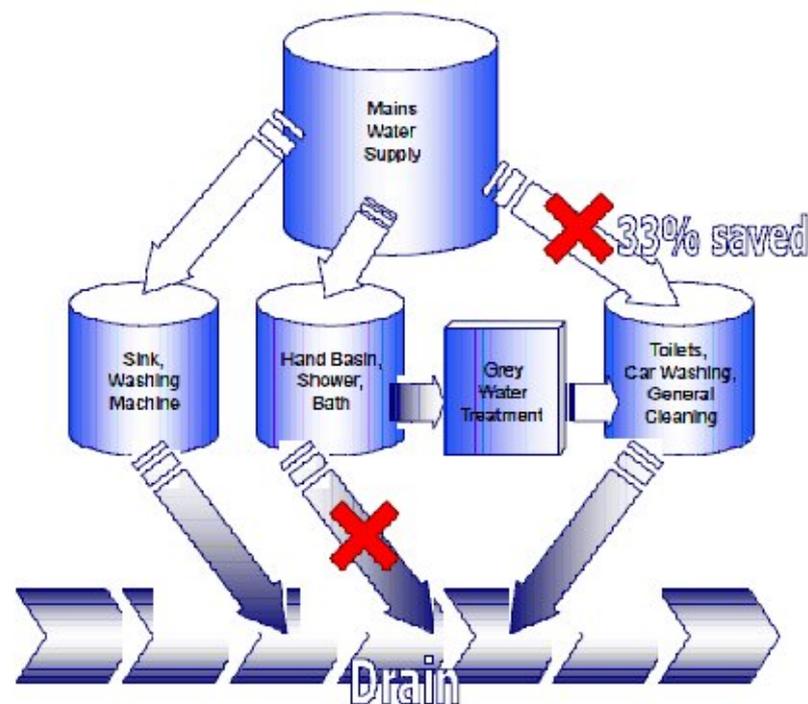


Figure 18 . Potential water savings from greywater recycling
(Source: Maidstone Borough Council Sustainable Construction SPD)

- 3.35** It is important to note that rainwater harvesting and greywater recycling may not be appropriate for use together, as they can supply water for the same purposes.

Designing buildings flexibly

- 3.36** Part (f) of CS64 requires new buildings and conversions to be designed flexibly from the outset to allow for a range of future uses. This helps to ensure that buildings do not have to be demolished to allow the site to be used for different purposes. This is particularly important for commercial developments and conversions, which may be changed to another use in the future, and less so to dwellings which are likely to remain as that use throughout their lifecycle.

The Code for Sustainable Homes

- 3.37** To satisfy policy CS64, all developments of five or more dwellings must achieve Code for Sustainable Homes Level 3 as a minimum. The Code for Sustainable Homes was introduced in 2007 as an environmental assessment method for new homes (not including institutions such as student accommodation or sheltered housing). Developments are assessed against the Code by a registered assessor licensed by the Building Research Establishment (BRE), and credits are awarded for incorporating a range of sustainability features. Dwellings are rated from 1 to 6, with a level 6 house being 'zero carbon'. All new homes have to have a Code rating, although it is possible to obtain a nil-rated certificate. Under policy CS64, developments of 5 or more dwellings must achieve Code for Sustainable Homes Level 3 as a minimum.

3.38 The Code is broken down into nine categories of environmental sustainability, and the following table shows the categories, the issues within them, the credits available, and how they are weighted.

Categories	Issues	Credits available	Weighting factor (%)
Energy and Carbon Dioxide Emissions	Ene1: Dwelling emission rate (M) Ene2: Building fabric Ene3: Internal lighting Ene4: Drying space Ene5: Energy labelled white goods Ene6: External lighting Ene7: Low or zero carbon (LZC) technologies Ene8: Cycle storage Ene9: Home office	29	36.4
Water	Wat1: Indoor water use (M) Wat2: External water use	6	9
Materials	Mat1: Environmental impact of materials (M) Mat2: Responsible sourcing of materials – basic building elements Mat3: Responsible sourcing of materials – finishing elements	24	7.2
Surface Water Run-off	Sur1: Management of Surface Water Run-off from developments (M) Sur2: Flood risk	4	2.2
Waste	Was1: Storage of non-recyclable waste and recyclable household waste (M) Was2: Construction site waste management (M) Was3: Composting	7	6.4
Pollution	Pol1: Global warming potential (GWP) of insulants Pol2: NO _x emissions	4	2.8
Health and Well-being	Hea1: Daylighting Hea2: Sound insulation Hea3: Private space Hea4: Lifetime homes (M)	12	14
Management	Man1: Home user guide Man2: Considerate constructors scheme Man3: Construction site impacts Man4: Security	9	10

Ecology	Eco1: Ecological value of site Eco2: Ecological enhancement Eco3: Protection of ecological features Eco4: Change in ecological value of site Eco5: Building footprint	9	12
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3.39 Some of the issues above have (M) next to them, which means they are mandatory. The Code contains two types of issues which are mandatory. The first type of mandatory issue has to be achieved to allow a Code rating to be given, but no credit is awarded for them. These four issues are:

- Mat1: Environmental impact of materials
- Sur1: Management of Surface Water Run-off from developments
- Was1: Storage of non-recyclable waste and recyclable household waste
- Was2: Construction site waste management

3.40 The remaining mandatory issues become more onerous at higher levels of the Code, and do contribute credits. These are:

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Ene1: Dwelling emission rate (% improvement)	10	18	25	44	100	'Zero carbon'
Wat1: Indoor water use	≥120l/person/day		≥105l/person/day		≥80l/person/day	
Hea4: Lifetime homes	No requirement					Comply

3.41 The scores required to achieve each level of the Code are as follows:

Level	Score
1	36
2	48
3 (minimum required in Sheffield)	57
4	68
5	84
6	90

3.42 Dwellings designed to meet the requirements of the Code will be more robust, as the building fabric will deliver the performance over the whole lifetime of the building. To ensure the Code rating is optimised, the following four tasks should be undertaken:

- Employ a Code assessor
- Set out a Site Waste Management Plan (SWMP) – mandatory during construction
- Register with Considerate Constructors Scheme – relatively highly weighted
- Undertake a baseline ecological survey – confirming ecological improvement is highly weighted

3.43 Using good design, many of the credits and mandatory minimum performance standards can be met with little additional cost, such as:

- Ene4: Drying space – 1 credit for an internal or external drying line.
- Ene5: Energy-labelled white goods – up to 2 credits for A+ rated fridges and freezers, A rated washing machines and dishwashers, and B rated tumble dryers.
- Was3: Composting – 1 credit, which is easier to obtain if the dwelling has a garden to put a compost bin in.
- Man1: Home user guide – up to 3 credits can be obtained for this, and most of the information needed for it will have to be provided to the Code assessor anyway.

3.44 The NHBC Foundation has produced a guidance document entitled ‘The Code for Sustainable Homes Simply Explained’, which contains useful information about how to achieve levels 3 and 4. It can be accessed here <http://www.nhbcfoundation.org/Researchpublications/TheCodeforSustainableHomessimplyexplained/tabid/421/language/en-GB/Default.aspx>.

3.45 Code assessments are undertaken at different stages as a development progresses. A pre-assessment is undertaken at the design stage, to indicate the score the development is likely to achieve. This is based on design drawings, specifications and commitments, and results in interim certificate of compliance. Final assessment and certification is undertaken post-construction. This confirms compliance and involves site records and visual inspections.

Building Research Establishment Environmental Assessment Method (BREEAM)

- 3.46** BREEAM is similar to the Code for Sustainable Homes, but for non-residential developments. It also applies to multi-residential developments such as student halls of residence or sheltered housing where more than 10% of the net internal floorspace is communal.
- 3.47** Each type of development to be assessed has its own specific BREEAM manual, which can be downloaded from the BRE's website at www.breeam.org. BREEAM is broadly broken down into nine categories of environmental sustainability:
- Management
 - Health and Well-being
 - Energy
 - Transport
 - Water
 - Materials
 - Waste
 - Land Use and Ecology
 - Pollution

Further credits are also available for particularly innovative solutions.

- 3.48** Buildings are rated from Pass to Outstanding, with the following scores required for each rating:

Rating	Score
Pass	30
Good	45
Very Good (minimum required in Sheffield)	55
Excellent	70
Outstanding	85

- 3.49** Like the Code for Sustainable Homes, BREEAM has some mandatory credits. There are more mandatory credits at the higher levels. The following table shows the mandatory credits at each level:

	Pass	Good	Very Good	Excellent	Out-standing
Man1: Commissioning	1	1	1	1	2
Man2: Considerate Constructors				1	2
Man4: Building user guide				1	1

Man9: Publication of building information					1
Man10: Development as a learning resource					1
Hea4: High frequency lighting	1	1	1	1	1
Hea12: Microbial contamination	1	1	1	1	1
Ene1: Reduction of CO ₂ emissions				6	10
Ene2: Sub-metering of substantial energy uses			1	1	1
Ene5: Low or zero carbon technologies				1	1
Wat1: Water consumption		1	1	1	2
Wat2: Water meter		1	1	1	1
Wat3: Storage of recyclable waste				1	1
LE4: Mitigating ecological impact			1	1	1
TOTAL	3	5	7	17	26

3.50 To see the level of information required by an assessor and understand what each type of scheme needs to do to achieve the ratings, several Pre-Assessment Estimators are available on the BREEAM website and can be accessed here, following a short registration process <http://www.breeam.org/page.jsp?id=87>.

3.51 A BREEAM assessment is a two-stage process. The first part of the assessment is undertaken during the design stage, to indicate the likely score for the scheme. The second stage is undertaken post-construction, and reviews the design stage assessment to ensure all the specified issues have been implemented. If the required standard has not been achieved at the construction stage, measures should be undertaken retrospectively to increase the BREEAM score until it meets the required standard.

Securing BREEAM 'Very Good'/Code for Sustainable Homes Level 3

Currently, the achievement of these standards is secured by planning conditions. The conditions can only be fully discharged when a post-construction certificate is provided, although partial discharge of conditions may be possible with a design stage assessment.

In the future, the Council's requirements for BREEAM/Code compliance will increase. Where higher standards are required, it may be necessary to design schemes to ensure compliance from the outset, rather than achieving the standards through compliance with a condition.

- 3.52** To help with finding a Code for Sustainable Homes or BREEAM Assessor, the BRE have a website called Green Book Live, where it is possible to search for assessors within an area. The site can be accessed here:
<http://www.greenbooklive.com/search/search.jsp?partid=10001>.

Building Regulations

- 3.53** On 1st October 2010, the Building Regulations were revised. This included a substantial reduction in permissible carbon emissions, to approximately 25% beyond the requirements in the 2006 Regulations. For dwellings, the new carbon emissions requirement is the same as the requirement for energy/CO₂ emissions in Code Level 3. For more information about how the changes to the Building Regulations affect the implementation of Core Strategy policies, see Guideline CC2 in the Climate Change and Design SPD.

Green Roofs

- 3.54** Paragraph 11.8 of the supporting text to policy CS64 refers to green roofs as a method for minimising surface water run-off and reducing the risk of flooding. Guideline CC1 in the Climate Change and Design SPD sets out the developments on which green roofs will be expected.
- 3.55** Figure 19 shows a typical green roof cross-section.

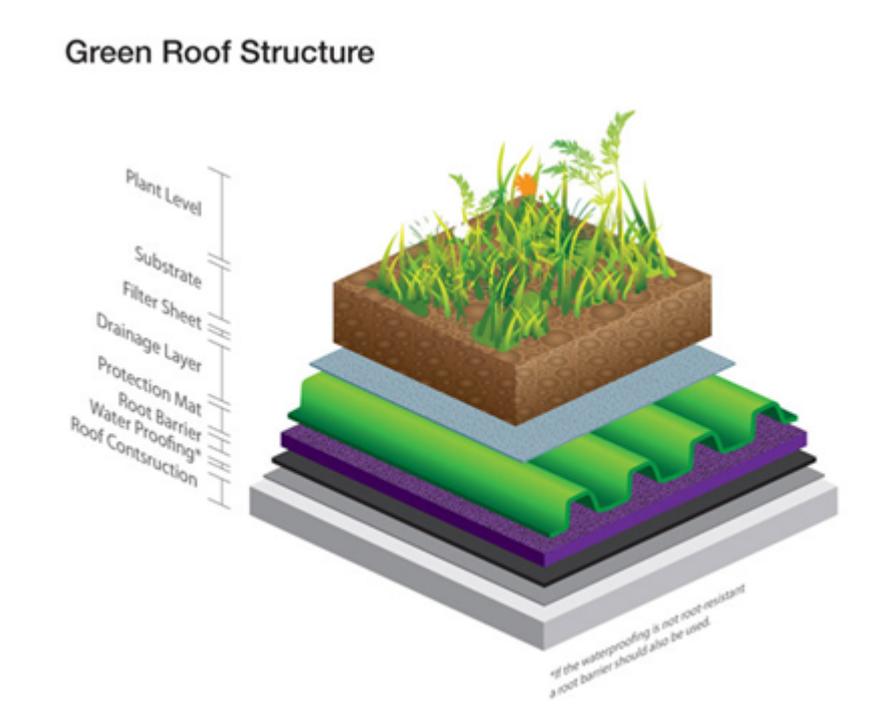


Figure 19: Green roof cross-section
 (Source: <http://www.greenroofguide.co.uk/>)

- 3.56** There are three main types of green roofs; extensive, intensive and semi-intensive. *Extensive* green roofs are composed of lightweight layers of draining material, which support low-growing, hardy, drought tolerant plant species. The depth of the substrate

is usually around 6-20cm. This type of green roof is lightweight and suitable for a variety of applications, particularly where weight is a design issue. They also require little maintenance as the vegetation is adapted to extreme conditions. The roof on Sharrow School in Sheffield is a mixture of extensive and intensive.



Figure 20 : Extensive and intensive green roof on Sharrow School , Sheffield
(Source: www.thegreenroofcentre.co.uk/article/commercial_case_studies/sharrow_school)

- 3.57** *Intensive* green roofs have deeper substrate of up to 40cm, and can support a range of vegetation types, including plants, trees, shrubs, perennials, grasses and annuals. As a result they are heavier and require more maintenance than extensive roofs. The garden on the West One development in Sheffield is an intensive green roof.



Figure 21 . Intensive green roof at West One, Sheffield
(Source: <http://www.greenroofs.com/projects/pview.php?id=763>)

- 3.58** *Semi-intensive* green consist of a slightly deeper layer of growing material than extensive roofs, allowing different varieties of plants to be grown. These roofs are not suitable for recreational use.

3.59 The following table shows the main features of different types of green roofs.

	Extensive	Semi-intensive	Intensive
Use	Ecological landscape	Ecological landscape	Garden/park
Type of vegetation	Mosses, herbs, grasses	Grasses, herbs, shrubs	Lawn/perennials, shrubs, trees
Typical depth of substrate	6-20cm	12-25cm	15-40cm
Weight	60-150kg/m ²	120-200kg/m ²	180-500kg/m ²
Cost	Relatively low	Periodic	Relatively high
Main benefits	Water management, improved thermal performance of building, biodiversity	Water management, improved thermal performance of building, biodiversity, improved air quality	Water management, improved thermal performance of building, biodiversity, improved air quality

3.60 The cost of maintenance can be a concern when green roofs are being considered. An intensive green roof will require a relatively high level of maintenance, but an extensive roof only adds about £1/m² per year to the cost of maintaining a standard roof ⁽⁴⁾.

3.61 Currently, there are no British Standards to guide the design and installation of green roofs. However, the Council recommends considering the following guidelines to maximise the benefits of green roofs:

- Establishing the appropriate type of green roof for the building
- Ensuring minimum depth of growing medium of 70mm
- Enabling a roof load of 120kg/m² for extensive green roofs
- Providing access to the roof for community/educational buildings.

4 <http://livingroofs.org/2010030887/perceived-barrier/maintgreenbarr.html>

4 CS65 Renewable Energy and Carbon Reduction

The policy

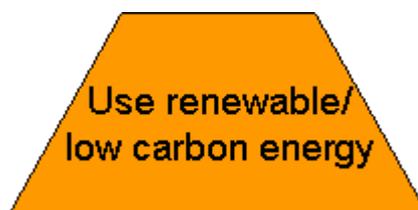
Policy CS65

Renewable energy capacity in the city will exceed 12MW by 2010 and 60MW by 2021. The Smithywood and Hesley Wood areas are potential locations for larger-scale wind generation though not to the exclusion of other sustainable locations. Where appropriate, developments will be encouraged to connect to the City Centre District Heating Scheme. Shared energy schemes within large developments or between neighbouring developments, new or existing, will also be encouraged. All significant developments will be required, unless this can be shown not to be feasible and viable, to:

- a. provide a minimum of 10% of their predicted energy needs from decentralised and renewable or low carbon energy; and
- b. generate further renewable or low carbon energy or incorporate design measures sufficient to reduce the development's overall predicted carbon emissions by 20%. This would include the decentralised and renewable or low carbon energy required to satisfy (a).

The renewable or low carbon energy technologies must be operational before any new or converted buildings are occupied. If it can be demonstrated that the required reduction in carbon emissions cannot be met through decentralised renewable or low carbon energy and/or design and specification measures, a contribution towards an off-site carbon reduction scheme may be acceptable.

- 4.1** Policy CS65 sets out Sheffield's approach to planning for renewable and low carbon energy, and carbon reduction. The use of renewable and low carbon energy forms part of the third level of the Energy Hierarchy.



The third level of the Energy Hierarchy

- 4.2** It sets targets for renewable energy capacity based on a study of potential for renewable technologies in the city. Based on the same study, the policy also identifies potential locations for larger-scale wind generation, to the north east of the city.
- 4.3** The third part of the policy is about encouraging connection to Sheffield's City Centre District Heating Scheme (DHS). The City Centre DHS is a network of more than 44km of pipes which supply heat to over 140 buildings in the form of hot water, produced from the recovery of energy from waste by incineration. Buildings on the network

include Ponds Forge International Sports Centre, the City Hall, Sheffield Hallam University and University of Sheffield buildings, the Royal Hallamshire Hospital and a number of Council buildings. A map of the network can be viewed here <http://www.veoliaenvironmentalservices.co.uk/Sheffield/District-Energy/>. The DHS also produces electricity, which is sold to the grid. Due to the efficiency of the system in producing heat and power, the DHS prevents over 21,000 tonnes of carbon dioxide being released each year.

- 4.4** Where proposed developments are near to the DHS, they will be encouraged to connect to it to help reduce their carbon emissions. Part L of the Building Regulations (2010) requires minimum standards for carbon emissions to be achieved. To calculate a building's performance, the type of fuel is taken account of. As the DHS has a carbon emissions factor significantly lower than a gas-fired heating system, it helps to achieve the requirements of Part L. Connection to the DHS can also count towards achieving BREEAM and Code for Sustainable Homes ratings.
- 4.5** Subparagraphs (a) and (b) of the policy set specific requirements for energy generation and carbon reduction, to be achieved by significant developments where feasible and viable. 'Feasible' means that it is physically possible to achieve the requirements within the constraints of the site, and 'viable' means that it is financially possible whilst ensuring the scheme makes a reasonable profit.

Significant developments – new builds and conversions of 5 or more dwellings (including apartments), or more than 500 sq m gross internal floorspace.

- 4.6** Part (a) requires significant developments to provide a minimum of 10% of their predicted energy needs from decentralised and renewable or low carbon energy.

Decentralised and renewable or low carbon energy – decentralised energy is energy generated at or near to the point of use. This is an efficient way of producing energy, as it reduces the losses from transmission. It also reduces reliance on the grid, and therefore increases security of supply.

Renewable energy comes from sources such as sunlight, wind, rain, tides, and geothermal heat, which are naturally replenished. Low carbon energy comes from sources which produce less carbon dioxide than fossil fuels, but are not renewable, for example ground source heat pumps and gas-fired combined heat and power.

Renewable and low-carbon energy sources are also called Low or Zero Carbon technologies (LZCs).

Renewable and low carbon energy technologies

- 4.7** The following section will provide information on the different types of renewable and low carbon energy technologies that are available.

Solar photovoltaic cells

- 4.8** Photovoltaic (PV) cells use the sun's energy to generate electricity. They do not require the sun to be shining for them to work, although they are most efficient on sunny days. To ensure the efficiency of PV panels is maximised, the orientation of the building, and the tilt and shading of the panels should be considered. Solar Century's website contains guidance on the orientation and tilt of solar PV panels <http://www.solarcentury.co.uk/Knowledge-Base/PV-performance>.
- 4.9** The two main types of PV panels are crystalline and thin-film.



Figure 22 .Thin-film PV
(Source: <http://www.flickr.com/photos/30261607@N00/1794085399/>)



Figure 23 . Crystalline PV
(Source: <http://www.flickr.com/photos/knowmybackyard/2394376192/>)

- 4.10** Mono-crystalline PV cells are currently the most efficient technology available and the most commonly used, in the form of aluminium framed, glass covered panels, although they are more expensive than thin-film PV. For optimum performance, PV panels should face between south-east and south-west, and should be installed at an angle of 30-40°. They should not be installed where they are overshadowed.
- 4.11** A typical domestic system would require 1.5-2kWp (kilowatt peak), which would require 12-16m² of roof area. The cost is currently £5-7,000 per kWp installed, although the price of PV is falling as uptake increases. A 1kWp system produces approx 800 kWh/yr, saving 454 kg/yr CO₂. An average sized dwelling could save around £110 per year on its electricity bill from a PV system, and payment from the Renewables Obligation Certification (ROC) scheme. The ROC scheme supports renewable energy generation by paying the generator for each megawatt hour (MWh) of electricity generated. In addition, a PV system can generate income through a feed-in tariff (see page 40).
- 4.12** An office building may require around 100m², which would cost between £60,000 and £70,000, and would reduce carbon emissions by 1%-5%.

Solar thermal panels

- 4.13** Solar thermal panels use the sun's energy to generate hot water. The two main types of solar thermal panels are evacuated tube and flat plate collectors. Figures 24 and 25 illustrate these. Evacuated tube collectors are more efficient than flat plate collectors,

and require less roof space. However, they are also more fragile as the tubes are made of glass.



Figure 24 . Evacuated tube collector
(Source:

<http://www.flickr.com/photos/afagen/4020510142/>)



Figure 25 . Flat plate collector
(Source:

<http://www.flickr.com/photos/mncerts/4933159242/>)

- 4.14** Solar panels should be located on south facing roofs, or within 30 degrees of south, to maximise efficiency, and should not be shaded. They are best suited to buildings which have a particular demand for hot water, such as dwellings, hospitals and swimming pools.
- 4.15** If solar panels are proposed, the design of the building must incorporate space for a twin coil hot water storage cylinder. A typical 3-bedroomed semi-detached dwelling requires around 4m² of roof space for a solar hot water system that would provide around 60-70% of hot water needs. This would cost between £2,000 and £4,000, and would save around 350 kg/CO² per year, compared with a gas-fired system. Annual savings on heating of around £50 per year could be expected.
- 4.16** For an office building, a system to provide 50% of hot water load (10% of total heating requirements), the cost would be approximately £15,000-£24,000. This would reduce carbon emissions by 1%-5%.

Wind turbines

- 4.17** Wind turbines convert the kinetic energy of the wind into mechanical energy and ultimately electricity. They range from small, building-mounted turbines, to large freestanding installations.
- 4.18** Large, grid-connected turbines can range from 50 kilowatts (kW) to 7 megawatts (MW) and typically require a minimum wind speed of 6m/sec to operate efficiently. Most of the recently installed large wind turbines are between 2MW and 3MW. A turbine of this capacity is normally about 120m high. Figure 26 shows the structure of a typical large turbine.

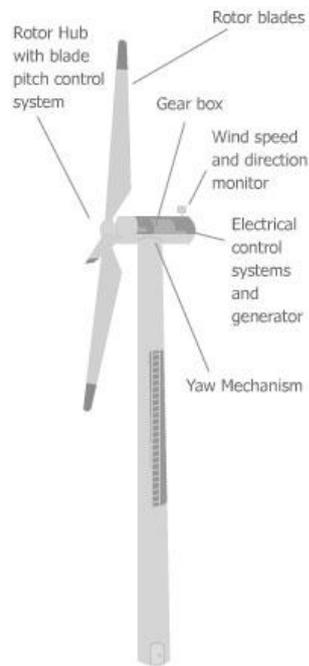


Figure 26 . A typical large turbine
(Image courtesy of RenewableUK)

4.19 Large turbines should be sited at least 400m away from residential properties, to minimise the effects of noise. Other constraints that should be considered when selecting sites include:

- proximity to the Peak District National Park
- whether the site is in the Green Belt
- topple distance to major arteries (150m to roads and railways)
- air traffic and communication masts
- local topography (for wind speed and flow)

4.20 Any potential for shadow flicker, where the sun is behind the blades causing moving shadows, should be considered on a site-specific basis. Large turbines are used to generate electricity to feed into the grid, and are not suitable for supplying specific developments.

4.21 Smaller and medium turbines of between 2.5kW and 50kW can either be building-mounted or free-standing. They also require a minimum wind speed of 6m/sec, but are vulnerable to turbulence caused by obstacles such as buildings and proximity to other turbines. If a turbine is to be building-mounted, vibration and noise issues should be considered.

4.22 Smaller turbines are best suited to dwellings and offices, while medium turbines work well for community-scale developments such as for a number of dwellings. A 2.5kW system costs between £11,000 and £12,000, and saves around 1800kg/CO² per year. Annual electricity savings for a 2.5kW system could be £350-£700, including ROCs (see paragraph 4.11).

- 4.23** Three main factors influence the power generated by turbines; wind speed, availability and turbine arrangement. Wind speed is the most important of these, and the power available from the wind is a function of the cube of the wind speed. This means that doubling the wind speed gives eight times the amount of power. For example, a turbine located on a site where wind speed is 5m/s will give nearly double the amount of power generated by the same turbine on a site with a wind speed of 4m/s⁽⁵⁾.
- 4.24** Availability is the capacity of a turbine to operate when wind is available, or an indication of its reliability. Modern turbines are over 98% reliable. Turbine arrangement is an important consideration where more than one is proposed, to ensure that they shield each other as little as possible.
- 4.25** Although wind turbines may not always be suitable, adverse visual impacts upon sensitive landscapes can be reduced by appropriate hours of operation, siting, design, sizing and screening.

Biomass boilers

- 4.26** Biomass boilers burn organically-derived fuel to generate heat. The five main types of biomass are:
- Virgin wood – from forestry or wood processing
 - Energy crops – high-yield crops such as willow or Miscanthus
 - Agricultural residues – from harvesting or processing
 - Food waste – from manufacturing, processing, and post-consumer waste
 - Industrial waste – from manufacturing and industrial processes
- 4.27** The most commonly used types of biomass are virgin wood and energy crops, which are formed into chips or pellets. Biomass boilers are typically sized between 5kW and 10MW, depending on the size of the development they are supplying. The technology is best suited to developments with a fairly constant heat load, such as hospitals, schools, offices, leisure centres and apartment blocks. Figure 27 illustrates how a biomass boiler works.

5 Renewable UK (2010) <http://www.bwea.com/ref/tech/html>

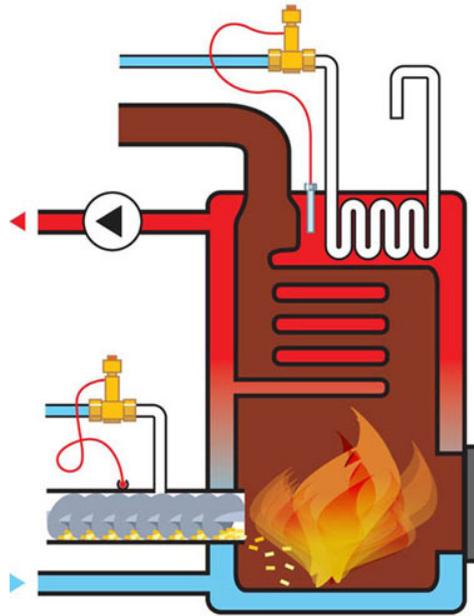


Figure 27 . Biomass boiler

(Source: www.danfoss.com/North_America/BusinessAreas/Industrial+Automation/Products_information/Bio-mass+boiler.htm)

- 4.28** Biomass boilers will require regular deliveries of fuel and significant space will be required within the development for fuel storage. Proposals for biomass boilers will need to be discussed with the Council's Carbon Reduction and Air Quality team, to ensure they do not have an adverse impact on air quality.
- 4.29** A biomass boiler for a dwelling costs around £4000, and saves 1300kg/CO² per year, or 25%-35%, if it is instead of a gas system. Savings may be greater if biomass is used instead of other fuels such as electricity. A larger system for an office costs £26,000-£32,000, and saves 10%-20% of carbon emissions. The cost of heating a house with a biomass boiler is roughly the same as heating a house with gas.

Ground Source Heat Pumps

- 4.30** Ground Source Heat Pumps (GSHPs) use the relatively constant temperature of the ground to generate heat for hot water and space heating. A mixture of water and anti-freeze is circulated around a loop of pipe buried in the ground, and heat from the ground is absorbed by the liquid. It is then passed through a heat exchanger, and a compressor concentrates this low grade heat into higher temperature useable heat, which is then pumped around the building. The cooled fluid is then passed back into the ground loop where it absorbs more heat. GSHPs can also be used to provide cooling in warmer months, by removing heat from a building and transferring it into the ground. Systems are typically sized between 1kW and 200kW.
- 4.31** The ground loops can be buried in the ground in different ways, as illustrated by Figure 28. The size and layout of the site will impact on the type of ground loop that can be used.

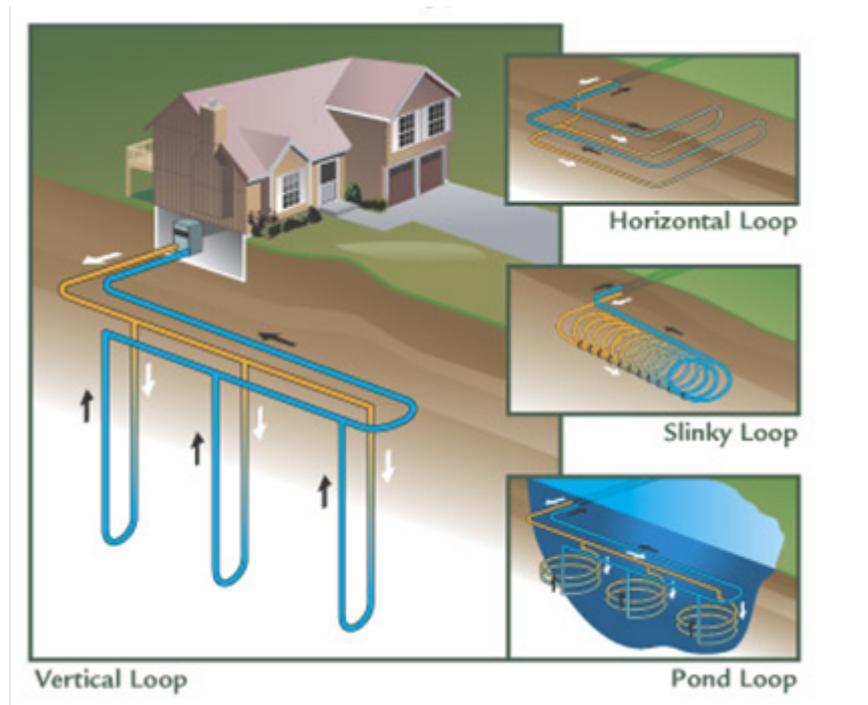


Figure 28 . Different types of Ground Source Heat Pumps

(Source: <http://www.puregreenenergy.co.uk/Products/DrillingAndTrenches.html>)

- 4.32** The pond loop in Figure 28 shows that the technology can be used in water as well as in the ground. This may be appropriate if a development includes a pond or larger water feature.
- 4.33** GSHPs are not classed as renewable energy, as they require electricity to power the exchanger, compressor and pump. However, they deliver two to three times as much heat as is used in electrical energy to drive the system (this is called the coefficient of performance), so are considered to be a low-carbon technology.
- 4.34** The technology works best in buildings that are well insulated, as they produce a lower temperature than traditional boilers. For very low temperatures, a back-up system may be needed, although combining a well insulated building and a well designed GSHP system is likely to be sufficient without a back-up. GSHPs also work well with underfloor heating because of the lower temperature, although they can be used with normal radiators. They should be sized to provide 100% of heating load, as they are most effective when supplying heat continuously. However, they will only pre-heat hot water, so an immersion system would still be needed.
- 4.35** A typical domestic system would cost between £4,500 and £14,000 and would save around 580kg/CO² per year, or 20%-30% of carbon emissions if replacing electricity. Savings are minimal if replacing gas. A typical office system would cost between £190,000 and £240,000, and save 5%-15% of carbon emissions, again if replacing electricity.

Air Source Heat Pumps

- 4.36** Air Source Heat Pumps (ASHPs) work in a similar way to GSHPs, but extract heat from the air instead of the ground. They require a collector on the outside of a building,

which looks a bit like air conditioning units. The technology can be effective even down to temperatures of -15°C . ASHPs deliver heat at a lower temperature over a longer period, so may need to be left on all the time in the winter. As with GSHPs, the technology can also be used for cooling a building.

4.37 There are two main types of ASHP: air-to-water systems and air-to-air systems. Air-to-water systems are used for heating via a wet central heating system. They work at a lower temperature than traditional systems, so are well suited to underfloor heating. For very low temperatures, a back-up system may be needed, although combining a well insulated building and a well designed ASHP system is likely to be sufficient without a back-up. A storage tank may be needed to store the hot water. Air-to-water systems produce warm air which is circulated by fans. These systems are not suitable for providing hot water. Figure 29 shows an air-to-water heat pump system.

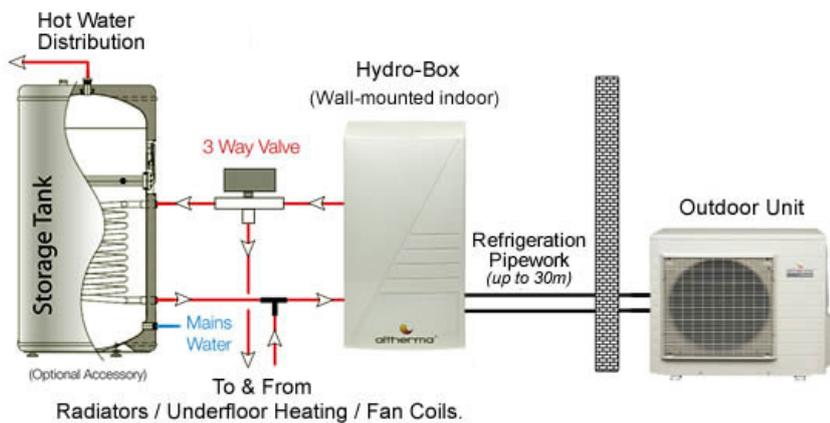


Figure 29 . Air-to-water system
 (Source: www.thefueleffect.co.uk/Default.asp?Page=19)

4.38 Air-to-air systems directly heat or cool the air within a building as required. Figure 30 shows an air-to-air system being used for heating in the winter. Figure 31 shows the same system being used for cooling in the summer.

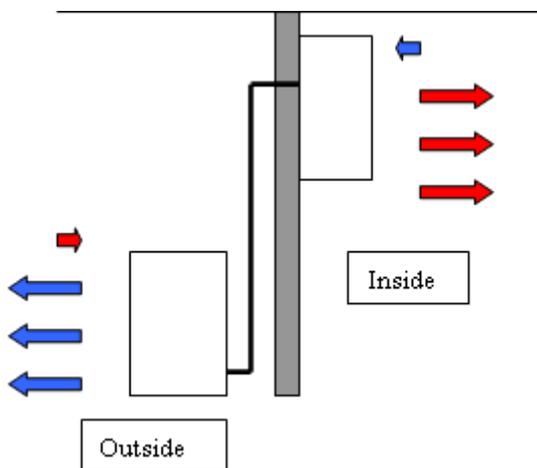


Figure 30 . Air-to-air system – winter

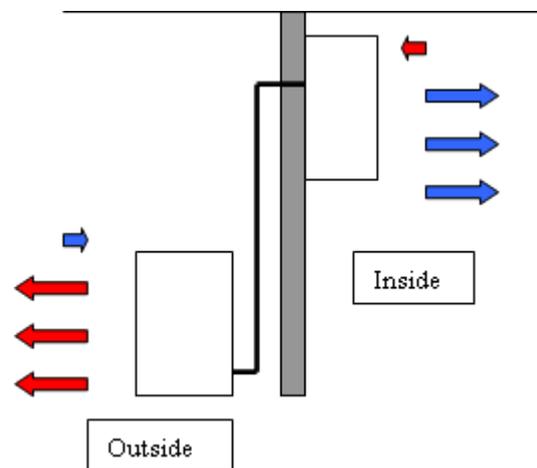


Figure 31 . Air-to-air system – summer

- 4.39** Figure 29 shows the outdoor unit needed for an ASHP, and the location of this must be considered as part of any proposal involving ASHP, to ensure the design is satisfactory. This will need to be discussed with the planning officer dealing with the planning application.
- 4.40** A domestic ASHP system costs £4000-£6000, and saves 15%-25% of carbon emissions if replacing electricity. Savings are minimal if replacing gas. An office system costs £80,000-£100,000, and reduces carbon emissions by up to 10%, again if replacing electricity.

Combined Heat and Power

- 4.41** Combined heat and power (CHP) systems are used to generate heating and electricity simultaneously. They capture the heat that would otherwise be wasted as a by-product of generating electricity. CHP systems are around 80% efficient, which is considerably higher than using grid-connected electricity and gas. They are best suited to developments where there is a year-round demand for heating and electricity, such as hotels, hospitals, universities and leisure centres. Small systems can also be used in domestic properties.
- 4.42** CHP systems can be fuelled by a number of sources, but the two most common are gas and biomass. A biomass CHP system will require space within the development to store fuel. CHP systems can vary in size considerably, depending on their use. A domestic micro-CHP system might be around 5kW, whereas a large-scale industrial system could be up 50MW. Figure 32 shows how a CHP system works.

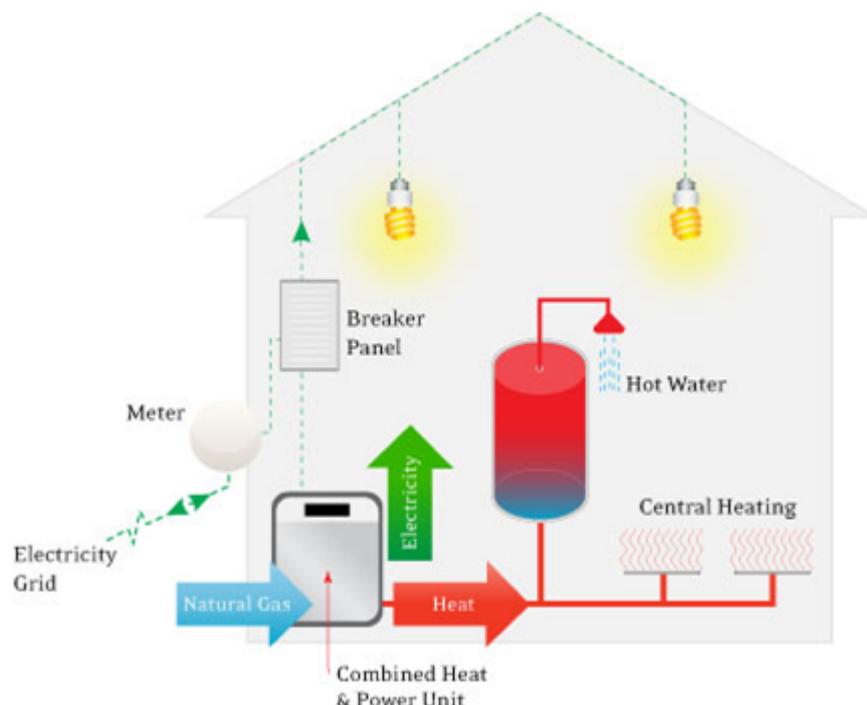


Figure 32 . CHP system

(Source: <http://www.eas-energyassessmentservices.co.uk/bio-energy-generation-systems-for-home-and-business.php>)

- 4.43** Large CHP systems can also be used to provide heat to other buildings through a network of pipes. This is called a District Heating Scheme. See paragraphs 4.3-4.4 for more information about Sheffield's City Centre District Heating Scheme.
- 4.44** A domestic micro-CHP system costs around £3000, and reduces carbon emissions by 25%-30%. A larger system for an office would cost between £40,000 and £50,000, and reduce carbon emissions by 15%-25%. Cost savings from CHP systems vary, depending on the system selected.

Summary of carbon savings and costs

- 4.45** The following table provides a summary of the potential carbon savings and costs for each of the above technologies, based on the figures for dwellings.

Technology	Carbon saving	Cost
PV	454kg/yr for average dwelling	£5 - 7,000 per kWp installed
Solar hot water	350kg/yr for average dwelling	£2,000 - £4,000
Wind (2.5kw)	1800kg/yr	£11,000 - £12,000
Biomass boiler	1300kg/yr	£4,000
GSHP	No saving against gas, 580kg/yr against electricity	£4,500 - £14,000
ASHP	No saving against gas, 200kg/yr against electricity	£4,000 - £6,000
Micro-CHP	800kg/yr	£3,000

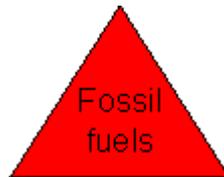
Feed-in tariffs (FiT)

The feed-in tariff scheme was introduced in 2010 to provide a financial incentive for the take-up of electricity-generating technologies. The scheme guarantees a minimum payment for electricity generated, and another payment for electricity exported to the grid. The feed-in tariff scheme applies to installations of the following technologies up to 5MW:

- Photovoltaic panels
- Wind turbines
- Hydroelectric schemes
- Anaerobic digestion
- Micro-CHP (pilot scheme only)

To qualify for payments, the technologies must be Microgeneration Certification Scheme approved.

- 4.46** The Microgeneration Certification Scheme (MCS) is an independent scheme that certifies small-scale renewable and low carbon energy technologies and installers against consistent standards. When incorporating a renewable or low-carbon energy technology within a development, it is helpful to the Planning Officer determining the application if a certified technology has been selected. Further information and details of technologies and installers can be found here <http://www.microgenerationcertification.org/>.
- 4.47** The renewable and/or low carbon energy technologies to be used in a development should be identified as early as possible in order to understand any implications for design. This should include identifying the scale of energy generation, such as building, site or district, depending on the scale of the development.
- 4.48** Part (b) of policy CS65 requires significant developments to reduce their predicted carbon emissions by 20%, using renewable or low carbon energy, or low carbon design measures. Following the changes to Building Regulations Part L (see paragraph 3.54), this part of the policy is currently not deemed to be viable. For more details, see Guideline CC2 in the Climate Change and Design Supplementary Planning Document.



The fourth part of the Energy Hierarchy

- 4.49** The fourth level of the Energy Hierarchy is the use of fossil fuels. The use of fossil fuels should be reduced as far as possible to reduce carbon emissions and reliance on centralised energy supplies which are depleting.

5 CS66 Air Quality

The policy

Policy CS66

Action to protect air quality will be taken in all areas of the city. Further action to improve air quality will be taken across the built up area, and particularly where residents in road corridors with high levels of traffic are exposed to levels of pollution about national targets.

- 5.1** Policy CS66 is a strategic policy dealing with the city-wide approach to planning for air quality. It is important that air quality is protected across the city, to ensure that it does not worsen in areas that do not currently suffer from air pollution. The policy also sets out that action to improve air quality is needed across the built up area, and that residential areas along road corridors are likely to be exposed to levels of pollution above national targets.
- 5.2** The forthcoming City Policies and Sites document will contain a policy on pollution control, including air pollution. This will set out criteria for dealing with applications where air quality is an issue.
- 5.3** This practice guide does not deal with air quality in detail. Specific actions to deal with air quality will be covered in more detail in the forthcoming Sustainable Transport Supplementary Planning Document. However, the following paragraphs will explain the process for dealing with air quality through planning.
- 5.4** The impact on air quality from small developments can be difficult to quantify, as it may only be negligible. However, the cumulative impact of smaller schemes can contribute to worsening air quality, so the Council will secure mitigation measures such as travel plans for these schemes.
- 5.5** For large-scale developments which are likely to impact upon air quality, such as supermarkets, an Air Quality Impact Assessment (AQIA) will be required. Advice can be sought from the Development Management team as to whether an AQIA will be required with a particular application. For large schemes, a package of mitigation measures will be required, such as travel plans, air quality monitoring equipment, electric vehicle charging points, and the use of specific low fuel use servicing vehicles.
- 5.6** The Development Management team work closely with the Council's Carbon Reduction and Air Quality team to ensure that the appropriate measures are secured to mitigate the impacts of development on air quality.

6 CS67 Flood Risk Management

The policy

Policy CS67

The extent and impact of flooding will be reduced by:

- a. requiring that all developments significantly limit surface water run-off;
- b. requiring the use of Sustainable Drainage Systems or sustainable drainage techniques on all sites where feasible and practicable;
- c. promoting sustainable drainage management, particularly in rural areas;
- d. not culverting and not building over watercourses wherever practicable;
- e. encouraging the removal of existing culverting;
- f. not increasing and, where possible, reducing the building footprint in areas of developed functional floodplain;
- g. not locating or subdividing properties that would be used for more vulnerable uses in areas of developed functional floodplain;
- h. developing only water-compatible uses in the functional floodplain;
- i. designating areas of the city with high probability of flooding for open space uses where there is no overriding case for development;
- j. developing areas with high probability of flooding only for water-compatible uses unless an overriding case can be made and adequate mitigation measures are proposed;
- k. ensuring any highly vulnerable uses are not located in areas at risk of flooding;
- l. ensuring safe access to and from an area with a low probability of flooding.

Where an overriding case remains for developing in a zone with high probability of flooding, development will be permitted only if:

- m. more vulnerable uses, including housing, would be above ground floor level; and
- n. the lower floor levels of any other development with vulnerable equipment would remain dry in the event of flooding; and
- o. the building would be resilient to flood damage; and
- p. adequate on and off-site flood protection measures would be provided.

Housing in areas with a high probability of flooding will not be permitted before 2016/17.

- 6.1 Policy CS67 sets out the planning approach to managing flood risk in Sheffield. The first part of the policy is about reducing the extent and impact of flooding, so avoiding flood risk in the first place. The second part of the policy sets criteria to be met where there is an overriding reason to development in areas with a high probability of flooding.
- 6.2 Parts (a), (b) and (c) of the policy are about reducing surface water run-off, and using sustainable methods of drainage.

Sustainable Drainage Systems (SUDS)

Sustainable Drainage Systems (SUDS)

SUDS provide a way of managing rainfall and surface water run-off, using techniques that mimic natural drainage. SUDS collect and manage rain as it falls, allowing it to soak into the ground and reducing the amount and speed of run-off. This helps to reduce flood risk, and replaces the need for traditional underground piped drainage systems.

6.3 There are a number of techniques that can be used to create SUDS, both landscape features such as ponds, swales, and green roofs, and engineered features such as permeable paving and soakaways. Each site where SUDS are to be used will require a different mix of features, depending on a number of factors including the size of the site, topography, geology, and the maintenance strategy.

6.4 The main benefits of SUDS are summarised in the following sections.

Water volume management

6.5 SUDS provide robust facilities for water volume management through storage and movement in on- or near-surface features for everyday rainfall and larger storm events. They can reduce run-off volumes through infiltration, and can contribute to catchment level flood risk management through flow control and managing surface water movement. In many scenarios they will reduce the volume and rate of water entering sewers, freeing capacity and reducing sewer flooding. The nature of SUDS provides further opportunities for adaptation to climate change as rainfall becomes more intense.

Water quality management

6.6 SUDS features are able to remove sediments and breakdown pollutants that have originated from urban surfaces, promoting improved water quality within developments and contributing to wider river water quality. In some situations, SUDS can contribute towards reducing flow volumes and rates into combined sewers, reducing the incidence of combined sewer overflows.

Amenity and biodiversity

6.7 SUDS are easily integrated into landscapes within development, and contribute to the visual quality and value attached to these areas. Many features can simultaneously provide formal and informal recreational opportunities, for example wildlife walks next to ponds and grass spaces temporarily used for storm storage. SUDS provide the conditions for rich habitat to be integrated into development.

6.8 The following additional values for the public realm contribute to its improved community use and appreciation.

Education

6.9 SUDS provide a strong link locally with wider natural processes such as climate change and biodiversity.

Mitigating climate change

6.10 SUDS are low carbon technologies using low embodied carbon construction; for example earth profiles, aggregates and limited concrete.

SUDS techniques

6.11 SUDS components work in a variety of ways with each potentially delivering a number of drainage functions at the same time. For example, a grass swale can deliver movement of water at the same time as attenuating or temporarily storing water, and providing some infiltration and a stage in the cleaning of run-off. A diverse range of SUDS components are available and can be tailored to each site's constraints and opportunities. Further information can be found in The SUDS Manual, available at <http://www.ciria.org.uk/suds/publications.htm>.

6.12 The sequence of features used in SUDS is called a management train. Figure 33 illustrates this.

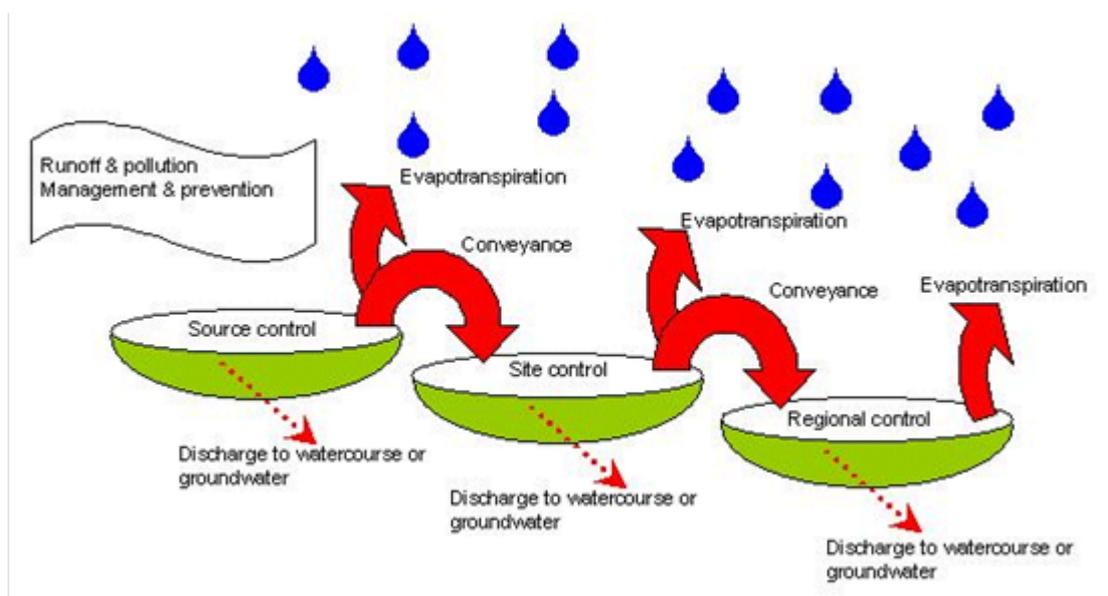


Figure 33 . SUDS management train

(Source: http://www.ciria.org.uk/suds/suds_management_train.htm)

6.13 The management train is a hierarchical concept to help describe different components' functions. It is not precise, for example a permeable paving system with storage below may provide both source control and site control, in that it can store a 1 in 100 year event. The management train intention is to provide a more robust system providing attenuation and cleaning through a series of features; spreading the level of risk, slowing the concentration of flows, and reducing the size of downstream components such as regional ponds.

Prevention

6.14 Prevention starts with the design of sites to reduce the amount of impermeable surfaces in the first place, with consideration of any potential land contamination. It also encourages good management practices, for example in preventing pollution incidents.

Source control

6.15 Source control techniques aim to control rainfall as close to the source as possible, and reduce run-off from sites. They also help to improve water quality within development, allowing water to be used as part of the amenity. Typical techniques include green roofs, permeable paving, rain-gardens, and capture swales adjacent to surfaces.

Site controls

6.16 Site controls receive water from more than one component upstream and often perform important attenuation functions. Typical features include detention basins and swales.

Regional controls

6.17 Regional controls receive water from across a whole site or a number of sites and are usually basins, ponds or wetlands. They perform cleaning of water and storm storage.

SUDS features

6.18 The following are examples of SUDS features:

- Permeable paving – can either allow water to infiltrate rather than becoming run-off, or store water with its substructure. In both situations water receives considerable cleaning.
- Rain gardens – vegetated areas into which run-off flows and infiltrates.
- Bio-retention areas – Vegetated depressions with modified free draining soils temporarily holding and treating water before piped release.
- Swales – vegetated channels that collect, convey and store run-off. They can be under-drained to improve water quantity and quality performance.
- Filter drains – also called French Drains, these are stone-filled trenches that collect, clean and convey run-off.
- Channels and rills – employed in denser development to visibly move water – can be vegetated.
- Filter strips – grass verges over which water flows into another part of the system such as a swale. They should be 5-15m wide and should be naturally vegetated.
- Detention basins – depressions in the ground that store run-off for short periods during rainfall events, but are usually dry.
- Retention ponds – contain a permanent volume of water storage and help to store and clean the water.
- Wetlands – shallow areas that are permanently wet and are planted with aquatic vegetation to store and clean water.
- Green roofs (see page 25) – include a vegetation and a drainage layer to collect, clean and store rainfall.
- Rainwater harvesting (see page 18) – collect and store rainwater on-site, which can then be used around the site.

Considerations in design

Early consideration

- 6.19** For the reasons given in the following paragraphs, SUDS design should be considered at an early stage of designing a development, when the type, style, and density of development alongside the design of public realm, open spaces and green links are considered in terms of run-off. The earlier the consideration of SUDS, the better practice can be achieved and at a lower cost.
- 6.20** If the ownership and maintenance responsibility of any SUDS feature is proposed to be transferred to the Highway Authority, the Council's Parks Department or Yorkshire Water, the developer should contact the relevant organisation and obtain their guidance and specification details before any outline design of the system is started. See the Sheffield City Council website for further information <http://www.sheffield.gov.uk/planning-and-city-development/planning-documents/planning-guidelines/design-guidance>.

Site topography

- 6.21** Topography provides the basis for the movement of water through sites in all conditions. Site building layout needs to be designed for this movement by providing key routes to discharge points such as open spaces, watercourses and sewers. Topography should rarely provide a barrier to SUDS design, as level areas can be created as part of a development for storage whether on the surface in under-drained grass spaces, ponds or basins, or on hard standing such as car parks, or below surface such as voided stone sub-base or crated construction.

Exceedance routes

- 6.22** Any system's capacity to control flows will be based on a predicted rainfall. Exceedance routes should be planned to avoid flooding and damage to property in the case of a more extreme event. This may involve the use of planned everyday routes for rainfall management such as green corridors.

Infiltration

- 6.23** Careful consideration needs to be given to SUDS relying on infiltration. Infiltration tests showing year-round scenarios should be demonstrated, and a risk assessment of likely down-slope impacts associated with subsurface movement of these flows should be undertaken.

Distribution of storage

- 6.24** Source control will reduce the scale of land take for open features for water transport and storage, by controlling volume and keeping water near the surface. Sites can be subdivided into logical sub-catchments, for example based around topography or road layout. These areas provide a focus to achieving source control before controlled flows are directed to either site or regional controls. Options should be explored for using off-site open spaces for storage and final cleaning. Rates of run-off release from sites should be agreed with the Local Authority, in consultation with the Environment Agency and Yorkshire Water as appropriate. See paragraph 11.21 of the Core Strategy for further information on run-off rate requirements.

Run-off cleaning

6.25 To ensure run-off is sufficiently cleaned, it is important to consider the catchment characteristics in terms of pollutants. An industrial area may require three or four stages of cleaning through SUDS features before discharge. The SUDS Manual provides guidance on the relative performance of SUDS features in improving water quality.

Multi-functionality

6.26 In many observed developments there are spaces that could have functioned within a SUDS management train. Design of developments should to integrate the SUDS thinking into the whole design so that opportunities are realised, this is especially the case in dense developments. Multi-functionality needs to be considered at all stages, for example sports areas and car parks providing occasional storage of flows, amenity landscaping such as verges, planted areas and permeable surfaces functioning for everyday water cleaning and volume control.

Safe design

6.27 Profiles of all SUDS features should consider safe edges and slope gradients to areas of open water. Design detailing needs to remove potential hazards and enhance the scheme's aesthetics, such as the use of mitred outfalls in preference to high head walls. Features obviously intended for amenity or interaction such as new watercourses or channels should not receive untreated water from car parks or road surfaces.

Stages in design

6.28 The table below provides a suggested list of actions during a design process:

Stage	Purpose and outcomes
Pre-application and stakeholder discussions	<p>Developer initiates contact with the local planning authority as early as possible to:</p> <ul style="list-style-type: none"> • Make sure everyone is aware of the proposed development • Ensure effective lines of communication are clear • Identify the design criteria and opportunities/constraints for the site • Ensure SUDS are integrated within the rest of the development • Understand the approaches for the adoption of SUDS in the public realm
Outline planning application and outline drainage proposal	<p>Develop outline drainage proposals via initial discussions that will define the approaches to integrate the SUDS scheme into the landscape. This could be incorporated into a design and access statement. Specific requirements will include:</p> <ul style="list-style-type: none"> • Demonstrating that sustainable drainage principles have been applied and system operation has been accounted for in the overall design parameters • Information on the appropriate sizing of drainage components • Using SUDS management train principles

	<ul style="list-style-type: none"> • Initial calculations of the flow rate from the site • Initial estimates on the amount of runoff that needs to be controlled for a storm with a 1% probability (1 in 100 year event) • An outline of the SUDS scheme with routes mapped • Demonstrating that initial scheme design considers climate change • Agreement on adoption, maintenance and operation of the systems • Identifying space for storage areas and conveying exceptional overland/exceedance flows (for extreme events) • Compliance with Code for Sustainable Homes (where appropriate)
Full planning application and detailed drainage assessment, design and consultation	<p>Prepare a detailed drainage design for submission with planning application. The scope of the drainage assessment is likely to include:</p> <ul style="list-style-type: none"> • Adequate land set aside for SUDS • SUDS designs that are integrated into the overall site concept and layout • Calculations showing peak runoff flow rates before and after development • An indication of overland flow rates and that drainage exceedance has been considered • An indication that opportunities to deliver SUDS have been maximised • Calculations showing that runoff flow and volumes can be appropriately controlled and managed • Need for investigation and further remediation of contaminated land • A method statement on how surface water will be controlled during construction • Agreement on adoption, maintenance and operation of the systems • The need for long-term monitoring

Source: CIRIA (2010), *Planning for SUDS – making it happen*

Adoption and management

6.29 Solutions to adoption and management will have a considerable influence on SUDS design. It is important to explore SUDS design considering a full management train, so that options are considered for working with the relevant bodies in relation to the scheme. This could include potential management companies, landlords, site maintenance contractors, relevant Council departments, and Yorkshire Water. Some source control features may also involve private individuals within the curtilage of the site.

6.30 There is no procedure for the adoption of any SUDS by the Local Authority or Yorkshire Water. If the ownership and maintenance responsibility of any part of the drainage system, including any SUDS feature, is proposed to be transferred to the Highway

Authority, the Council's Parks and Countryside department or Yorkshire Water, the developer should contact the relevant organisation and obtain their guidance and specification details before any outline design of the system is started. If the SUDS features are to remain in private ownership, full details of the owners and their maintenance roles and responsibilities should be provided as part of the Planning process.

- 6.31** Everyday management of SUDS will depend on the SUDS features used. Most green soft SUDS can be managed as part of the overall landscape management. In some situations this will be a wholly private arrangement, for instance on a business park or social housing site. In other situations this might involve a Council department, for example Highways or Parks and Countryside.
- 6.32** Currently, highway drainage will only be adopted by the Highways Authority when it is just managing highways water within land owned by the Authority. However, it is acceptable to provide an alternative adopter providing they are a suitably established body, for example a social housing company. In such circumstances, it may be possible to use drainage infrastructure such as swales to manage other sources of water such as roofs.
- 6.33** Management charges levied on residents or businesses for overall estate management are potentially a key mechanism to ensure adoption of integrated SUDS within development. A surface water system avoiding the use of sewers could legitimately transfer the equivalent water company surface water charge to SUDS management within the estate.
- 6.34** A SUDS management plan should be produced including an overview of the design concept. A SUDS maintenance schedule should form part of this with particular attention given to critical features such as inlets, outlets and repair methods. Routine actions such as litter collection and grass cutting as well long-term actions such as de-silting and wetland vegetation removal should be included.
- 6.35** SUDS in private ownership should be accompanied by sufficient and appropriate information to ensure features are not mismanaged or damaged. Handover to adopting bodies will usually be dependent on demonstrating construction and performance according to design.
- 6.36** Community understanding and involvement in the SUDS should allay fears and generate improved ownership.

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please contact:

Development Services
Forward and Area Planning
Tel: 0114 205 3075
www.sheffield.gov.uk