Sustainable Construction

Supplementary Planning Document
November 2021

milton keynes council

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1 Foreword

Milton Keynes has a history of pioneering approaches to sustainable design and aspires to be the greenest city in the world. Our local plan - Plan:MK - commits to continue the borough's dedication to high environmental standards, green urban landscapes and being 'different by design'. Alongside this are the Council's objectives of being carbon neutral by 2030 and carbon negative by 2050, as well as more specific recommendations related to new housing made by the Climate Change Task and Finish Group. Central to achieving these goals is ensuring that the newest developments are built using the most up-to-date and sustainable building materials and techniques. Equally important is improving the environmental performance of existing buildings.

Policy SC1 in Plan:MK sets out how new developments can be built in a sustainable manner, including considerations such as: prioritising use of materials that have smaller ecological and carbon footprints; making sure buildings have the space to accommodate greater levels of recycling waste; closing the gap in environmental performance between new dwellings as designed and as built; and reducing water usage in new developments. This Sustainable Construction Supplementary Planning Document outlines how Policy SC1 is to be interpreted and provides certainty for those bringing forward new development. It also provides guidance on the types of electric vehicle charging infrastructure that new developments should provide.

I hope this document helps you to ensure that new developments in the borough meet not only the needs of those first to use them, but also the needs of future generations.

Councillor Peter Marland

Leader of Milton Keynes Council and Interim Portfolio Holder for the Planning Service

2 Introduction and Context

The UK Government has committed to achieving net zero carbon emissions by 2050, and here in Milton Keynes we have set a target to be carbon neutral by 2030, and carbon negative by 2050. To meet these necessary targets will require substantial changes to how we live, including how we build and use buildings. In the UK 42% of emissions are attributable to the built environment, with 22% coming from the operational and embodied carbon footprint.[1] During construction buildings emissions come from the materials used in construction, transport emissions from bringing people and materials to the site, and construction emissions. Once built, buildings are responsible for emissions from operational energy, such as heating, cooling, lighting and water, as well as energy use to power appliances and machinery.

At Milton Keynes Council we have set aggressive and necessary targets to reduce our own emissions and achieve net zero, to limit emissions in line with the UN Paris Climate Agreement (COP21). However, we are already seeing more extreme weather patterns, and this is likely to accelerate, despite our necessary action on emissions. Therefore, we expect new buildings to be adapted to likely future climate scenarios, and through the planning system we will seek to mitigate climate change impacts such as flooding, the biodiversity crisis and urban heat islands, and to make our built environment more adaptable to these challenges, through measures such as building green walls and roofs where appropriate. In this sense it is a "forward-looking" document; it seeks to help solve the climate issues of tomorrow.

The planning system, through its influence on new development, plays a critical role in ensuring that the buildings we build now will be fit for purpose in the future, and in reducing the amount of greenhouse gas (GHG) emissions released during the whole lifecycle of buildings, from construction, occupation and eventual decommissioning. The National Planning Policy Framework (NPPF) states that the purpose of the planning system is to contribute to the achievement of sustainable development, including high quality, *beautiful* and sustainable places. Supporting the move to a low carbon future and use of renewable and low carbon energy in a changing climate is a core planning principle of national planning policy.

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[1] UKGBC, https://www.ukgbc.org/climate-change/ (accessed March 2020)

This Supplementary Planning Document (SPD) seeks to make it easy to interpret and understand the requirements of the Council's adopted Local Plan, Plan:MK.2016-2031 that relate to sustainable construction, as set out in policy SC1.

This document, and policy SC1, focus on issues relating to sustainable construction, and do not address other issues that affect the sustainability of a development, such as siting, location, transport links, sustainable drainage, provision of bicycle storage areas and density. These issues are covered by other policies within the Plan:MK.

In developing this guidance, we have had regard to the emerging Council agenda from the Climate Change Task and Finish Group and the Sustainability Action Plan, and Ambition 6 in the Milton Keynes Strategy for 2050 document (January 2020 Draft for Engagement). We have also considered best practice implemented in other planning authority areas, national policy and guidance.

In addressing the challenges of delivering an environmentally sustainable world we are seeing rapid innovation and new approaches across a range of sectors. In this SPD we have captured examples of technologies that developers may wish to consider, however we anticipate that over the life of this SPD the pace of change will mean that there are new, better ways of meeting and exceeding the planning requirements set out in policy SC1. We encourage developers to ensure they are doing all they can to deliver sustainable construction in Milton Keynes. Developers may decide to build new developments to other sustainable building standards, e.g. BRE Home Quality Mark or Passivhaus. We support use of such standards, provided the developments proposed also meet the standards set out in Policy SC1 in Plan:MK.

We also take this opportunity to signpost Policies SC2 (Community Energy Networks and Large Scale Renewable Energy Schemes) and SC3 (Low Carbon and Renewable Energy Generation) in Plan:MK. This SPD does not provide specific guidance on these policies. However, these policies inform key aspects of our strategy on sustainable development and must be considered in the design process.

2.1 Status of the Document

This SPD has been prepared to support policies in the Milton Keynes Council Plan:MK. It, in combination with Policy SC1 in Plan:MK, supersedes the Sustainable Construction Guide SPD adopted in April 2007.

The document is a material consideration in the determination of planning applications submitted to the Council and should be read in conjunction with the policies set out within the Milton Keynes Council Local Plan, Plan:MK. The decision to adopt the SPD was made on 23 November 2021, subject to a 10-day call-in period.

2.2 Consultation on the SPD

Consultation on this document took place between 02 November 2020 until 04 January 2021.

2.3 Purpose of the SPD

The SPD will help to ensure that we meet Plan:MK policy objectives with regards to sustainable construction. In particular, it aims to provide clear guidance as to how the requirements set out in policy SC1 can be met. It provides examples of innovative or novel approaches that may be taken to achieve the requirements and provides more detail of how calculations will be made. It aims to provide greater certainty and a consistency of approach to dealing with planning applications and their implementation.

2.4 Structure

The SPD begins with a summary. This summary is non-technical and designed to provide a straightforward overview of the content of the SPD. The SPD is then broken down into chapters each of which is aligned to a requirement within SC1:

- BREEAM Certification for Non-Residential Buildings
- Materials and Waste
- Energy and Climate
- Energy and Climate Statements
- Water
- Retrofitting

In each of these sections detailed guidance on how the requirements of the policy can be met is provided. A glossary and a template Energy and Climate Statement are provided in the Annexes.

3 Summary

3.1 Introduction

As set out in the main introduction, the purpose of this is SPD is to set out in more detail how developers can meet the requirements of Plan:MK policy SC1, and the matters that planners will consider when assessing planning applications.

The purpose of policy SC1 is to ensure that new development in Milton Keynes is responsible for as little carbon emissions as possible. This will help us to meet our net zero carbon target, which is part of a national and global effort to prevent the worst impacts of climate change. At the same time we know that some climate change is already 'locked in' due to historic emissions and policy SC1 also considers how buildings can be designed in a way that will limit the damage to them and protect their occupants in cases of extreme weather, such as flooding or heat waves.

Policy SC1 considers six broad categories within development activity and the built environment which relate to sustainability:

- BREEAM Certification for Non-Residential Buildings
- Materials and Waste
- Energy and Climate
- Energy and Climate Statement
- Water
- Retrofitting

This summary provides an overview of the guidance, which is set out in more detail in this SPD.

3.2 Applicability of Guidance

To ensure that the planning system is proportionate, and we do not create an unfair burden on developers, or prevent schemes being brought forward some of the requirements of SC1 only apply to larger developments. This is summarised in Table 1 below.

Table 1 – Applicability of SC1 requirements

Topic	Policy Number	Applicable to			
		Non-Resi >1000 sq. m. which has a BREEAM Outstanding Rating	Householder Development	Minor/Small Scale Major Development (<11 dwellings; <1000 Sq. m. non-residential)	Small/Large Scale Major Development (>11 dwellings; >1000 Sq. m. non-residential)
Overall	SC1 A	Yes	No	Yes	Yes
Materials and Waste	SC1 B-G	No	No	Yes	Yes
Energy and Climate	SC1 H-J	No	No	Yes	Yes
	SC1 K.1	No	No	No	Yes
	SC1 K.2	Yes	No	No	Yes
	SC1 K.3	Yes	No	No	Yes
	SC1 K.4	No	No	No	Yes, if proposal is for or includes residential development.
	SC1 K.5	Yes	No	No	Yes, if proposal is for or includes residential development.
	SC1 K.6	No	No	No	Yes, if proposal is for or includes residential development.
Water	SC1 L	No	No	Yes, but only for residential developments.	Yes, but only for residential developments.
	SC1 M	No	No	Yes	Yes
Retrofitting	SC1 N	Yes	Yes	Yes	Yes
Community Energy Networks and Large-Scale Renewable Energy Schemes	SC2 A	Yes	No	Yes	Yes
	SC2 B	Yes	No	No	Depending on development scale and type, potentially.
	SC2 C1-3	Yes	No	Yes	Yes

3.3 BREEAM Certification for Non-Residential Buildings

BREEAM is an internationally recognised way of assessing the sustainability of masterplanning projects, infrastructure and buildings. It has six ratings that can be awarded:

- Outstanding
- Excellent
- Very Good
- Good
- Pass
- Unclassified

To grade a development a BREEAM assessor will consider its designed performance across a number of different topics, which include subjects such as energy, pollution or waste. In each topic there are different targets, and meeting the targets leads to 'credits' being awarded.

In Milton Keynes, if a non-residential development that is larger than 1000sq. m achieves BREEAM Outstanding, we will not require it to meet the other elements of policy SC1, with the exception of K.2/3/5. This is because the BREEAM rating already demonstrates that the project is very sustainable, in line with our objectives from the policy.

If a developer is seeking to achieve BREEAM Outstanding the sorts of design features they will need to use include:

- Considering innovative construction techniques
- Using sustainable technologies, from low energy lighting to rainwater harvesting
- Displacing fossil fuel energy for example through generating renewable energy on-site

3.4 Materials and Waste

It takes energy to create the materials used in construction, and the choice of material by developers will affect how energy efficient a building is, because of this we want to make sure that the right materials are used in new development in Milton Keynes.

Further, through reducing the amount of waste generated in the construction process we will reduce the energy needed to process waste, prevent new materials being produced unnecessarily, and reduce our landfill requirements.

To support our objectives we have set requirements for developers in the following areas:

- Reusing land and buildings
- Reusing and recycling demolition materials
- Prioritising ‘low carbon’ materials and construction techniques
- Installing green roofs and green walls
- Designing buildings so they can be adapted to different uses in the future
- Providing space which encourages building users to recycle

3.5 Reusing land and buildings

Milton Keynes is a developed area, and there are few sites in areas suited for development (e.g. not on land designated as Open Countryside, etc) that do not already have buildings on them. While it may seem like an attractive option to developers to demolish and replace those buildings, demolition often creates lots of waste, and requires lots of energy.

Because of this we prefer developments which are able to make use of existing buildings. This is known as ‘adaptive reuse’. As well as reducing waste, adaptive reuse can help us to preserve the buildings that give Milton Keynes its distinct character, and it can also reduce the local disruption caused by construction works.

Developers who wish to demolish a building will need to demonstrate to us that they have considered adaptive reuse, and that this is constrained due to:

- Building condition
- Market demand for new function
- Current building regulations
- Functional and technical feasibility
- Efficient redesign
- Financial feasibility

3.6 Reusing and recycling demolition materials

Where we grant permission for a building to be demolished, we expect that developers will recover at least 70% of the materials from the previous building to use either in the new development, or for use in another local development. We define local as within 35 miles.

This reduces the need for new materials to be used in the new building and prevents demolition materials from filling up our limited landfill capacity. There are guides available, such as the Construction Industry Research and Information Association (CIRIA) Reclaimed and Recycled Construction Materials Handbook'[2], which can help developers when thinking about how to reuse waste material.

3.7 Sustainable materials and construction techniques

We ask developers to prioritise using materials which are low carbon and have a low ecological footprint. We also ask them to take an approach to construction which reduces environmental damage, supports good air quality, makes *beautiful* places and provides future resilience to the changing climate.

This includes a requirement to reduce the use of materials on site for example by;

- Not using more materials than are necessary (known as 'overspecifying')
- Not ordering more materials than are needed for the project
- Ensuring waste is sorted on site to encourage recycling

We expect that developers will reuse materials already on site (or sourced from local sites) where possible. However, we recognise this will not be possible for all materials. New materials for development should be sustainably sourced and/or be made with a high level of recycled content. We also want developers to think about the journey that materials take to site. Reducing the number of journeys made, and the distance of those journeys will reduce the carbon emitted from the construction of a building. Carbon emissions, and energy usage can also be reduced on site through the use of energy efficient tools and equipment, the use of mains electricity where available, and insulating any temporary buildings used as on site welfare facilities.

Good design and choosing the right materials are important to build buildings which will be energy efficient once they are being used. This includes selecting 'cool materials' which reflect light and heat away from buildings, and using materials with a high thermal mass, which can absorb heat and release it slowly over time.

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2 https://www.ciria.org/ItemDetail?iProductCode=C513D&Category=DOWNLOAD&WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91

Choices about materials, the design of buildings and the landscapes around them also have an important role in reducing internal air pollution. We expect developers to think about ventilation, but also to use non-toxic materials that will not release dangerous pollutants into the air.

3.8 Green Roofs and Walls

Green roofs and walls are a layer of living plant material added to the roof or wall of a building. There are lots of benefits that they can provide, including:

- Helping manage the amount and speed of water that enters the drainage system when it rains
- Providing insulation to buildings to reduce temperature fluctuations
- Improving air quality
- Increasing biodiversity

Because of these benefits we want to see an increase in the use of green walls and green roofs in Milton Keynes and expect them to be included in building designs wherever this is possible. For the green roof or wall to be successful in the long term, developers will need to consider the plants they are going to use and ensure that their environment will allow them to thrive. This means taking into account:

- The amount of sun the surface will receive, including any shading from parapets or nearby buildings
- Any airflows or exhausts that may change the existing conditions
- The wind exposure
- The level of rainfall the plants will receive and any ‘rain shadows’

As the roof or wall will need to be maintained, developers will also need to think about how access is provided.

3.9 Building lifecycle considerations

In this SPD we have described how we want existing buildings to be reused, and where this is not possible how materials from the demolition process should be reused and recycled. To make this easier for the future we want the buildings that are built now to be designed in a way that makes it easy to use them for different purposes, and are easy to take apart at the end of their life. To do this we are asking developers to consider:

- The ‘functional adaptability’ of their building, and

- ‘Designing for deconstruction’ (DfD)

Functional adaptability describes the ability to change a building. Key features include having a building structure that allows internal layouts to be changed easily, removing barriers to extending a building and fitting flexible services that can be connected to in different ways at different times in the buildings life.

DfD refers to building in such a way as to make disassembly easy. In practice this means avoiding the use of composite materials, putting together buildings with simplified and standardised fittings, which can be taken apart easily, and finally maintain good records of the building so a future contractor knows what to do when it comes to taking it apart.

3.10 Recycling space

We want to make it as easy for people to choose to recycle as possible. This means making sure that bins are provided to allow people to separate waste when they are throwing it away. It also means making sure that communal bin stores are secure and have enough space.

We expect developers to think about how bins are collected in Milton Keynes and make sure that their layouts facilitate safe and easy bin collection with accessibility for waste collection vehicles when required in line with other policies within the developmen plan, while also providing space for bins to be stored that is not unsightly.

3.11 Energy and Climate

In Milton Keynes we want to make sure the buildings we build now have a low carbon footprint, so that they do not contribute to further climate change, and that these buildings are resilient to the changes in the climate that are already being caused by greenhouse gas (GHG) emissions.

Developers must therefore:

- Implement the energy hierarchy
- Consider providing energy storage and demand management
- Design resilient buildings and built environment

We also require developers of large schemes (more than 11 homes, or more than 1000 sq. m commercial) to provide an Energy and Climate Statement setting out how they are addressing specific issues relating to carbon reduction, air quality, overheating and quality and monitoring regimes. A template to help developers to complete this is provided in Annex C.

3.12 Energy Hierarchy

The energy hierarchy is an approach based on three steps, the first of which is to use less energy. This can be done with energy efficient technologies, and for new buildings we want developers to focus on fabric standards, and consider how passive design can reduce the need for active heating and cooling (active heating and cooling is heating and cooling that uses energy, for example central heating or air conditioning).

Only once energy use has been reduced as much as possible should building design consider the next step, which is the efficient supply of energy using technologies such as Community Heat Networks or heat pumps to supply energy while using as little electricity or fossil fuels as possible.

Finally, for the energy that the building still needs once energy use has been reduced and energy is being supplied efficiently, developers should look at how renewable and low carbon energy can be provided.

Examples of renewable technologies that may be considered for developments include:

- Biomass heating systems, including wood burning stoves
- Solar thermal
- Solar photovoltaics
- Wind turbines

3.13 Energy Storage and Demand Side Response

In the future much more of our energy will come from renewable sources and be generated at a local level. This means that there will be more variability in the amount of electricity that is generated at different times, for example solar generation can only happen when there is enough sunlight.

To help match the amount of electricity being generated with the demand for it energy storage is important, it allows us to store energy that has already been produced until we need it in the future. Energy storage can be mechanical (for example pumped hydro electric) or chemical (batteries). Batteries are expected to be very important in the future, and are the most appropriate option for urban development, so we have focussed on them in this SPD.

Because batteries contain lots of chemicals there are some risks associated with them, including fire resistance, fire and explosion propagation, as well as concerns about performance, efficiency and resilience to ambient conditions. We will therefore require developers who intend to build battery storage systems to provide us with sufficient information so we can properly assess their application.

Demand side response describes how the demand for electricity from consumers can be matched to the supply of electricity. This is important because if there is a mismatch between supply and demand it can mean that not enough electricity is provided, or that there is too much electricity which can damage the infrastructure used to transport electricity.

As more of our energy is generated from renewable sources and there is greater use of electricity for heating and transport (through electric vehicles), demand side response will become more and more important.

There are three key elements of demand side response:

- Demand response: Providing a financial incentive to turn off or turn down energy usage at times of peak grid demand
- Demand reduction: Through energy efficiency measures which reduce the need for electricity
- Distributed generation: Using local generation of heat or electricity

3.14 Resilient buildings

'Climate resilience' refers to the ability of buildings, the built environment, and communities to withstand the changes in climate that are happening as a result of GHG emissions. Many of these changes are now 'locked in' by historic emissions and our forecast future emissions as we work towards carbon neutrality or 'net zero'.

In Milton Keynes we expect to see:

- More frequent and intense rain, leading to pressure on drainage, and a higher risk of flooding
- More heat waves, creating issues of overheating and demand for cooling systems
- Periods of drought which will create greater risk of water shortages, and could damage building materials and cause subsidence to properties with clay soil
- More frequent 'extreme weather' such as storms, which may damage buildings.

Buildings and the landscape around them will need to be designed to mitigate these climate effects. Examples of measures that might be included are:

- Reducing the risk of overheating by using passive cooling techniques, shading and appropriate materials, as well as maximising ventilation (both in buildings and between buildings)
- Reducing the urban heat island effect by using reflective materials for pavements and roofs
- Reducing the risk of flooding by using green roofs and walls, which capture water, and using sustainable drainage systems (SuDS)
- Mitigating the impact of flooding by minimising the use of ground floors and basements

3.15 Water

In the section above we have explained that one of the expected changes in our climate is an increase in droughts. This will make it more important than ever that we carefully manage the use of water in Milton Keynes. The Ruthamford South Water Resource Zone in which the majority of Milton Keynes sits, is already in a position of water stress.

It also takes energy to treat waste water, and to pump it around the network of water pipes. Because of this reducing our water use has important environmental benefits. Water is also an essential utility that will become more scarce as the climate changes. Thereore, better water management, and the re-use of water is important for the sustainability of our communities.

New homes in Milton Keynes will have to achieve an estimated water usage of no more than 110 litres per person per day. To improve the water efficiency of their buildings developers should consider:

- Installing low flow and water efficient technologies (such as low flow taps and showers)
- Preventing leaks in pipes through using durable plumbing
- Providing visible water meters that allow water use to be monitored

Alongside reducing the amount of water that is used in our buildings, developers should also consider how alternative sources of water to mains water can be used, through rainwater harvesting and grey water recycling.

Rainwater harvesting is the process of collecting rainwater (for example from the roof through gutters) to use in the home. The simplest systems collect rainwater in a water butt for use in the garden, but rainwater can also be filtered and used in the home in situations where drinking water is not required, such as flushing the toilet or doing laundry.

Greywater is water that has already been used in the home and is 'dirty', for example water from showering or doing the washing up. Like rainwater, this greywater can be cleaned and reused in certain places in the home.

Water which is not from the mains, and is not safe to be drunk is described as 'non potable'. It is very important that non-potable systems are kept separate from mains water to avoid contamination, and that clear signage is used to avoid any confusion.

3.16 Retrofit

As well as thinking about how new buildings can reduce carbon emissions and be resilient against climate change, we also need to think about how our existing buildings can be upgraded to make them more efficient. This is known as 'retrofit'.

Many retrofit measures can be undertaken without consent from the Local Planning Authority, but this depends where the property is located and also whether or not it has any special designations (for example if it is a listed building).

Examples of where planning permission could be required include:

- Air source heat pumps
- Biomass heating system, including wood burning stoves
- Double and triple glazing
- Externally applied solid wall insulation
- Green walls and roofs
- Mechanical ventilation and heat recovery
- Rainwater harvesting
- Roof insulation at rafter level
- Slim profile double glazing
- Solar thermal
- Solar photovoltaics
- Wind turbines

3.17 Conclusion

Through this SPD we are seeking to ensure Milton Keynes is a greener, more sustainable place to live and that we achieve our objectives to reach net zero carbon. If you are uncertain about any content in the SPD or how the guidance applies to your proposed development, please get in touch with the Planning department.

4 BREEAM Certification for Non-Residential Buildings

BREEAM is an international sustainability assessment method for master planning projects, infrastructure and buildings. Under BREEAM, both new construction and refurbishment projects are awarded a rating from Pass to Outstanding. Non-residential development of more than 1000 sq. m which is demonstrated to achieve a BREEAM Outstanding rating will not be required to meet the requirements of policy SC1 with the exception of requirements K.2/3/5. This chapter therefore provides an explanation of the BREEAM certification system, and some of the features a non-residential development will need to have to achieve an 'Outstanding' rating.

Policy SC1

A. Development proposals will be required to demonstrate how they have implemented the principles and requirements set out below. With the exception of requirements K.2/3/5, non-residential development of 1000 sq.m or more that is demonstrated to achieve a BREEAM Outstanding rating will not be required to meet the requirements below.

4.1 BREEAM Certification System

BREEAM requires independent third-party certification of the assessment of the sustainability performance of buildings. The assessment and certification are available at several stages of a development's life cycle including:

- Design
- Construction
- Operation
- Refurbishment

BREEAM has five schemes, for different types of project:

- Communities
- New Construction

- Refurbishment
- In-Use
- Refurbishment and fit out

There is also a bespoke process available for projects that do not fit within these categories. The relevant schemes for non-commercial development would usually be 'New Construction' and 'Refurbishment and fit out' (the latter for existing developments) but developers should select the scheme appropriate to their project. Guidance on each of the schemes can be found at breeam.com.

BREEAM Rating	% score
Outstanding	≥ 85
Excellent	≥ 70
Very Good	≥ 55
Good	≥ 45
Pass	≥ 30
Unclassified	< 30

Figure 1: BREEAM Scores

A BREEAM assessment awards a project a percentage score which is equivalent to a rating from Pass to Outstanding, as shown in Figure 1. This percentage score is calculated through considering a series of categories, such as energy, pollution or waste. Each category is then sub-divided into assessment issues, with their own aim, target or benchmark. For each target or benchmark reached the development will score points which are known as credits. The score for each category is calculated based on the % of available credits achieved, and the category weighting. The final performance rating is based on the sum of the weighted category scores, subject to the minimum standards for each level being achieved.

4.2 Development Features for BREEAM 'Outstanding'

The BREEAM Outstanding rating requires innovation across all aspects of the project. Examples of the approach taken for developments which have successfully achieved BREEAM Outstanding, are set out below as a guide for developers:

- Integrating the BREEAM process in the brief from day one
- Having a BREEAM specialist in your project team who is engaged throughout both the design and construction phase, encouraging the team to collate evidence as the design unfolds.
- Incorporating lifecycle costing into the design
- Reducing embodied carbon, alongside the conventional focus on operational carbon (see 5.4 D. Sustainable Materials and Construction Techniques and 9 Retrofitting)

- Considering innovative construction management techniques to reduce the environmental impact of the construction process (see 5.4.3 Sustainable Construction Techniques)
- Making use of sustainable technologies, such as renewable energy generation, LED lighting and rainwater harvesting (see Chapter 6. Energy and Climate and 8 Water)
- Responding to user needs, as '*The BREEAM system rewards innovation to create not just a sustainable building, but a place for sustainable businesses to thrive*[3].'
- Including consideration of small efficiency gains in utilities, and displacing the grid and fossil fuels with renewable energy technologies
- Embracing innovative technologies

Many of the credits needed for BREEAM Outstanding can come from renewable energy technologies, especially if a scheme is able to completely displace fossil fuels by marrying clever design with innovative technologies. For example, combining passive construction techniques (see 6.1.2 Passive Design) with heat pumps and solar PV, is one way to achieve a head start on achieving BREEAM Outstanding. In addition, water recycling and onsite treatment can also make a real difference.

4.3 Smart Buildings and the Internet of Things (IoT)

BREEAM Outstanding requires developments to respond to the needs of their users. This requires going beyond a good Building Management System (BMS) and incorporate the use of smart buildings technology and the Internet of Things (IoT). Smart building technology is technology which automates the control of electrical, mechanical systems, and structure of a building. The IoT is a system of internet connected objects and appliances, that are able to identify and transfer data to each other. Together, smart building technology and the IoT allow for maximum efficiency, comfort and complete remote management, including non-intrusive maintenance. Examples include:

- Integrating CCTV with fire and occupancy sensors
- Automated blinds and temperature controls

When incorporating these systems, it is important that users retain a level of control and are able to make the building work for them. This means there should be the ability to override building automation if required.

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[3] Ms Messenger, Sustainability Adviser at BAM

4.4 Planning Assessment of BREEAM

In some cases, the construction design may have achieved an Interim BREEAM Outstanding rating and certificate of assessment prior to planning application, and in these cases Policy SC1A will be considered to have been met. However, at planning application stage, it is unlikely that the plans submitted would be detailed enough to have been assessed and certified.

Therefore, if developers intend to achieve BREEAM Outstanding for their project rather than meeting the requirements under SC1 (with the exception of requirements K.2/3/5), they must demonstrate that they have registered the development with a BREEAM certification body. A pre-assessment report or Design Stage (DS) certificate must be submitted to Planning before construction starts.

Once construction has been completed, the developer will need to submit the Post Construction Stage (PCS) certificate proving that BREEAM Outstanding rating has been achieved for the development. The PCS certificate must be submitted to the planning department before occupation.

5 Materials and Waste

Using carbon efficient materials, reducing the amount of materials used, and recycling and reusing materials all play an important part in ensuring GHG emissions are reduced. This chapter provides further guidance on how the requirements of Policy SC1 B to G can be met.

Policy SC1: Materials and Waste

B. Reuse land and buildings wherever feasible and consistent with maintaining and enhancing local character and distinctiveness.
C. Reuse and recycle materials that arise through demolition and refurbishment, including the reuse of excavated soil and hardcore within the site.
D. Prioritise the use of materials and construction techniques that have smaller ecological and carbon footprints, help to sustain or create good air quality, and improve resilience to a changing climate where appropriate.
E. Incorporate green roofs and/or walls into the structure of buildings where technically feasible to improve water management in the built environment, provide space for biodiversity and aid resilience and adaptation to climate change.
F. Consider the lifecycle of the building and public spaces, including how they can be easily adapted and modified to meet changing social and economic needs and how materials can be recycled at the end of their lifetime.
G. Space is provided and appropriately designed to foster greater levels of recycling of domestic and commercial waste.

5.1 Context

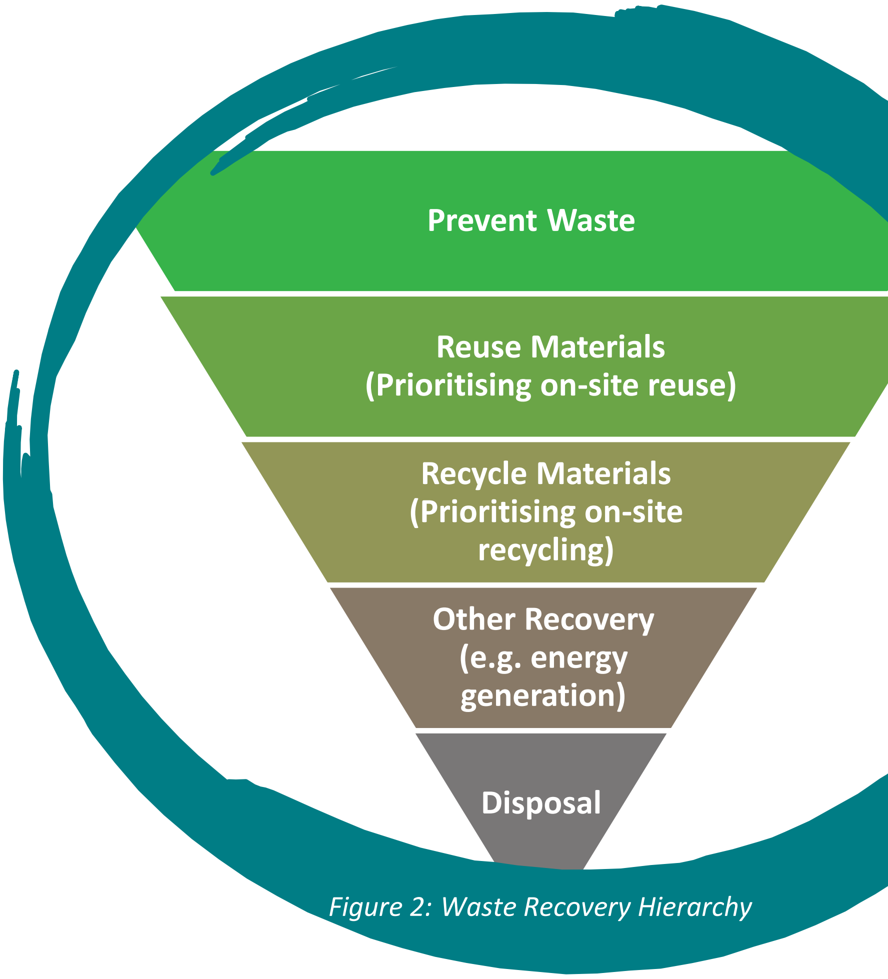

Figure 2: Waste Recovery Hierarchy

In developing new buildings, we expect developers to minimise waste generated, and maximise reuse through the implementation of the Waste Recovery Hierarchy throughout the demolition and construction process.

Under the Milton Keynes Local Validation List, Site Waste Management Plans (SWMP) must be produced. The requirements of these plans is provided in the Waste Development Plan Document.[4] Developers may wish to consider following Defra's SWMP guidance[5] to assist them in managing waste, as well as 'smartsite' from BRE[6], and WRAP's research which is now part of the CIRIA library[7].

We expect developers to make use of sustainable construction techniques, and that new buildings will be designed to reduce emissions and waste across their lifecycle making the most of new technologies such as green roofs, as well as more conventional design considerations such as providing adequate space for recycled waste storage and accessibility for waste collection vehicles, when required by other policies in the development plan. Materials should be selected with sustainability in mind.

More details as to how developers could meet planning policy requirements are set out below.

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[4] Policy WCS3, https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/waste-development-plan-document

[5] https://webarchive.nationalarchives.gov.uk/20130123184111/http://archive.defra.gov.uk/environment/waste/topics/construction/pdf/swmp-guidance.pdf

[6] https://www.bresmartsite.com/

[7] https://www.ciria.org/CIRIA/Sign_In.aspx?WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91&LoginRedirect=true&returnurl=%2fCIRIA%2fResources%2fResource_Efficiency_Knowledgebase%2fResources%2fREK%2fResource_Efficiency_Knowledgebase_.aspx

5.2 B. Reuse of Land and Buildings

Where there are existing buildings on a development site, consideration should be given to whether these can be reused, refurbished, repaired or converted. This is known as 'adaptive reuse'. Reusing buildings presents opportunities to not only reduce waste, but also to preserve the character of an area and avoid disruptive demolition work.

Where developers are seeking to demolish rather than reuse an existing building, they will be expected to demonstrate why reuse is not possible or appropriate. In assessing whether an existing building is suitable for adaptive reuse, developers should consider:

- Building condition and contribution to character of the local area
- Functional and technical feasibility
- Efficient redesign

Case Study of Adaptive Reuses: Nevill Holt Opera

Shortlisted for the 2019 RIBA Stirling Prize, the Nevill Holt Opera, is a 400 seat auditorium, near Market Harborough in Leicestershire reusing a former stable block at a historic hall.

The building has a new roof and upper walls but retains many of the original building's structures and materials.

Photographs: Hélène Binet

In undertaking adaptive reuse, the building may be changed or reshaped. Original features may be reused for other purposes, for example original beams repurposed as desks in an office conversion.

Historic England provides guidance for the Adaptive Reuse of Traditional Farm Buildings which developers may find it useful to consider.[8] Where buildings provide a positive contribution to the character of the area and/or are a heritage asset, greater weight shall be placed on the building's retention and adaption.

5.3 C. Reuse and Recycle Materials

Where demolition is necessary, developers should seek to optimise the reuse and recycling of demolition materials. Reusing materials is better than recycling them, and where possible reuse or recycling should happen on rather than offsite. Undertaking a pre-demolition waste audit will enable developers to understand the materials on site and make a clear plan as to how to divert these materials from landfill. For schemes where demolition is planned, the developer will be expected to demonstrate how they will achieve waste recovery of at least 70%[9].

CIRIA has produced a 'Reclaimed and Recycled Construction Materials Handbook'[10], which sets out practical advice for dealing with specific materials. Materials that can potentially be reused include:

Figure 3: Materials Reuse

Bricks and Blocks

How construction materials can be reused and recycled in a variety of ways on a construction site is typified by the example of bricks and blocks.

Bricks can be reclaimed and reused in new brickwork

Bricks and blocks can be crushed and used as a construction material

Bricks and blocks can contain recycled material such as waste in their manufacture

[8] Historic England https://historicengland.org.uk/images-books/publications/adaptive-reuse-traditional-farm-buildings-advice-note-9/heag156-adaptive-reuse-farm-buildings/ (Accessed January 2020)
[9] This equals [1-(waste sent to landfill ÷ waste generated)] x 100.
[10] https://www.ciria.org/ItemDetail?iProductCode=C513D&Category=DOWNLOAD&WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91

- Unwanted furniture, fixtures and fittings - historic fireplaces, timber floorboards, doors
- Building materials such as bricks, concrete, roof tiles
- Metals such as aluminium, copper, lead and zinc found in frames, guttering, roof covering, piping, flashing, etc.
- Plastics which can be recycled
- Sub-soil and topsoil which may be using in landscaping
- Green waste which may be used as mulch or composted

Waste that cannot be reused should be recycled. For example, re-using demolition rubble (foundations, columns, slabs, floors) for aggregate in roads and as inert fill on minerals sites and for new construction, or using masonry material for driveways or waste soil for landscaping. To produce quality recycled aggregate from demolition waste it is essential to separate the different materials from the debris to avoid contamination.

Hazardous waste arising from demolition needs to be stored in line with the requirements of the Environment Agency until it can be reused or recycled. Where on-site crushing and screening forms part of the reuse or recycling approach, developers should note that operating a mobile plant requires a waste management license. Some small-scale recovery may be exempt from licensing but will still need to be registered with the Environment Agency.

5.4 D. Sustainable Materials and Construction Techniques

The use of sustainable materials, i.e. those with a low embodied carbon and ecological footprint, should be prioritised, and the approach to construction should reduce environmental impacts, help to sustain or create good air quality, and improve resilience to a changing climate where appropriate.

This approach can have benefits for developers through reducing costs, as well as mitigating the generation of waste, and safeguarding resources for future generations.

All Design and Access Statements, or where included, Sustainability Statements should provide justification for the choice of building materials and construction techniques used, demonstrating that consideration has been given to the guidance below.

5.4.1 Waste and Recycling

As well as waste arising from the demolition process described at 5.3 C. Reuse and Recycle Materials above, waste will result from the construction process. This may be minimised through the procurement phase, by:

- Requiring suppliers to participate in 'take-back' schemes where suppliers retrieve packaging and any unused materials
- Avoiding over-ordering of materials, which accounts for 13 million tonnes of new building materials being thrown away each year[11]

All schemes should consider how waste will be managed during the construction phase. Segregating waste produced at source is more effective than off-site sorting and avoids contamination of reusable materials. Space should be provided in site plans to effectively manage waste at a site waste compound. The site waste compound should be situated so as not to give rise to pollution, and make provision for dedicated material skips, and space for the storage of specialised material for on-site recycling.

Waste management training for the construction workforce, and clear signage and colour coding of waste, skips and bins can support effective waste management practice.

Wherever possible developers should promote 'closed loop recycling' where materials are recycled back into the same material (for example recycling glass back into glass containers instead of aggregate.) This includes:

- Metals and high value materials
- Timber, plasterboard, packaging, and
- Concrete crushed and re-used for concrete aggregate

For any materials that have not been reused or recycled, consider exchange, sale or donation, directories are available which provide organisations and schemes for the collection, storage, haulage, reuse, reclamation, recycling and disposal of construction and demolition wastes, as well as websites which facilitate advertising and trading for a selection of available materials. Specialist waste exchanges may also be used, who can sort, clean, repair and refurbish the waste materials and then find businesses that can reuse or recycle them.

[11] http://www.sustainablebuild.co.uk/ReducingManagingWaste.html

There are many opportunities to use recycled materials, and if materials are not available on site these could be sourced from other construction projects, ideally from local sources.

There are also construction materials with high recycled contents available, identified by WRAP best practice recycled content benchmarks. Developers should specify in their application the proportion of reclaimed or recycled materials to be used in the proposed development.

As set out above, as per the Local Validation List, all major applications and applications involving significant demolition during construction are required include a Site Waste Management Plan.

5.4.2 Sustainable Materials

When selecting new materials developers should consider:

- Fire risk requirements introduced in 2021 as part of Government's *Planning Gateway 1* suite of Planning and Building Regulations reforms.
- The 'embodied carbon' of the material, which is the CO2e emissions resulting from the production of the material
- The energy performance of the material in use over the lifecycle of the building
- The emissions due to transport of the material to site - locally sourced materials (within 35 miles) will be considered favourably
- Avoiding the use of materials or products that produce volatile organic compounds (VOCs) and formaldehyde
- The durability of the material, so as to minimise the maintenance and replacement requirements
- Whether the materials can be reused or recycled
- How the materials chosen will ensure the proposal contributes to "high quality, *beautiful* and sustainable places", as required by Paragraph 126 in the NPPF.

Figure 4: Example sustainability marks

Where new materials are required several materials certification programmes exist which can provide assurance that materials are responsibly sourced. These include Forest

Stewardship Council (FSC), Corporate Sustainability Assessment (CSA), Programme for the Endorsement of Forest Certification (PEFC), and Sustainable Forestry Initiative (SFI). Developer's may also wish to consider BRE's Green Guide to Specification[12].

The materials selected should promote the efficient use of the building in operation. For example:

- Using 'cool materials', which reflect light and maximise heat radiance, in roofs and pavements can help reduce the urban heating effect and improve the built environment, as well as reducing the use of air conditioning[13]
- Selecting materials with a high thermal mass, which absorb heat and release it slowly over time, preventing overheating in the summer and cooler conditions during the winter, acting as a buffer against heat fluctuations (see 6.1.2 Passive Design)

As well as considering the sustainability of materials used, applicants should consider the amount of materials their building requires. Reducing material use mitigates the carbon emissions from production, transport and installation. As such developers should avoid over-specifying their scheme and should not over-order materials. Where developers are using a small amount of a material that is only available in bulk, they should make use of a materials exchange scheme, or plan to use the material for future jobs.

On site space should be allocated for the safe and correct storage of materials to avoid damage by damp, excess moisture, rain or daylight, as well as to prevent theft.

5.4.3 Sustainable Construction Techniques

Developers are encouraged to utilise Passive Design measures[14], which are described in detail at SC1 H, and also to consider Biophilic Design. Biophilic design is focussed on connecting 'people to nature and natural processes enabling them to act in more productive ways'.

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[12] https://www.bregroup.com/greenguide/podpage.jsp?id=2126

[13] Roofs and pavements cover about 60 % of urban surfaces and absorb more than 80 % of the sunlight that contacts them, which is then converted to heat. Increasing the reflectance of buildings (particularly roofs) and paved surfaces, whether through white surfaces or reflective coloured surfaces can reduce the temperature of the built environment. https://www.coolrooftoolkit.org/wp- content/pdfs/CoolRoofToolkit_Full.pdf

[14] For comprehensive information on Passive Design please check 'Passivhaus', the low-energy construction standard developed in Germany, http://www.passivhaus.org.uk

This complements the Passive Design principles of making best use of natural daylight and ventilation and avoiding overshadowing and optimising solar gain through the use of architectural features and green infrastructure.

Biophilic Design proposes:

- Providing natural space with naturalised or planted areas around buildings and ensuring that windows overlook these areas
- Routing access paths through planted areas
- Bringing nature and planting inside and on buildings, including the use of green walls/roofs
- The use of natural materials

As well as addressing overheating, this approach also tackles the relationship between materials and air quality. Although pollution is usually associated with the external environment, internal air can also become polluted.

Sources of internal air pollution include:

- The infiltration of external pollutants, such as nitrogen dioxide and particulates from vehicles
- Build-up of internal contaminants such as cleaning products, for example the potentially carcinogenic acetaldehyde from fabric softeners in drying laundry
- VOCs and formaldehyde given off by furnishings and building materials

As well as to provide adequate ventilation and air filtration to promote good indoor air quality, developers should consider specifying environmentally sensitive (non-toxic) building materials, and the use of materials or products that produce VOCs and formaldehyde should be avoided. The impact of materials on air quality, and choices made to use environmentally sensitive materials can support the achievement of relevant BREEAM credits, if you will be applying for BREEAM certification, provided a clear audit trail is included in the submission.

In addition to utilising sustainable construction techniques, developers should consider how they will undertake the construction process as efficiently as possible, reducing waste, pollution and carbon emissions.

Developers are expected to understand the CO2e emissions that will arise as a result of their construction activity and should consider whether they can use low energy forms of construction. This includes:

- Ensuring plant and equipment is well maintained and operated correctly, and if possible, using energy efficient plant and equipment
- Insulating welfare facilities, and using efficient lighting
- Using mains electricity where available and avoiding oversizing generators. Generators load should be higher than 40%, with maximum efficiency typically above 70% load

A quick win can be achieved by reducing journeys to and from the site by planning work and delivery schedules in order to reduce CO2 arising from transport. This can also help to mitigate the impact of construction on the local community.

Applicants should also consider how they will minimise concrete dust, air and water pollution arising from activities on site.

Depending on the characteristics of each development proposal and site, conditions may be used to secure the submission of a Construction and Environment Management Plan if planning permission is granted.

5.5 E. Green Roofs and Walls

Excellent architecture and urban design are required if we are to adapt to the extremes of climate change. Green roofs and walls enhance biodiversity, reduce flood risk (by absorbing heavy rainfall), provide insulation and improve the appearance of developments, both existing and new.

Developments should aim to incorporate green roofs and/or green walls into their design where technically feasible. This will be particularly important:

Figure 5: Example of a green roof; Fukuoka, Japan.

- In areas with low levels of vegetation, such as local and town centres, and Central Milton Keynes (shopping and business areas), which are both more likely to feel the effects of climate change.
- For developments where occupiers will be susceptible to overheating such as schools and offices
- Where the site is an area that has historically suffered from surface water flooding.

- Where the development is likely to result in a loss of biodiversity habitat on the site and/or the surrounding area.

Developers will need to bear in mind that proposals will also need to comply with any relevant building regulations requirements, including those regarding structural loads. We expect that ongoing maintenance plans for green walls and green roofs will be known at the time of application submission, with plan specifics following guidance in the GRO Code.

Green roofs and walls may not be appropriate in certain settings, particularly for heritage assets and in Conservation Areas. Any such proposal would need to carefully consider the impact of the green roof/green wall/associated structural changes on site character/significance, in accordance with Policy HE1 in Plan:MK.

In general, green roofs and walls should be designed to primarily benefit biodiversity. For more information about the Council's expectations of developers in relation to biodiversity please refer to the Biodiversity Supplementary Planning Document.

Where a building includes a green roof or wall, developers are expected to provide:

- A statement of the design objectives for the green roof or green wall
- Details of its construction and the materials used, including a section at a scale of 1:20
- Planting details, including details of the planting technique, plant varieties and planting sizes and densities as well as the ecological rationale for the selection of the plant species
- A management plan detailed how the structure and planting will be maintained

5.5.1 Green Roofs

There are two main types of green roof:

- Intensive roofs: In effect a 'rooftop park' which allows access for people and create ecological habitats. As such they have a deep layer of growing medium, and the weight of an intensive roof will be considerable. Therefore, reinforcement of an existing roof structure or inclusion of extra building structural support may be required.
- Extensive roofs: Relying on a shallow layer of growing medium or substrate and focussed on creating biodiversity rather than amenity or recreational benefits. Sedum roofs fall within this category. Extensive roofs are lightweight and have low maintenance requirements. For extensive roof systems, we recommend substrate based systems are used. These consist of either a porous substrate or

similar reused aggregates (where they are high quality and demonstrably uncontaminated), which are heavier but provide greater biodiversity and hold more rainfall.

For existing buildings, the structural capacity of the roof may limit the type of green roof to be installed, however new buildings can be designed with suitable structural capacity for an appropriate green roof. Extensive green roofs have relatively low loading and as such may be the most cost-effective approach for developers to explore. Approximate loading information is provided at Figure 6: Green Roof Loading.

Roof Type	Loading (Kg/m³)*
Gravel surface	90 – 150
Paving slabs	160 -220
Vehicle surface	From 550
Extensive green roof (sedum mat)	60 -90
Extensive green roof (substrate based)	80 -150
Intensive green roof	200 -500

*loads are fully saturated

Figure 6: Green Roof Loading[15]

To work out the exact weight of a roof system, developers should consider:

- The type of green roof to be installed
- The water-storage system
- The type of growing medium or substrate and plants
- Equipment for heating, ventilating and air conditioning
- How many people will be using the green roof (for intensive roofs)

In addition to biodiversity and cooling benefits from green roofs, they can also reduce the need for draining infrastructure by reducing the amount of surface water running off a roof. Reducing surface water runoff is also important in improving climate resilience (see 6.3 J. Resilient Buildings and the Built Environment), relieving pressure on local drainage systems and reduce the likelihood of flooding during the heavy rainstorms.

[15] https://livingroofs.org/introduction-types-green-roof/

The reduction is surface water run-off is achieved as green roofs initially retain rainwater release it slowly, with water being held in plant and the growing medium layer. Some rainwater will also evaporate back into the atmosphere. We are open to considering installation of green roofs as part of an integrated water management system and SuDS. For more detail on our position on SuDS, refer to Policy FR2 in Plan:MK.

Although green roofs result in additional construction cost, this will in most cases be offset when 'whole life costs' are considered, due to reduced need for drainage infrastructure, reduced energy consumption for cooling and extended roof life.

When designing a building with a green roof, developers will need to consider:

- Drainage
- Maintenance
- Roof Pitch
- Access
- Wind exposure
- Rain shadow
- Sunlight, orientation and shading from adjacent structures
- Height of parapet walls
- Hot/cold air emissions from equipment
- Appropriate vegetation for the conditions

For proposals involving buildings of any height with green roofs, developers will be expected to strictly follow guidance in DCLG's *Fire Performance in Green Roofs and Walls* (2013)[16] or latest edition, and to take into account guidance in the Green Roof Organisation's *GRO fire risk guidance document* and *The GRO Green Roof Code* (2021)[17]. These standards address issues of fire resistance, waterproofing, growing mediums, vegetation, installation methods and procedures, and maintenance. Where relevant, such proposals must also show they have addressed the requirements of the *Planning Gateway One* suite of planning reforms introduced in 2021[18].

5.5.2 Green Walls

Green walls provide a green system using plants either planted into the structure of the wall itself or upon a structure attached to the wall. Green walls will not work in all locations and require careful design. Specialist advice should be sought to avoid failure of the system. There are two main types of green wall:

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16 https://www.greenrooforganisation.org/downloads/
17 https://www.gov.uk/government/publications/fire-performance-of-green-roofs-and-walls
18 https://www.gov.uk/guidance/building-safety-planning-gateway-one

- Green Facades: Consisting of climbing plants growing onto a supporting structure such as a wooden trellis, wire cables or mesh. The plants are usually rooted in a growing medium at the base of the structure but can be rooted in planters at different heights in the structure or at the top with plants cascading down. Green façade structures are lightweight and can be attached to existing walls or stand alone as free-standing structures making them suitable for retrofit.
- Modular Green Walls: are more complex and made up of modules of growing medium designed to support plant growth supported on or within a steel framework. They need irrigation systems and plant nutrient supply, leading to a more extensive requirement for ongoing maintenance. The planted panels can be designed with a variety of plants depending on the aesthetic and habitat requirements of a project.

Green walls can improve the thermal efficiency of buildings and reduce pollution through trapping dust and pollutants from both the air and rainfall.

By providing shading from the sun, green walls can significantly reduce daytime temperature fluctuations on walls' surfaces from between 10°C and 60°C to between 5°C and 30°C[19]. Green walls can also provide winter insulation, and green walls with evergreen plants have been shown to reduce heating demand by up to 25%[20].

Green walls can also help reduce Urban Heat Island Effect (UHIE): UHIE by intercepting both light and heat radiation which would otherwise be mostly absorbed and converted to heat by the building's surfaces and then radiated back into the surrounding environment.

Green walls require more maintenance than extensive green roofs, and often incorporate irrigation systems, they are also more likely to suffer from difficulties due to low light levels.

Figure 7: Green wall in Camden, London.

[19] Peck S W, Callaghan C, Kuhn M E and Bass B 1999. Greenbacks from green roofs: forging a new industry in Canada. Canada Mortgage and Housing Corporation.

[20] Ibid.

When designing a building with a green wall, developers will need to consider:

- Drainage
- Maintenance
- Access
- Shading and rain shadow from adjacent structures
- Appropriate vegetation for the conditions
- The location of mechanical plant equipment
- The inclusion of areas of blank wall
- The amount of external heat generated by the development

As with green roofs, the weight of the green wall system will have to be incorporated into the structural capacity of the building at the design stage or taken into consideration during retrofit. How a green wall will be maintained should also be considered from the outset of the design process.

However, for buildings that are 18+ metres and 7 or more storeys in height, green walls should not be used. This reflects tighter building regulations standards post-Grenfell which require walls/external cladding materials on buildings 18+ metres high to be non-combustible. This would almost certainly rule out use of green walls which tend to be of limited combustibility.

With regards to the fire risk of green walls in buildings below 18 metres, or 7 storeys, high, developers will be required to follow guidance in DCLG's *Fire Performance in Green Roofs and Walls* (2013)[21] or latest edition.

5.6 F. Building Lifecycle Considerations

To reduce waste in the built environment, it is important that buildings are not only constructed efficiently but are designed to have a long useful life. This means buildings should be flexible and able to adapt to changing needs, many of which will not be foreseen at the time the building is constructed. This is known as functional adaptability. Being able to easily adapt buildings will reduce the materials wasted through demolition, and mean less carbon is used across a building's life cycle. This approach also applies to outdoor spaces. For example, we can design amenity open spaces to be easily adapted into allotments, by minimising use of 'hard' landscaping

[21] https://www.greenrooforganisation.org/downloads/

measures as much as possible, where consistent with other policies within the local plan.

At the design stage it is also important to consider the eventual end of the buildings life, and through 'designing for deconstruction' (DfD) ensure that the materials and components of the building have high reuse and recycling potential.

Developers are expected to set out how they have designed for functional adaptability, and out how the materials and components for the scheme will support future deconstruction, making use of the guidance below. This should include how information relating to building materials and components will be captured and stored for future use.

5.6.1 Functional Adaptability

Developers should identify how they will ensure the functional adaptability of their building. This is likely to include one or more of the following approaches:

- A structural layer which enables internal flexibility
- Internal layouts and modular solutions
- Building extendibility
- Flexible services

When considering how the structural layer can support functional flexibility, developers should ensure that:

- The structural layer of the building is not entwined with other elements
- There is sufficient space (floor space and ceiling height) within the structural layer to enable alternate internal layouts
- There is sufficient load bearing capacity within the structural layer to enable additional partitioning and different layouts to those designed

Within a structurally flexible building developers will need to consider how the internal layout can be adapted, this could be through ensuring partition walls cause minimum damage to the floor and ceiling or may include using off-site construction or modules which can relatively easily be inserted or removed from building structures.

Modular solutions may also be suitable for enabling the future extendibility of a building. Ensuring that there are not barriers to a building being extended (either vertically or horizontally) is also key to building flexibility. This includes avoiding putting in services or structures that would act as a barrier to an extension, for example designing underground services such as drainage pipes or water mains to enable future potential lateral connections which may otherwise require rework or major shutdowns.

Internal services are also critical to the flexibility of a building, and it is important to ensure the accessibility of, and distribution routes for local services including power, and data infrastructure. Specifically, developers should consider:

- Lighting which can be relocated within the ceiling grid, or use of up lighting
- Designing air diffusers on flexible ducts for easy relocating at minimum cost with minimum disruption to occupants
- Ensuring space and capacity should be available in ceiling and duct shafts for reinstalling exhausts and ducts
- Designing sprinkler heads to facilitate easy relocating within ceiling grids
- Designing pre-wired horizontal distribution systems in ceilings or floors, with spare capacity and easy access to accommodate change of workplace layouts.

5.6.2 Designing for Deconstruction

While the adaptive reuse of a building will be preferred, it is likely that in the future a building will reach the end of its life. DfD is an approach which focuses on enabling the structure to be dismantled to facilitate the segregation and extraction of materials that can be removed intact during redevelopment, and then reused or recycled wherever possible, thereby removing demolition waste. There are two main considerations for DfD:

- Types of materials and components used
- How materials and components are put together and deconstructed

Materials and components that are composite are harder to recycle, so should be used only as reusable components. Materials such as wood, steel members, brick and carpet tiles are all examples of material that can easily be reused or refurbished. Developers should avoid the use of hazardous materials.

When putting together buildings, connections should be simplified and standardised, and building systems should be simplified. Fittings, fasteners, adhesives and sealants should allow for disassembly, and building complexity should be reduced.

Finally, appropriate project documentation is very important for DfD, so that there is sufficient information available for the demolition contractor to be able to deconstruct the building. The building documentation should identify the components and materials that have been used and their potential for reuse and recycling.

5.7 G. Recycling Space

To ensure that high levels of recycling are maintained across Milton Keynes, and we are able to achieve even higher recycling rates, new buildings should be designed to enable and encourage recycling. This means designing buildings to provide enough space for storing recycled waste and making it easy to segregate waste.

Developers should include in their Sustainability Statement information which sets out how the design of the development will foster greater levels of recycling of domestic and/or commercial waste, using the guidance below. Designated storage and collection points should be identified in both outline and detailed planning application drawings, and the corresponding distance between these and the proposed collection vehicle route should be set out. Note that where a Site Waste Management Plan is required as per the Local Validation List, it should not duplicate information in the Sustainability Statement, however, make sure that there is continuity between the two documents.

All developments should demonstrate that waste collection points will be accessible to refuse vehicles, with sufficient proximity to be conveniently located for ease of access of both occupants and collection services. Designs should ensure safe working conditions for collection teams.

Waste storage areas should be well lit, accessible to all occupants, including wheelchair users, and easy to maintain to ensure services feel safe and clean. Developers will need to balance the need to screen waste storage areas, with providing natural surveillance to discourage anti-social behaviour.

Municipal areas within large developments requiring waste bins should employ underground bins with an over-ground receptacle. This allows longer periods between servicing and thereby greatly reduces the risk of overflow and rodent or gull interference.

Additional guidance for developers on designing waste storage space is provided in Appendix 2 of the Waste Development Plan Document.[22]

5.7.1 Residential Developments

Milton Keynes' household waste collection system currently makes use of clear sacks for recycling and black sacks for residual waste, in addition households are provided with a 55 litre box for glass and a 140 litre green wheeled food and garden bin. Wheeled bins for recycling and waste collection for householders are due to be in place by 2023, with a pilot scheme by 2021, and developers should visit our website for up to date information about the waste collection system their Sustainability Statement should address.

Residential development will require internal temporary storage for waste, external storage and a defined kerbside collection space. For larger developments the external storage and collection space may be a combined communal bin store.

Enough space needs to be made available within homes to enable waste segregation at the point of disposal in the home and internal temporary storage. This should include space for at least two bins in the kitchen, with recycling bins of sufficient size to accommodate waste to be recycled, which is often bulkier than other types of waste. No individual waste bin should be smaller than 15 litres, and there must be a minimum total capacity of 60 litres.

Where possible developers should provide for external waste storage requirements within each individual property, giving residents responsibility for their own waste. In some instances, this may not be possible, for example in apartment blocks. In these cases, communal store areas should be provided, or underground bins considered. Chutes will only be permitted where they enable residents to segregate their waste.

Where there is individual external waste storage for householders it should be designed to minimise the visual impact and avoid adversely affecting the street scene. It should be easy to move waste bins from the storage area to the collection point. Both bin storage and collection points must be on hard standing.

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[22] https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/waste-development-plan-document

Where there is a communal bin store it should be conveniently located, and ideally accessible without leaving the building. For larger developments several communal bin stores may be required. Details of caretaking access and management arrangements relating to the bin store should be set out in the Sustainability Statement. In addition:

Figure 8: Estimated required waste storage

Development Type	Waste Storage Capacity ($L/1000m^2 GFA$)
Offices	2,600
Retail	5,000
Restaurants / Fast Food	10,000
Hotels	7,500

- Bin stores must be clearly signed in accordance with WRAP iconography and secured by combination keypad or equivalent
- Bin stores must be within 10 metres of where the refuse vehicle passes and have a suitable dropped kerb
- There must be space for one set of bins comprising two 1100 litre bins (refuse and recycling) and one 240 litre bin (glass) for every 9 single occupant flats or 6 double occupant flats
- Where appropriate, there must be sufficient space for a refuse vehicle to turn around

5.7.2 Commercial Developments

Milton Keynes Council does not currently offer a trade collection service directly, however our contractor can offer this service collecting materials in line with the current Council collection scheme, alternatively commercial occupiers may arrange collection through a private waste contractor.

All commercial developments must provide adequate storage for both recycling and residual waste. The storage area should be big enough to allow the number of containers to be maximised, so as to reduce the number of collections required. The amount of waste storage required will vary between different commercial occupiers, however a guide to waste storage capacity required is provided in Figure 8.

Storage containers must be located internally or within the external boundary of commercial premises. Any external storage must be screened from public areas (including multi-story residential properties). They should also be conveniently located for both collection crews and the occupants of premises. A walkway of at least 1.3 metres should be provided within the store to allow access to each of the individual containers and allow containers to be removed.

5.7.3 Mixed Use Developments

In mixed used developments household waste must be separated from commercial waste, and there should be a physical barrier or separation between the areas designated for commercial waste and those designated for residential waste. Combination access should be designed to ensure that occupants are only able to access their designated waste areas.

6 Energy and Climate

The buildings we build now will continue to operate for decades, and possibly even centuries. As such it is important, they are designed in a way which means they do not contribute further to climate change, through having a low energy profile, and that they are resilient to the changes in our environment that we are already seeing as a result of climate change.

This chapter provides further guidance on how the requirements of Policy SC1 H – J can be met.

Policy SC1: Energy and Climate

H. Implement the Energy Hierarchy within the design of new buildings by prioritising fabric first, passive design and landscaping measures to minimise energy demand for heating, lighting and cooling.
I. Review the opportunities to provide energy storage and demand management so as to tie in with local and national energy security priorities.
J. The design of buildings and the wider built environment is resilient to the ongoing and predicted impacts of climate change.

6.1 H. Energy Hierarchy

All new developments should be designed following the principles of the Energy Hierarchy. Beginning with using fabric first, passive design measures and landscaping to minimise the use of energy in a building. Then addressing remaining energy demand through renewable energy technologies or offset to reach net zero emissions. Figure 9 depicts the Energy Hierarchy.

This first ‘reduce’ stage of the Energy Hierarchy requires developers to design in a way that reduces the energy demand of a development. Part K.1 of Policy SC1 in Plan:MK stipulates that residential developments of 11 or more homes, or non-residential development of 1000 sq. metres or more, must achieve a minimum performance requirement of a 19% improvement on Building Regulations Approved Document Part L 2013. Developers must demonstrate how they will meet this requirement in their Energy and Climate Statement to show, amongst other things, how the energy demand will be reduced through efficiency measures. Further guidance on these two items, reductions over Part L and the Energy and Climate Statement, is provided at section 7 Energy and Climate Statements.

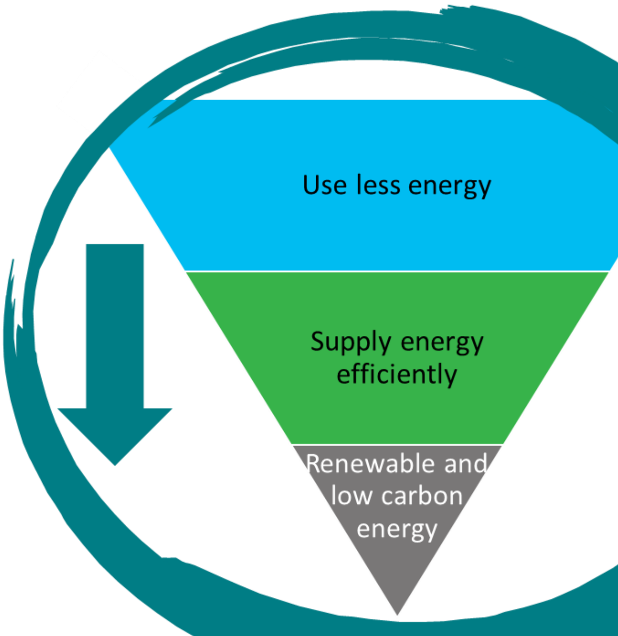

Figure 9: Energy Hierarchy

Once a development has met the minimum carbon standard, developers must consider the provision of heat, either by connecting into an existing district heating network where possible or providing an on-site communal heat network. Ideally this should focus around zero on-site emission heat sources, including waste secondary heat and heat pumps, with the aim to drive innovation and encourage technologies that displace fossil fuels.

Finally, as per SC1 K of Plan:MK all developments must provide on-site renewable energy generation, or connection to a renewable or low carbon community energy scheme, that contributes to a further 20% reduction in the residual carbon emissions subsequent to the 19% reduction over Part L stated above.

6.1.1 Fabric First

Achieving the required 19% additional reduction will require a thorough review of, and focus on fabric standards, including glazing specifications, lower air permeability targets and advanced building services efficiency, in line with the principle of 'fabric first'.

A 'fabric first' approach to building design involves maximising the performance of the components and materials that make up the building fabric itself, before considering the use of mechanical or electrical building services systems.

6.1.2 Passive Design

A passive approach to building design relies on exposure to the sun to meet heating and cooling requirements, using building materials that reflect, transmit or absorb solar radiation. Heat within a building (generated by the sun) is also used to trigger air movement to provide a cooling effect and ventilation without requiring mechanical and electrical systems such as pumps, fans or electrical controls to move air. Integrating passive design measures can help improve both Building Regulation UK Part L (BRUKL) performance and achieve better BREEAM ratings where applicable.

The main passive design measures which can be included on both residential and non-residential development are as follows:

- Optimisation of natural daylight
- Optimising solar gain, including limit overshadowing
- Optimising insulation
- Minimising cold bridging and optimising air tightness
- Maximising insulation of heating infrastructure
- Minimising the length of hot water pipe runs
- Optimise thermal mass (for example through the use of concrete, stone or tiles)
- Choosing different coloured materials to reflect or absorb heat
- Incorporating green roofs, green walls and other green infrastructure
- Cross ventilation where air can move through the building naturally

These are illustrated by Figure 10: Elements of Passive Solar Design.

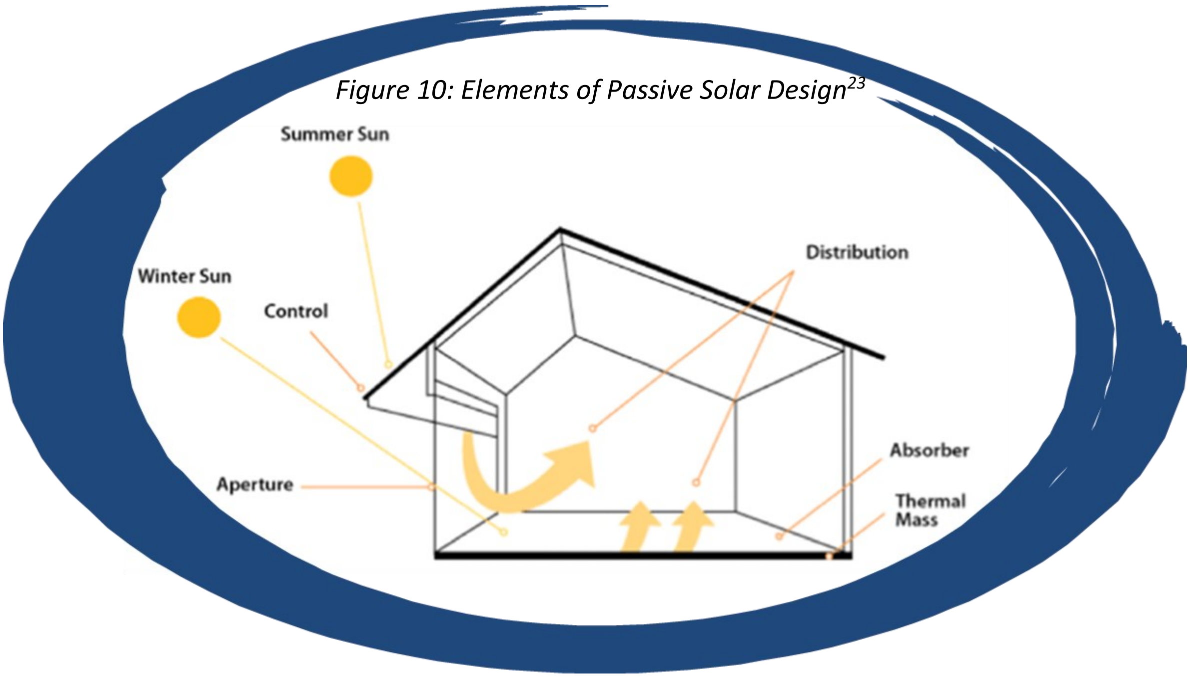

Figure 10: Elements of Passive Solar Design[23]

Passive Heating: Heating a building through passive solar design is primarily achieved via south facing glass and the use of thermal mass for absorption, storage and distribution of heat. Different approaches include making use of 'direct gains', where

[23] Image reproduced under creative commons licence from Chel, Arvind & Kaushik, Geetanjali. (2017). Renewable energy technologies for sustainable development of energy efficient building. Alexandria Engineering Journal. 57. 10.1016/j.aej.2017.02.027.

the living space is used as a solar collector, heat absorber and distribution system, or 'indirect gains', where the thermal mass is situated between the sun and the living space. In designs that use direct gains, masonry walls and floors are usually dark in colour, and store heat during the day and release it at night. Designs which use indirect gains rely on thermal mass absorbing the sunlight that strikes it and transferring heat to the living space by conduction.

Passive Cooling: Shading, thermal mass/thermal stores and cross ventilation are the most common forms of passive cooling in a building. Shading is the use of shades or overhangs on south facing windows prevent overheating from solar gain without compromising daylight. Thermal stores which have absorbed the cool air overnight balance warmer daytime temperatures. Non mechanical ventilation is used to exchange warm interior air for cooler air from outside. Using green roofs and walls, as well as water features, are other forms of passive cooling.

Passive design measures should be prioritised over active measures so as to reduce overall energy demand and reduce the sizing of building services. It is important that an integrated approach to energy efficient design is taken, considering the three elements of solar gain (direct and indirect), the thermal properties of building materials, and ventilation and heating, in relation to one another from the outset. The health and wellbeing benefits of an energy efficient building with passive measures should also be considered. The Ashden Toolkit [24]for local authorities sets out the health and wellbeing effects of an energy efficient home, which include reduction in fuel poverty, and reduced pressure and costs to the NHS – it is estimated that ill health caused by cold homes is £2.5 billion per year.

6.1.3 Landscaping Measures

Landscaping measures are another approach that can reduce the energy demand of a building, both by reducing cooling requirement and increasing the efficiency of heating.

Landscaping for cooling: Shading is the most cost-effective way to reduce solar heat gain and cut air conditioning costs. In addition to the shading measures described in the

Figure 11: Landscape design measures at University of Warsaw Library, Poland.

[24] https://www.ashden.org/programmes/co-benefits

passive cooling section above, the use of plants and trees can provide shade to windows and increase evapotranspiration to reduce air temperatures surrounding a building, precooling outside air before it enters a building.

Landscaping for heating efficiency: Appropriately chosen landscaping that is well placed and maintained, can provide wind protection for buildings, or act as a windbreak. For windy areas, windbreaks can reduce air filtration into buildings, which improves heat efficiency by reducing 'wind chill'.

Landscaping for insulation: Plants such as shrubs, bushes and vines can also be placed next to buildings to create 'dead air' spaces, which can insulate buildings, keeping them cooler in summer and warmer in winter.

6.2 I. Energy Storage and Demand Management

Ofgem have highlighted the importance of energy system flexibility to ensure that the power generated and distributed to consumers matches the amount required. This system flexibility has traditionally been based on supply side interventions, but as the UK's energy system changed in response to our carbon commitments, demand side solutions will be more important. The three key measures identified by Ofgem are:

- Energy Storage
- Demand-side response
- Distributed generation

This section sets out our expectations of how developers can contribute to local and national energy security.

Energy storage can take different forms, including batteries, pumped hydroelectric storage or mechanical flywheels. It is anticipated that battery storage will play an increasingly important role in the energy transition, allowing the storage of electrical energy from renewables for later use, and helping to balance grid load.[25] It is therefore important that developers consider whether they can include energy storage within their schemes.

6.2.1 Battery Storage

A battery refers to an electrochemical device which supplies electrical energy. A primary battery converts electrochemical energy to electrical energy and consists of one or more electrochemical cells. An electrochemical cell converts electrochemical

[25] http://fes.nationalgrid.com/

energy to direct current (D.C.). A battery is formed of two or more cells arranged in series or parallel and may require a cell or battery management system (BMS) to ensure safety and reliability. A secondary (or rechargeable) battery is a reversible device that converts electrochemical energy to electrical energy and vice versa.

Key components of a battery energy storage system (BESS):

- Battery management system (BMS)
- Power conversion system (PCS) for conversion of D.C. to A.C.
- Transformers
- Switchgear
- Heating or cooling provision
- Safety measures such as fire management, fire suppression or firefighting provisions
- Security measures (fencing, CCTV etc)

Figure 12: Battery Energy Storage System.

Common battery types used in the UK, for large scale energy storage include:

- Lead acid (most commonly used, low cost and well established)
- Lithium-ion
- Nickel cadmium
- Nickel metal chloride

When submitting a planning application, it is imperative that developers state the specific chemistry of the battery, in order for the level of risk, and mitigation measures to be determined. Risks associated with batteries include fire resistance, fire and explosion propagation, performance, efficiency and resilience to ambient conditions.[26]

It is important to identify which planning regime would apply to a specific energy storage project. Although there may be some similarities between projects, care should be taken to comply not only with the planning legislation, but also to ensure that a risk analysis covers the whole system development.

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[26] https://publishing.energyinst.org/topics/power-generation/battery-storage/battery-storage-guidance-note-1-battery-storage-planning

[27] https://publishing.energyinst.org/__data/assets/pdf_file/0007/655054/web-version.pdf

Annex D Battery Energy Storage sets out the criteria that developers should be cognisant of when developing large scale battery energy storage systems, either as a standalone proposition or as part of a wider scheme. The criteria will be considered by officers when reviewing planning applications that include battery storage.

In addition to managing energy on site, including bringing generators on line at specific times, energy generated by renewable energy such as solar PV can be stored in the form of battery storage, which can be for onsite use, or to provide demand side response services to balance a local smart grid or the National Grid. Demand Side Response (DSR) or demand management measures are terms that are often used interchangeably.

Energy Insitute, Battery storage guidance note 1: Battery storage planning[27]

The Planning Background

Many development projects in England and Wales are authorised under the Town and Country Planning Act 1990 (TCPA). However certain projects are consented using alternative authorisation. Developments in the electricity industry are often covered under the Electricity Act 1989, which gives development rights to companies which hold a generation, transmission or distribution licence. This exemption is often used to authorise minor changes to power stations, substations and the like, subject to limitations, restricting the height of any new structures to less than 9 m and excluding substantial changes to the overall site.

New installations are required to either seek planning approval through the TCPA process, or, for larger generation installations, to apply using the process under the Planning Act 2008 (PA). Electricity storage is considered to be generation. The planning treatment for generation projects varies in accordance with the generating capacity of the project. In England, generation projects below 50 MW are determined by the local planning authority (LPA) and projects above 50 MW are determined by the Planning Inspectorate advising the Secretary of State under the Planning Act 2008. Some larger energy storage sites might require new overhead transmission lines, for which the relevant planning legislation is determined by voltage. As the threshold for consent by the LPA is 50 MW for generation projects, in recent years this has determined the upper capacity limit for storage projects.

6.2.2 Demand Side Response (DSR)

As the decarbonisation of heat and the electrification of transport become more prevalent in new developments, there will be additional demand placed on the grid. DSR measures will be key to counteract the peak stresses on grid. Ofgem defines DSR as “Consumers signing up to special tariffs and schemes which reward them for changing how and when they use electricity”.[28] The main types of DSR are listed below:

Demand response: Energy users are provided with a financial incentive to turn down or turn off non-essential equipment at times of peak demand helping the grid to balance supply and demand without the need for additional generation (e.g. power stations) to be used. The kind of equipment that might be turned down or off includes lighting, air conditioning, electric heating, pumps, and other non-essential equipment. Participating in demand response is voluntary and is designed not to impact on day to day operations or comfort.

Demand reduction: The long-term reduction of demand through effective energy management, including investing in energy efficiency by upgrading lighting, insulation, refrigeration, motors and pumps. An example of this work is the Government’s Electricity Demand Reduction pilot, which provided financial support to organisations if they delivered electricity savings at peak times.[29]

Distributed generation: The local generation of heat or electricity to be used either on site or exported to the electricity grid or a heat network. Distributed generation includes combined heat and power (CHP), heat networks, heat and air pumps, hydro, solar thermal and PV, and wind. More details of options for distributed generation, and guidance for developers is provided at 7.2 K.2 Onsite renewable energy generation and low carbon community energy schemes).

In order for residents and businesses to be able to participate in DSR activity, developers will need to ensure that smart metering technology and capability is installed in all developments (individual dwellings and larger buildings).

Additionally, since renewable energy technologies will be a requirement in all developments (including batteries where possible), it is important to recognise the role that an increase in the numbers of electric vehicles (EVs) could have on energy demand. In order to avoid evening peaks ‘smart charging’ capability will have to be

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[28] https://www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/smarter-markets-programme/electricity-system-flexibility

[29] https://www.gov.uk/guidance/electricity-demand-reduction-pilot

provided. This will also help with using EV's batteries for DSR, an area that is currently being developed[30].

Developers will be required to provide EV charging points in line with the Milton Keynes Parking Standards SPD as well as guidance in section 6.2.3. All residential developments should as a minimum provide passive provision (e.g. providing the fuse box and ducting for later installation of a charge point) with sufficient power to enable charging at a minimum of 7kW per hour. For communal parking in commercial developments and larger residential developments, developers will also be required to consider how rapid charging points are best provided.

Where future occupiers are likely to have a large fleet, for example a depot, consideration needs to be given to how the energy demands of this fleet will be met

Milton Keynes, Domestic Energy Balancing EV Charging project

Milton Keynes Council and Milton Keynes Go Ultra Low Programme are funding a trial of domestic smart chargers, vehicle to grid (V2G) chargers and home battery storage to investigate ways to balance the peaks of electricity use associated with charging electric vehicles at home.

The project is one of four pioneering trials which will place Milton Keynes at the forefront of developments in electric vehicle charging technology. The trials, which are part of the city's Go Ultra Low programme, will focus on advancing and testing new technologies. They will run in the city until December 2021 and the results will be published in early 2022.

More information about the project, and the potential benefits of V2G infrastructure can be found at: https://electricnation.org.uk/about/the-project/

when it is fully electrified. This is likely to include discussions about grid capacity with the District Network Operator (DNO). For fleets made up of large vehicles, such as Heavy Goods Vehicles (HGVs), the fleet may initially switch to being fuelled by Compressed Natural Gas (CNG) or Liquid Natural Gas (LNG) rather than to electric.

[30] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/657144/DSR_Summary_Report.pdf

Developers may therefore wish to consider the proximity of sites for this use to a high-pressure gas main to enable cost effective refuelling.

6.3 J. Resilient Buildings and the Built Environment

'Climate resilience is the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate. Improving climate resilience involves assessing how climate change will create new, or alter current, climate-related risks, and taking steps to better cope with these risks.'[31]

As progress is made towards reducing greenhouse gas emissions on the route to net zero, because of historic emissions already released a certain level of climate change is already 'locked in'. Climate projections indicate hotter drier summers and wetter milder winters with more intense rainfall.[32] Any new development will need to be designed so that it remains comfortable for users over its lifetime and avoids making local climate conditions worse.

The impacts on buildings and developments from changes in climate conditions in the UK will include the following:

- Increased pressure on drainage due to increased frequency and intensity of rainfall, and therefore an increased risk from flooding.
- Issues of overheating, due to a higher frequency of heat waves and therefore greater demand for cooling systems.
- Adverse impacts on building materials, from more prolonged periods of drought as well as the risk of water shortages.
- Higher risk of building damage due to more frequent extreme weather events, including strong winds.
- Risk of subsidence to properties on clay soils during prolonged dry spells.

Spatial planning and the planning system have a key role in mitigating and adapting to climate change, shaping places with greater resilience to climate change, as highlighted within the UN Paris Climate Agreement (COP21).[33] The NPPF, at paragraphs 149 to 154, reinforces the great importance that the Government places in addressing climate change through the planning system.

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[31] https://www.c2es.org/content/climate-resilience-overview/

[32] https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf

[33] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Adaptation measures should not increase energy use which would exacerbate climate change. Economists estimate that every £1 invested on adaptation could save £4 in avoided damages[34]. New and existing developments should contribute to the reduction of GHG emissions and have a positive impact on community resilience to extreme heat and flood risk – the right development in the right place.

Planned resilience to flooding and increased biodiversity minimises the risk to disruption of delivery of public services and increases personal and community wellbeing. Development proposals that make use of both green and blue infrastructure to provide ecosystem services and support community resilience to extreme heat and flood risk will be viewed favourably. Infrastructure should be provided in line with the approach set out in Policy INF1 in Plan:MK[35]. Adaptation measures include but are not limited to the following design features:

- Green infrastructure – shading, soil stability.
- Blue infrastructure – sustainable drainage systems (SuDS), balancing lakes. Milton Keynes has a well-established network of balancing lakes managed by The Parks Trust, with the flood control purposes of these lakes and associated watercourses managed by Anglian Water.
- Building design – minimise solar gains for periods of heat stress and include built-in bat and bird bricks to support local bird populations.
- Flood risk – minimise use of ground floors and basements and preventing flows of surface water into foul water disposal systems, thereby preventing risk of ground & water pollution. Ensuring foul water disposal is resilient to ongoing and predicted impacts of climate change and ensure, particularly where open systems (e.g. reed beds) are used, no harm to biodiversity.
- Hard standing – large expanses to be avoided where possible, and make use of lighter colour materials and shading where necessary.

Developments will need to, amongst other things, allow for additional shading or cooling requirements as the climate changes this can be achieved through applying the 'Cooling Hierarchy', namely: minimising internal heat generation through energy efficient design, reducing the amount of heat entering the building in summer, for example by using balconies, louvres, shutters or vegetation, using thermal mass and

[34] National Adaptation Programme:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209866 /pb13942-nap-20130701.pdf

[35] https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/plan-mk

high ceilings, passive ventilation through windows, shallow floorplates and the aforementioned stack effect, and finally 'free cooling' using mechanical ventilation (where any heat-recovery system will need a bypass for summer operation). All buildings should be designed to be robust to withstand storms and high winds, and to be easily maintained and repaired.

Wider landscaping measures to minimise the urban heat island effect include the following:

- Allowing sufficient space in between buildings
- Providing adequate shading and buffering to be provided in buildings through layout and planting
- Providing community orchards and allotment spaces
- Using green spaces to allow cooling and provide external space for building occupiers
- Using green walls and green roofs to cool and shade buildings

Landscaping measures should also retain existing street trees and plant extra tree planting wherever possible, to take account of our Sustainability Action Plan (2020)[36] objective of afforestation in Milton Keynes and delivery of a Forest for the Borough of Milton Keynes of (at a minimum) an additional one million trees, as well as our objectives to maintain grassed areas to retain carbon in the soil.

The Natural Environment section of the Planning Practice Guidance provides advice on delivering green infrastructure and catering to biodiversity in new development, both of which can make the environment more resilient to a changing climate. Other sources of guidance on these topics includes The Town and Country Planning Association's (TCPA) *Guide 7: Planning for green and prosperous places* document[37] and the joint TCPA and The Wildlife Trusts *Planning for a Healthy Environment: Good Practice Guidance for Green Infrastructure and Biodiversity* guide, which emphasises the ecological benefits of green infrastructure.

Historic Environment Scotland has produced a short Guide called 'Climate change adaptation for traditional buildings'.[38] This document considers how buildings can be improved or adapted to increase a buildings resilience to extreme weather events.

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36 Milton Keynes Council Sustainability Action Plan (2020)
37 https://www.tcpa.org.uk/Handlers/Download.ashx?IDMF=db632de1-38cc-468a-9401-0599b0bea52b
38 https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=a0138f5b-c173-4e09-818f-a7ac00ad04fb

below provides further information, developers should consider these adaptation measures as starting point in designs.

Table 2 - Historic Environment Scotland Adaptations Advice

Climatic Change	Impact on Buildings	Potential damage	Adaption Measures
Warmer winters	Higher internal humidity.	Greater prevalence of insect pests and fungal attack. Warping of timber elements.	Improved ventilation.
	Increased moss and algal growth.	Staining and discolouring of masonry, dampness.	Improved weathering detailing.
Wetter Winters	Rising ground water levels.	Dampness in basements and wall footings.	Enhanced drainage adjacent to buildings. Improved water vapour handling on retaining walls.
	Prolonged saturation of masonry.	Algal growth, vegetation	Improved weathering details. Repointing of masonry. External coatings.
Hotter, drier, summers	Increased thermal stress on building fabric.	Cracking of hard materials	Repair with flexible traditional materials such as lime mortars
	High internal temperatures.	Thermal discomfort for occupants. Warping or splitting of timber elements	Improve natural ventilation. Install traditional blinds and/or canopies.
	Ground shrinkage.	Movement of foundations	Adapt surface drainage and landscaping or planting.
Wind Driven Rain	Penetration of render/harling.	Progressive wetting of walls.	Better detailing.
	Water penetration under roof covering.	Roof leaks.	Improved slating and detailing. Vapour open materials to disperse water.

More frequent intense rainfall	Water penetration into fabric	Masonry decay and binder loss, rot, and decay of internal woodwork, staining, reduced thermal efficiency	Improved weathering details. More frequent maintenance. Repair of mortar joints,
	Blockage of gutters.	Water overflows into/onto fabric.	Increase size at critical points. More frequent maintenance.
	Splash back from hard surfaces.	Wetting of adjacent masonry.	Remove hard surfaces adjacent to walls. Improve drainage around the site.
	Run off from adjacent areas.	Flooding of under-floor or basements.	Minimise hard landscaping. Improve natural drainage of driveways and pavements.
	Flash flooding from watercourses and roads.	Physical damage, saturation of fabric. Damage from hasty clearing up. Sewage contamination.	Attend to culverts and adjacent burns. Routes for surge waterflows round buildings.
High wind storms	Impact damage to fabric.	Damage to slates/leadwork.	Additional fastenings at ridges and slates. Higher codes of lead. Improved clips and raggle details.
	Collapse of unstable masonry.	Chimney damage	Maintenance of chimney fabric. Improved haunching of chimney cans.

7 Energy and Climate Statement

This chapter provides further guidance on how the requirements of Policy SC1 K.1 – 6 can be met. In addition, an example Energy and Climate statement is provided at Annex C.

Policy SC1: Energy and Climate

K. Development proposals for 11 or more dwellings and non-residential development with a floor space of 1000 sq.m or more will be required to submit an Energy and Climate Statement that demonstrates how the proposal will achieve the applicable requirements below:

1. Achieve a 19% carbon reduction improvement upon the requirements within Building Regulations Approved Document Part L 2013, or achieve any higher standard than this that is required under new national planning policy or Building Regulations.
2. Provide on-site renewable energy generation, or connection to a renewable or low carbon community energy scheme, that contributes to a further 20% reduction in the residual carbon emissions subsequent to 1) above.
3. Make financial contributions to the Council's carbon offset fund to enable the residual carbon emissions subsequent to the 1) and 2) above to be offset by other local initiatives.
4. Calculate Indoor Air Quality and Overheating Risk performance for proposed new dwellings.
5. Implement a recognised quality regime that ensures the 'as built' performance (energy use, carbon emissions, indoor air quality, and overheating risk) matches the calculated design performance of dwellings in 4) above.
6. Put in place a recognised monitoring regime to allow the assessment of energy use, indoor air quality, and overheating risk for 10% of the proposed dwellings for the first five years of their occupancy, and ensure that the information recovered is provided to the applicable occupiers and the planning authority.

The Energy and Climate Statement submitted as part of the application will be a valuable tool for Milton Keynes Council to assess how relevant developments (e.g. those of more than 11 dwellings, or over 1000 sq. m of non-residential floor space) meet the requirements set out in SC1.K. It is a requirement of our Local Validation List, which can be viewed on the Council's website.

An Energy and Climate Statement is a detailed document which sets out the most suitable and cost-effective solutions to reduce carbon emissions in line with requirement SC1 K.1 (19% over Part L 2013) and integrate enough Low or Zero Carbon (LZC) renewable energy technologies to achieve requirement SC1 K.2 (a further 20% reduction of the residual carbon emissions). The purpose of Energy and Climate Statements is to clarify how the development, whether it is commercial or residential, will achieve the required reductions in CO2 emissions and demonstrate a commitment to achieving a sustainable development.

The Energy and Climate Statement should project the annual energy demand for heat and power from the development together with the associated CO2 emissions, using the present Building Regulations Part L as a baseline, then demonstrate the strategy for how the emissions from energy use in the development will be reduced through a combination of energy efficiency measures and renewable energy technologies. In addition, the Energy and Climate Statement must contain calculations on contributions to the Council's Carbon Offset Fund, and where the proposal is for 11 or more dwellings, Indoor Air Quality and Overheating Risk performance.

The Energy and Climate Statement will combine a written explanation of the measures proposed with evidence of an initial feasibility investigation, taking account of site constraints and opportunities, with detailed calculations showing the CO2 emission savings achieved. Where relevant, the proposed measures should also be shown on the application drawings, which will provide certainty as to their detail and location and also allow an assessment to be made of how well they have been integrated into the proposed design. To demonstrate how the developer intends to close the energy performance gap, calculations on emissions must also be incorporated.

If the development is pursuing BREEAM Outstanding certification, the information in the Energy and Climate statement does not need to repeat extensively what is already stated in the pre-assessment or Design Stage Certificate but should be cross referenced or summarised, so as to provide a clear and accessible overview of the proposed approach to climate change mitigation and adaptation. The same applies to Standard Assessment Procedure (SAP) reports, BRUKL Output Documents, Environmental Impact Assessments or Air Quality Assessments (including an emissions/concentrations assessment). It will also be beneficial to reference generic guidance documents where appropriate.

A template Energy and Climate Statement for completion by developers is provided in Annex C. This sets out the expected structure and key headings for the statement. **Developers should also provide an 'unlocked' excel file(s) setting out their calculations for the carbon emissions reductions relevant to Parts K.1., K.2 and K.3 of Policy SC1 in Plan:MK.**

This section provides guidance on how developers can meet each of the six requirements of SC1 K.

7.1 K.1 Achieving a 19% carbon reduction improvement upon Part L 2013

Local Authorities can use their powers to require energy efficiency standards above Building Regulations. Policy SC1 Part K, sets out the level of carbon reduction we require developers to demonstrate, so as to meet our commitment to reducing carbon emissions and developing in a sustainable way.

Development proposals are required to achieve a 19% carbon reduction improvement upon the requirements within Building Regulations Approved Document Part L 2013 or achieve any higher standard than this that is required under future revisions or updates to national planning policy or Building Regulations. The requirements within the building regulations are expressed as a Target Emission Rate (TER) which is defined based on the annual CO2 emissions of a notional building of same type, size and shape to the proposed building, it is measured in annual kg of CO2 per sq. m. A proposed building's anticipated CO2 emissions rate is described either as:

- Dwelling emission rate (DER) for residential properties
- Building emission rate (BER) for buildings other than dwellings

As the Whole Plan Viability Study (2017)[39] for Plan:MK demonstrates, the requirement to exceed the TER by 19% would not be unduly onerous for developers. Analysis of BRUKL data for recently consented schemes in Milton Keynes also indicates an average improvement of 41% over the TER is already being achieved at the design stage.

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[39] Plan:MK Evidence Base - Milton Keynes Council (milton-keynes.gov.uk)

To achieve the 19% improvement there are several measures that developers can implement, many of which are already described in other sections of this SPD. The best approach is to follow the Energy Hierarchy (see 6.1 H. Energy Hierarchy) and employ a 'fabric first approach'. Natural 'passive' (for heating and cooling) measures (see 6.1.2 Passive Design) should be prioritised over 'active' measures to reduce energy consumption.

Sector wide analysis of BRUKL data indicates that for existing schemes improvements in the u-values of walls, roofs, floors and windows are all routinely achieved, as well as improvements in air tightness/permeability, which can also contribute to overall improvements in the BER/DER.

We do not expect 'active cooling' to be specified for developments where it can be demonstrated that the use of the 'passive' measures is enough to address the risk of overheating. In addition, no 'active cooling' is expected in any residential development. Where passive design measures are not enough to guarantee the occupant's comfort, cooling requirements should be identified for each of the elements of the development. Annex E provides further detail on overheating calculations.

Finally, the use of onsite renewable energy technologies can also help achieve reductions on the BER/DER (see 7.2 K.2 Onsite renewable energy generation and low carbon community energy schemes). In addition to renewable energy technologies, in order to achieve net zero targets in the UK, the decarbonisation of heat is required. This can be achieved by using heat pumps (see 7.2.6 Heat pumps). These have a very high coefficient of performance and currently qualify for government subsidies[40] that can help the business case. Wherever possible the Council would like to see the electrical components of these heating systems being powered by other renewable energy technologies.

Developers should note the Government's scheduled 31% improvement to the Building Regulations Part L standards for carbon emissions reductions in new dwellings. For the purpose of designing schemes to accord with Part K of Policy SC1, from when the 31% improvement comes into force (June 2022), it will supersede the 19% improvement currently required for residential schemes of 10 or more dwellings.

[40] The Renewable Heat Incentive is currently available for the domestic (https://www.gov.uk/domestic-renewable-heat-incentive) and non-domestic (https://www.gov.uk/non-domestic-renewable-heat-incentive) sectors, and is due to close for new applications in March 2021.

Parts K.2, K.3, K.4. K.5 and K.6 will continue to apply as usual. The 19% improvement for non-residential proposals shall be unaffected by this change.

7.2 K.2 Onsite renewable energy generation and low carbon community energy schemes

In addition to exceeding TER by 19% or any higher standard introduced by Government, applicable developments are expected to provide either on-site renewable energy generation, or connection to a renewable or low carbon community energy scheme (please see policy SC2 of Plan:MK). This must contribute to a further 20% reduction in the residual carbon emissions.

There are several renewable technologies that are currently suitable for onsite energy generation, which developers may wish to explore:

- Biomass heating systems
- Solar thermal
- Solar photovoltaics
- Wind turbines

In addition, the following low carbon energy generation technologies may be adopted to reduce carbon emissions:

- Combined heat and power (CHP)
- Heat pumps

Descriptions of each of these technologies, and additional guidance on their use is provided in the following section.

For all renewable or low carbon generation technologies the systems should be separately metered so that performance can be monitored. This helps building owners and occupiers to understand how effectively the technology is being operated and to identify any performance issues. As noted in Annex C, where on-site electricity generation is proposed, Energy and Climate Statements will need to include a management plan for the relevant renewable energy installations, detailing who will take ownership of the installations and maintenance responsbilities.

In addition, developments should include building energy monitoring at a level of detail that is proportionate to the scale of development. This may be through smart metering technology or a Building Energy Management System (BMS or BEMS).

Where developers are not able to provide on-site energy generation, or a community scheme is a more efficient route to achieving the 20% reduction in carbon emissions, developers are expected to set out in their application the community energy scheme they intend to join, as well as:

- Evidence of their eligibility to join the scheme, including if applicable correspondence with the scheme administrator and 'approval in principle' for the application
- Evidence of the contribution that the development will make to the community energy scheme

Examples of community led energy schemes include:

- Community-owned renewable solar PV or wind installations
- Community heat generation and heat networks[41]
- Community energy demand management

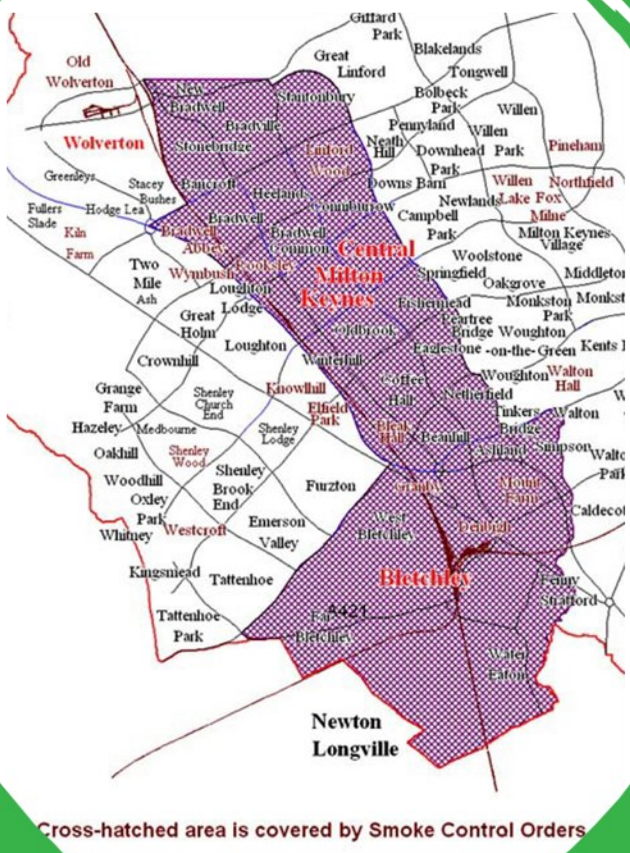
The methodology for calculating the emissions reduction from renewable energy generation and community schemes is also set out in Annex C.

[41] Developers may wish to use the free-to-use tool from Hotmaps https://www.hotmaps-project.eu/ to identify heating and cooling 'hotspots' in Milton Keynes, where heat networks may be more viable. Also available is the interactive map from energy provider ThamesWey, which shows the location and network associated with ThamesWey's heat network in Central Milton Keynes.

7.2.1 Biomass Heating Systems

Biomass energy usually refers to the use of logs, wood chip or wood pellets that are converted to heat in purpose-designed boilers. Biomass can also be used in the form of liquid biofuels. These are an option for CHP applications. The carbon that is released during their combustion is equivalent to the amount that was absorbed during growth, and so the fuel itself is not only renewable, but also almost carbon-neutral. Therefore, the carbon savings that can be achieved by substituting biomass for fossil fuel are substantial. However, in line with government policy LAQM PG16 (to work towards reducing emissions/concentrations of particulate matter), we do not recommend use of biomass for heating, e.g. in wood burning stoves, in individual homes.

Figure 13: Smoke control areas in Milton Keynes



Well-designed wood-burning installations using good-quality dry fuel will usually emit clear fumes. Within a Smoke Control Area wood can be burned in exempted appliances under the Clean Air Act 1956. Smoke control areas in Milton Keynes[42] are shown in Figure 13: Smoke control areas in Milton Keynes.

Any large-scale proposal to utilise biomass for should contain:

- The proposed equipment to be used, particularly if the development is in a Smoke Control Area
- A description of the facilities made available for delivery and storage of fuel. This should take into account frequency and nature of deliveries, i.e. size, weight of delivery vehicle, and access and manouvering requirements
- In the case of biofuel confirmation of the blend and standard of biofuel to be used (typically B100 BS EN 14214). Potential suppliers should also be listed.
- Information on how the proposal would meet the criteria in Policies SC2 (Community Energy Networks and Large Scale Renewable Energy Schemes) SC3 (Low Carbon and Renewable Energy Generation) in Plan:MK.

7.2.2 Solar Thermal

Solar thermal systems collect heat from the sun to warm a transfer fluid, which in turn heats water for use in the building. Solar thermal collectors are usually mounted on the roof of a building. South facing at a 30-40^{o} angle is ideal, but as the panels do not rely on direct sunlight, they can still be efficient at other angles.

There are two main systems in use in the UK:

- Evacuated tube collectors
- Flat-plate collectors

Evacuated tube collectors work best in colder climates and are more efficient. However, flat plate systems are cheaper, and work better in warm climates.

In a domestic setting, solar thermal systems are typically able to serve a proportion of the demand for domestic hot water and are therefore most appropriate to supplement, rather than replace conventional hot water systems. A well-designed system can deliver 50–70% of the hot water load, and 100% of summer hot water.

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42 https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/pollution/smoke-control-areas

Solar thermal systems for dwellings (up to 20 m^2 systems) should comply with the Domestic Building Services Compliance Guide[43]. The accompanying heating system such as the top up boiler must be compatible. For example, it must include a storage tank and be able to use pre-heated water.

Solar thermal systems for non-domestic buildings should comply with the requirements of the Non-Domestic Building Services Compliance Guide[44] which require that solar thermal systems above 20 m^2 should comply with the CIBSE Solar heating design and installation guide[45].

7.2.3 Solar Photovoltaics

Solar Photovoltaic (PV) panels (often called modules) convert sunlight directly into electricity. There are several types available, monocrystalline, polycrystalline, amorphous and hybrid, and they are available in the shape of panels, roof tiles, cladding and other bespoke finishes.

For newbuild projects or for roof or facade refurbishments, solar PV can be relatively easily integrated into the fabric of a building as a building component without additional structural support. For retrofit assessment of the structural capacity of the roof or wall may be required.

Solar PV works best in full sunlight, therefore when incorporating solar PV into a scheme, developers should consider:

- Roof orientation
- Overshadowing and the movement of shadows during the day and over the year

In addition, developers will need to provide safe access for inspection and maintenance.

The kilowatt peak (kWp) is the measure of the output of a solar PV system. The panel area required for one kWp is typically around 5-6 sq. m. An optimally aligned solar PV

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[43] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/697525/DBSCG_secure.pdf

[44] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/453973/non_domestic_building_services_compliance_guide.pdf

[45] https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008I7fjAAC

installation in Milton Keynes using crystalline silicon modules will typically generate 988 kWh per year per kWp[46].

It is also worth mentioning that there are now hybrid solar panels, which provide both hot water and electricity (i.e. they offer a combination of solar thermal and solar PV) and are being successfully used in refurbishment projects in Europe.

7.2.4 Wind Turbines

There is limited evidence to suggest that wind turbines mounted to buildings provide useful amounts of electricity. This is due to unfavourable wind conditions. Such schemes may also suffer from a lack of feasibility and viability, noise and vibration disruption for building users. Until this technology improves, we do not anticipate that developers will use wind turbines as a renewable energy generation source on buildings. However, any proposal for standalone onsite wind turbines will need to have regard to Policies SC2 and SC3 in Plan:MK, as well as our Wind Turbine SPD.

7.2.5 Combined heat and power

Combined heat and power (CHP) makes use of the 'waste' heat from electricity generation. The surplus heat can be used to provide hot water to serve space heating and/or domestic hot water systems.

CHP can achieve efficiencies of over 80% together with cost savings resulting from the price difference per kWh between grid gas and grid electricity. They also avoid the energy losses associated with long distance energy transmission.

The technology is regarded as 'low-carbon' rather than renewable because most CHP installations in the United Kingdom use natural gas as the fuel, although biofuel can also be used.

Some CHP systems also use an absorption chiller which uses the heat generated to provide cooling, in addition to heat and electricity. This is often referred to as tri-generation.

Applicants should contact CHP operators in the early design stages to ensure designs are optimised for CHP use.

[46] https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html#PVP

As noted in section 7.2, developers should be aware of the existing CHP network located in CMK, operated by ThamesWey.

7.2.6 Heat pumps

Heat pumps move thermal energy in the opposite direction of spontaneous heat transfer i.e. absorbing heat from a cold space and releasing it to a warmer one. A domestic refrigerator is an example of a heat pump that creates cooling and dumps heat via external coils and/or fins. However, if heat is required, then the same principle can be used. There are three types of heat pump:

- Air source heat pumps (ASHP),
- Ground source heat pumps (GSHP)
- Water source heat pumps (WSHP)

These technologies are referred to as low carbon as they use electricity to drive a substance called a refrigerant through a cycle of evaporation and condensation that helps both with heating and cooling. When assessing the use of heat pumps developers should consider how much electricity is required to work the pump compared to the energy savings of providing heat or cooling. This would form the basis of emissions savings calculations, however the carbon content of the electricity required to run the pump could be higher than the gas needed to run a traditional gas boiler.

Where heat pumps are used to heat water, this will be to a lower temperature than standard gas boilers. They therefore require low temperature heat systems with large radiators and underfloor heating. For new developments proposals should demonstrate that the central heating system is compatible with the low water temperatures. Where heat pumps are proposed as part of ‘retrofit’ works, developers may need to consider the use of a hybrid heat pump or a bivalent (combining with existing boiler) system.

Any proposal to use heat pumps should be supported with the following:

- A full description of the technology proposed and how it is to be incorporated with any other heat (or cooling) provision

- Evidence that the heat pump complies with other relevant issues as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification Requirements[47] document
- Details of the Seasonal Coefficient of Performance (SCOP) and Seasonal Energy Efficiency ratio (SEER), which should be used in the energy modelling
- The expected heat source temperature and the heat distribution system temperature with an explanation of how the difference will be minimised to ensure the system runs efficiently

Air Source Heat Pumps: There are two main types of air source heat pumps (ASHPs); air-to-water, which are used to directly heat hot water for central heating and taps, and air-to air, which heats the air in the building. ASHPs are also able to be used for cooling in summer.

Air-to-air systems are not able to heat water, and so rely on convection fan heating. An alternative heating system will be required for hot water required in the building.

Air source heat pumps are fitted to the outside of building, usually at the back or side to reduce the visual impact. This makes them less disruptive to install than ground source heat pumps. When installing ASHPs developers should consider:

- Identifying a location which receives hot air (e.g. a sunny wall) and has good air flow
- The visual impact of the ASHP installation
- The impact of the noise and vibration generated by the ASHP

For retrofit systems, the system that is being replaced will determine the level of carbon savings achieved, but when compared to a new (A-rated) gas boiler an ASHP could save 1,980 to 2,320 kg pa.[48]

Ground Source Heat Pumps: Ground source heat pumps (GSHP) are buried in the ground to extract solar heat from the earth. They can also be used for cooling in summer when the ground temperature is lower than the air temperature. There are two main systems:

- Horizontal or loop systems which are dug into trenches

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[47] https://mcscertified.com
[48] https://energysavingtrust.org.uk/renewable-energy/heat/air-source-heat-pumps

- Vertical systems which use boreholes, and therefore require a ground survey and a drilling license from the Environment Agency

Developers should consider the space available on site to bury a GSHP and any above ground impacts on open space. Where possible, the ground conditions of the specific site should be considered for the calculations.

Water Source Heat Pumps: Water source heat pumps (WSHP) use a body of water as the heat source for the heat pump such as a river, lake, large pond or borehole tapping into aquifers. While they are less popular than other forms of heat pump as they require more equipment, they tend to be more efficient than both ground and air source devices. This is because heat transfers better in water, and water temperatures are both more stable and higher in winter than the air or ground temperature.

For a WSHP to be effective the body of water must be of a sufficient size to maintain a constant temperature to the heat pump. If there is not enough water the heat pump will lower the temperature until the heat pump becomes inefficient, or the water freezes.

Developers will also need to consider the proximity of the body of water to the building.

7.3 K.3 Contributions to the Milton Keynes Council Carbon Offset Fund

As per SC1 K.3 Milton Keynes Council requires all residential developments of 11 or more dwellings and non-residential developments with a floor space of 1000 sq.m or more to make contributions to the 'Carbon Offset Fund' (COF)[49]. This fund of Section 106 contributions is managed by the Council and supports us, local Town and Parish Councils and our partners on the delivery of projects to offset residual carbon emissions from new developments. Developers must calculate the remaining regulated emissions after SC1 K.1 and K.2 have been applied and make payments into the COF to achieve 'carbon neutrality'.

Details of how these calculations should be undertaken is set out in Annex E Residual Carbon Reduction Calculations. Note that Policy SC1 does not require unregulated emissions to be considered and/or offset.

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[49] Unless the development site is party to a Milton Keynes Tariff 1 or 2 Agreement, in which case carbon offset contributions will be managed through the process outlined in the relevant Agreement.

7.4 K.4 'Indoor Air Quality' and Overheating Risk' performance for new dwellings

As the thermal resistance specification (U-values) of solid building fabric elements required to meet Building Regulations is increased and climatic conditions change there can be an increased effect of solar gain (i.e. solar irradiation through glazing) that can in turn cause overheating risk.

In addition, the requirements of the Building Regulations to control air permeability (the measured air permeability in new dwellings is not to be greater than the limit value of 10 m3/(h.m2) at 50 Pa) could lead to air quality issues if not adequately controlled, or if mechanical ventilation is not provided.

Applicants should take account of these issues as set out below. The outputs of these calculations (i.e. the projected performance of the dwellings) will form part of the baseline data for the quality and monitoring regimes required by Policy SC1 Parts K.5 and K.6.

7.4.1 Overheating Risk

Solar gains are beneficial in winter (to offset demand for heating) but can contribute to overheating in the summer, especially as climate change causes summers to get increasingly hotter. The effects of solar gain in summer can be limited by an appropriate combination of passive design measures such as window size and orientation, solar protection through shading and other solar control measures, as well as ventilation (day and night) and high thermal capacity.

In addition to providing the required SAP 2012 Appendix P calculations and ensuring that Criterion 3 of *Approved Document, L1A Conservation of fuel and power in new dwellings* is met, applicants should consider the effect of future climate change in increasing ambient temperature by modelling different scenarios at design stage. Please see section 7.5.3 Quality regime 'design-stage' requirements for further detail.

Developers must calculate overheating risk by carrying out an analysis as set out in CIBSE TM59 Design methodology[50], or equivalent methodology, for the assessment of overheating risk in homes. The results of this assessment should be included in the Energy and Climate Statement submitted with the application.

The CIBSE TM59 Design methodology sets out a twelve step approach (Section 2) to determine temperatures which are then assessed against two criteria for

[50] https://www.cibsejournal.com/technical/using-tm59-to-assess-overheating-risk-in-homes/

predominantly naturally ventilated dwellings (Section 4.2) for (a) living rooms, kitchens and bedrooms and (b) bedrooms only. For dwellings that are and those that are predominantly mechanically ventilated (Section 4.3), all occupied rooms should not exceed an operative temperature of 26 degrees Celsius for more than 3% of the annual occupied annual hours.

In situations where developments of dwellings are for vulnerable occupants then the requirements of Section 4.4 of the CIBSE TM59 methodology should be taken into account and if the development has corridors then Section 4.5 should be taken into account.

7.4.2 Indoor Air Quality

Indoor Air Quality (IAQ) is the air quality within and around buildings and structures. IAQ is known to affect the health, comfort and well-being of building occupants. Poor indoor air quality has been linked to sick building syndrome, reduced productivity and impaired learning in schools.

IAQ is affected by the quantities of gases (e.g. carbon dioxide, volatile organic compounds – VOCs), particulates and microbial contaminants (mould, bacteria, etc.). Although a number of publications set out recommended maximum levels (e.g. for carbon dioxide where indoor levels of no more than 1,000 ppm are suggested – above this causes drowsiness in occupants) there are currently no specific legislative requirements except Building Regulations Part F on ventilation, specifying indoor air quality standards for a limited number of substances only, and Part C includes radon.

To determine the 'as-designed' IAQ in new developments, developers should use a Dynamic Simulation Model model to simulate IAQ. These results must be included in the Energy and Climate Statement submitted with the planning application; they will form the baseline data for later quality regime and performance monitoring required by Parts K.5 and K.6 of Policy SC1.

For guidance on achieving optimum air quality in new dwellings, developers may refer to 'CIBSE KS17: Indoor Air Quality & Ventilation', as well as Building Regulations Part F as mentioned.

Developers must also meet the requirements for IAQ assurance that are set out in the quality regime described at 7.5 K.5 Quality regime for building performance.

7.5 K.5 Quality regime for building performance

The gap between the 'predicted' and 'actual' energy performance of new buildings is acknowledged to be significant, with BRE sources stating that actual energy performance is often between two and ten times higher than forecast by the compliance calculations carried out at the design stage.[51]

According to the Climate Change Committee report 'UK Housing – Fit for the future?', '*Closing the 'performance gap' between how homes are designed and how they actually perform when built or retrofitted is a vital first step to ensure improvements to Building Regulations are effective. […] An immediate improvement would be to enforce current standards, and to revise monitoring metrics and certification to focus on 'as-built' performance.*[52]'.

Paragraph 130. of the NPPF states: '*Local planning authorities should also seek to ensure that the quality of approved development is not materially diminished between permission and completion, as a result of changes being made to the permitted scheme (for example through changes to approved details such as the materials used).'*[53]

To meet the aspirations of local and national Government to achieve net zero carbon by 2050 or earlier, it is crucial that the low building carbon emissions calculated at the design stage, are delivered in practice.

Therefore, rather than waiting for a national system of compliance and enforcement for building carbon emissions, we have set a requirement for the use of quality and monitoring regimes in SC1 K.5 and K.6.

Developers are required to set out the quality regime that they will use for their development, including how it meets our minimum requirements in their Energy and Climate statement. Guidance for developers on the requirements of the quality regime are set out below.

We define a quality regime as a system or set of processes to ensure that the 'as built' performance (meaning post-occupancy performance) of the dwellings matches the values stated at design stage. This is done by comparing post-construction and

[51] https://www.breeam.com/wp-content/uploads/sites/3/2018/04/GN32_BREEAM_UKNC_2018_Energy_prediction_and_post_occupancy_assessment_v0.0.pdf

[52] https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf

[53] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

post-occupancy data with predicted design performance. It is also recommended that at the later monitoring stage this is compared with industry benchmarks to help determine the asset's potential performance and encourage improvement.

The quality (and subsequent monitoring) regime will need to ensure the developer will have the necessary data, both at design and post-occupancy stages. This is so that a developer can establish what the performance gap is (if any), or to demonstrate that, as required by Plan:MK, 'as built' performance (meaning performance once the building(s) is/are in use) matches the values put forward during the design stage. This will involve the setting of performance targets, which will require appropriate modelling (for energy use, carbon emissions, indoor air quality and overheating risk).

Some of these will already have been calculated in line with Parts K.2 and K.4 of Policy SC1. It is also recommended this is then compared with industry benchmarks to help determine the asset's potential performance and encourage improvement. This data will provide a baseline that later data, from subsequent metering and monitoring of the occupied dwellings, can be compared to.

In addition, the quality regime will need to follow a set methodology to ensure that the 'design' and 'as built' values of the key parameters mentioned in the policy (energy, carbon emissions, indoor air quality and overheating risk) are the same. As above, this will pave the way for the monitoring regime required by Policy SC1 Part K.6 which will take the form of a Post Occupancy Evaluation (POE). In order to be sufficiently robust, the quality regime will have to fulfil a series of requirements as specified below.

The chosen quality regime will need to involve an iterative feedback process whereby the build quality of new dwellings is tested during construction, and any issues are rectified, to ensure the building quality will be as designed.

The use of quality and monitoring regimes is still relatively novel in England and as such we anticipate that new regimes will emerge over the life of this SPD. The Council may therefore update its guidance to reflect these new quality regimes at a later date.

7.5.1 A recognised quality regime

Any quality regime adopted by developers must be appropriately recognised and include independent evaluation by a suitably accredited assessor. The quality regime must demonstrate that the performance gap has been addressed.

An example of a quality regime is the approach to ensuring building quality set out in the *Quality Assurance* section in Parts 9.1 (Project Preparation), 9.2 (Commissioning & Testing) & 9.3 (Inspections and Completion) of *Home Quality Mark ONE: Technical Manual: England, Scotland & Wales (2018)*[54], or as updated.

Another example is BSRIA's Soft Landings Framework[55].

As above, it is anticipated that quality regimes that aim to address the performance gap will be an area of growth in the future, so it may be possible to soon use other quality regimes, so long as they fulfil the quality regime requirements minimum components set out below.

More information on how we have considered available quality regimes is provided at Annex F.

7.5.2 Quality regime minimum components

In the context of SC1 K.5, a quality regime is a system or set of quality assurance processes that ensures the 'as built' performance of a dwelling - in terms of energy use, carbon emissions, indoor air quality, and overheating risk - matches its calculated design performance.

Developers must demonstrate in the Energy and Climate Statement that the quality regime they will use has the following minimum components:

1. Suitable modelling of different (including reasonable-worst case) scenarios at design stage and the issuing of performance targets for energy use, carbon emissions, indoor air quality and overheating risk.
2. Suitable processes and plans in place to ensure everyone involved in construction and dwelling management knows how to avoid common reasons for the performance gap, for example:
    a. specification (components - systems and fabric) does not match design;
    b. management factors
        i. handover and commissioning,
        ii. poor construction (workmanship, sequencing, quality control), refer to ZCH Builders' Book[56] for suggested areas of focus;

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[54] https://www.homequalitymark.com/wp-content/uploads/2018/09/HQM-ONE-Technical-Manual-SD239-.pdf
[55] Soft Landings Framework or Guides, Building Design Process UK | BSRIA
[56] Slide 1 (zerocarbonhub.org)

    c. building management and users' behaviour.
3. Suitable fabric and process testing, and iterative feedback mechanisms, during construction to ensure that any factors that would create a performance gap are identified and addressed.
4. As a whole, the quality regime ensures the 'as built' dwelling performance targets set (for energy use, carbon emissions, indoor air quality, and overheating risk) are achieved.
5. Third party verification that the quality regime has been carried out.

Carrying out of the chosen quality regime will be secured either through planning condition or legal agreement, depending on the case specific circumstances of each application.

7.5.3 Quality regime 'design-stage' requirements

In addition, developers must undertake advanced modelling - ideally using a Dynamic Simulation Model that implements the National Calculation Methodology to establish the baseline values at design stage.

Whichever modelling approach is used, it must be approved by MHCLG and include the modelling of expected usage profiles (rather than standard).

In order to have the necessary data for a meaningful comparison at post-occupancy stage, the developer also needs to model scenarios rather than just the ideal, for example testing extreme weather, high and low occupancy and poor management[57].

A performance target made up of a range between a central scenario and lowest acceptable performance (also known as reasonable worst case) needs to be published at design stage. This will serve as the baseline for future comparisons during the post-occupancy stage, as set out in 7.6 K.6 Monitoring regime. Some of the data needed to create these targets will have already been produced due to the requirements in Parts K.1, K.2 and K.4 of Policy SC1.

This information, alongside the proposed quality assurance processes associated with Sections 7.5.1 and 7.5.2, should be contained in the Energy and Climate Statement submitted with the planning application.

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[57] For a useful factor to use in the calculations on poor management you can refer to BREEAM New Construction and their Post-occupancy Assessment methodology.

7.5.4 Preparation for Metering and Monitoring Strategy

As above, the quality regime will need to specify the calculated design performance of the dwelling and specify the exact metrics (e.g. kg CO_2e per year) to be recorded. This will ensure there are meaningful metrics to compare 'as built' (post-occupancy) values with.

Equally, the quality regime must ensure the post-occupancy data will be available by implementing a suitable metering and monitoring strategy that will enable measurement (or later calculation) of energy use, carbon emissions, indoor air quality and overheating risk.

Indoor monitoring devices should be installed in each dwelling to record annual carbon emissions, energy use, indoor temperature (in living rooms, bedrooms and kitchens) and indoor air quality (in the rooms modelled in line with section 7.4.2) during occupation.

7.5.5 Suggested units of measure for each required parameter

It will be for developers to determine the most appropriate units of measure, and these may be specified by the selected quality regime. However, developers may want to consider:

- For energy use, using kWh/m2 and comparing measurements with CIBSE benchmarks.
- For Carbon emissions, it might be helpful to put this in the context of any applicable net zero carbon targets and using the metric kg CO_2e per year.
- For Indoor Air Quality, developers may use the principles of CIBSE KS17: 'Indoor Air Quality & Ventilation' to guide construction processes, and may choose which of the following metrics to model/monitor: total VOC ppm, nitrogen dioxide ppm, carbon monoxide ppm, PM10 ppm, PM2.5 ppm, % occupied hours in comfort range.
- For Overheating Risk and following CIBSE TM59 methodology, developers would measure percentage of hours that cannot exceed the target temperature, based on the running mean. This would apply to all occupied spaces. The second criterion is CIBSE Guide A's number of hours exceeding 26°C in bedrooms at night. Other variables may be used, depending on the quality regime selected.

7.6 K.6 Monitoring regime

Whereas the quality regime will be focused on the set of construction-stage processes ensuring the 'as designed' dwelling performance targets are achieved in practice, the monitoring regime required by Part K.6 focuses on collection of in-occupation dwelling performance data. Although, in the long term, the monitoring regime will indirectly function as part of the quality regime, by highlighting to owners/occupiers any issues with the design of the house that causes it to perform not as well as designed. For this reason is important that data is collected robustly, following good practice POE principles.

As per the requirements of SC1 K.6, annual reporting will apply to 10% of the dwellings in the proposed scheme for a period of 5 years.

We advise that developers use the POE methodology in section 11.4 of the *Home Quality Mark ONE: Technical Manual: England, Scotland & Wales (2018)*[58], or as updated, as a guide for meeting this requirement.

Developers are required to set out how their monitoring regime, based on the HQM methodology, will work in practice and be independently verified by a third party, in the Energy and Climate Statement to be submitted alongside the planning application.

The POE is a key part of establishing whether the performance gap has been addressed. Taking into consideration the monitoring, certification and compliance aspects flagged by the Climate Change Committee, the POE must fulfill the requirements below:

- Be carried out by an independent organisation and assured through third party certification or equivalent,
- Use consistent benchmarks and methodologies across multiple projects that are based on industry good practice (e.g. CIBSE) and recognised by standards such as HQM, BREEAM (or equivalent),
- Consider the asset's performance regarding its progress on its pathway to net zero carbon,

[58] https://www.homequalitymark.com/wp-content/uploads/2018/09/HQM-ONE-Technical-Manual-SD239-.pdf

- Incorporate POE principles into the project during early design and construction (e.g. establishing predicted performance and scheduling good practice handover, aftercare and POEs in the programme of works[59]),
- Produce occupier reports and client facing access or equivalent, in addition to the report for the Council.

As each dwelling to be monitored has been occupied, developers must ensure performance monitoring and data collection for all relevant parameters for one whole year is carried out in line with good POE practice. This will enable the Developer to verify whether the performance targets have been achieved.

This verification process should entail, after appropriate commissioning has taken place, comparison of the ‘as designed’ parameters (energy, carbon, air quality and overheating risk) to monitoring data under the same categories, to assess and compare actual performance. In order to account for seasonality, a minimum of 12 months monitoring data is required. On the other hand, to account for actual weather, the modelling results can be adjusted with degree days for the relevant year. A ‘performance gap metric’, which will compare designed and actual performance (e.g. a percentage difference) for each of the 4 required parameters (energy, carbon, air quality and overheating risk) should be issued at POE stage. This needs to be issued for both the ‘central’ scenario and the ‘lowest acceptable performance/reasonable worst case scenario’ as a minimum, with multiple scenarios considered if at all possible.

The process and reporting methodology used for this Post Occupancy Evaluation will need to be repeatable, so that performance can be monitored annually for five years, so as to meet the requirements of SC1 K.6.

A report will then be required to be submitted to both dwelling owners/occupiers and to Milton Keynes Council, which states the performance gap metric and identifies any reasons for deviation from predicted energy usage, carbon emissions, indoor air quality and overheating performance, as well as specific actions that may be taken to reduce the gap. This will enable owners/occupiers to highlight any issues on snagging lists, or to the relevant new home warranty provider.

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[59] For further detail and examples see Home Quality Mark or BREEAM New Construction

We will secure submission of the monitoring report to owners/occupiers and the council either by condition or legal agreement, to be determined at the time of application based on case-specific factors.

Completed monitoring reports should be emailed to us at mkc-co2-calculations@milton-keynes.gov.uk

8 Water

Water resource management is essential to managing water deficits within the water stressed Ruthamford Central Water Resource Zone, in which the majority of the Borough sits, along with some neighbouring authorities. Water scarcity is only likely to increase as the impacts of climate change continue to emerge and it is essential that new buildings take steps to ensure efficient use of water when they are operational. Energy is required to treat water and to pump it around the network of pipes. Reducing the amount of water used will therefore reduce the GHG emissions associated with the treatment and distribution of water. This chapter provides further guidance on how the requirements of Policy SC1 L – M can be met.

Further, if surface water is misconnected to the foul system, sewer capacity issues are created within sewers and at sewage treatment works. Development proposals should therefore be designed to ensure that the potential for misconnections is eliminated.

Policy SC1: Water

L. All newly constructed dwellings will be required to achieve an estimated water consumption of no more than 110 litres/person/day.

M. Water reuse and recycling and rainwater harvesting should also be incorporated wherever feasible to reduce demand on mains water supply, subject to viability. Proposals will be expected to maximise the use of the above measures subject to the outcome of the viability assessment.

New or refurbished non-residential developments, should aim to achieve the maximum number of water credits in a BREEAM assessment or the 'best practice' level of the Association of Environment Conscious Building (AECB) water standards. The AECB standards can also be used to guide the specification of suitable fittings/appliances in residential developments.[60]

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[60] www.aecb.net/ publications/ aecb-water-standards.

Developers will need to include in their Sustainability Statement information setting out the design options they have incorporated to reduce water demand, an assessment of whole building water consumption using the guidance below, and ownership and maintenance of any shared / communal water collection or management facilities.

8.1 L. Water Consumption

Water consumption can be reduced through a range of water efficiency measures. We require that the potential water consumption for new dwellings is in line with optional requirement in G2 of the Building Regulations (2010)[61] for consumption of water to be no more than 110 litres per person per day.

Guidance on how to calculate water efficiency is available at appendix A of the Building Regulations Part G, which should be adhered to in the preparation of the developments Water Strategy.

There are three strands to supporting efficient water use in residential dwellings:

- Using low flow and water efficient technologies
- Preventing water leakage
- Improving consumer awareness through metering

Each of these aspects is set out in more detail below.

While non-residential developments are not required to meet a target water consumption, developers wishing to adopt best practice should consider the requirements of Wat01 of the BREEAM assessment framework.

8.1.1 Water Efficient Technologies

The key water usage items in a residential setting, and technologies to reduce water use are set out in the table below. Developers should consider the inclusion of as many as these technologies as possible in their developments to meet or exceed the no more than 110 litre per person per day target.

Water Usage	Technology
Toilets (WCs)	WCs with a flush volume of 4.5 litres or less or clearly labelled dual flush toilets with a 4/2 litre flush

61 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/504207/BR_PDF_AD_G_2015_with_2016_amendments.pdf

Water Usage	Technology
Kitchen Taps	Flow rates of between 4 to 6 litres/minute
Bathroom Taps	Flow rates of less than 4 litre/minute delivered through either automatic shut off, screw down/lever, or spray taps. Use of spray, aerated, low flow automatic shut off or infrared controlled appliances as well as the installation of flow restrictors
Showers	Showers are generally more water efficient than baths. Aerated and low flow shower heads should be used to ensure flow rate does not exceed 6 litres per minute for a water pressure of 0.3MPa, assuming a delivered water temperature of 37^{o}C
Baths	Baths with a capacity of 100 litres to the overflow, fitted with a device that automatically stops the flow from the taps when the bath's maximum capacity is reached
Urinals	Waterless urinals, or urinals fitted with individual presence detectors that operate the flushing control after each use
White goods	Installation of washing machines which use 6 litres of water per kilogramme of washing, and dishwashers which use only 10 litres of water per wash
Landscaping	Integration of dry or low water use gardens, including use of drought resistant plants.

8.1.2 Water Leakage

Avoiding water being wasted through leakages is also important to reducing water consumption. Developers should use durable plumbing to prevent leakages, and for larger developments leak detection systems should be fitted to the mains water supply and toilet facilities.

8.1.3 Water Meters

Visible water meters have been shown to reduce the water consumption of occupants and should be provided in each individual property.

8.2 M. Water Reuse and Rainwater Harvesting

Alongside ensuring water is used efficiently, developers should consider how rainwater collection, water reuse and water recycling can further reduce the water consumption for new buildings. Moreover, findings published by Waterwise demonstrate that buildings with water reuse systems is lower than buildings with mains water systems[62].

At least 50% of water consumed in homes and workplaces does not need to be of drinkable quality (for example water used for flushing toilets, washing laundry and watering parks and gardens). Rainwater should be collected, or grey water reused to supply these uses. Grey water systems are often only feasible on large schemes as they require a dual plumbing system to be installed.

Non-Potable Water Uses

Non-potable water from greywater or rainwater systems can be used for:

- Flushing toilets
- Appliances such as washing machines
- Cleaning of equipment or process cleaning
- Cooling (boilers)
- Garden and landscaping use (irrigation)

However, it should be noted reusing greywater at a domestic scale is generally more energy and carbon intensive than using mains water, especially when intensive treatment is used. The efficiency of rainwater systems varies depending on the level of treatment required. To save energy, it is better to focus on water efficiency and specifically on reducing the volume of hot water used as set out above. Using treated greywater in place of mains water for garden irrigation saves energy and water, but the water must not be stored for long.

British Standards have published four documents that can provide guidance to developers considering the installation of rainwater harvesting and grey water reuse systems:

- BS 8595:2013: Code of practice for the selection of water reuse systems, which gives recommendations on how to select water reuse systems. It covers systems for rainwater harvesting, stormwater harvesting and greywater reuse
- BS EN 16941-1:2018: Rainwater harvesting systems
- BS8525-1:2010 and BS 8525-2:2011: Greywater systems

[62] https://www.waterwise.org.uk/knowledge-base/independent-review-of-costs-and-benefits-of-rwh-and-gwr-options-in-the-uk/

Developers should provide details of how any rainwater or greywater systems will be maintained.

8.2.1 Rainwater Harvesting

Rainwater harvesting refers to the collection of rainwater for non-potable use, this is most commonly from roof collection, but may be from other water runoff.

There are two forms of rainwater harvesting:

- Water butts
- Systems with treatment and storage tanks

Water butts are a straightforward collection system without treatment, that are installed directly to a gutter downpipe. Water can then be drawn directly from the water butt using a tap and used by the householder for gardening/landscape maintenance. This avoids the need for a separate plumbing system for the non-potable water. Due to their simple nature, and low maintenance requirements water butts may be the most suitable option for individual households. These systems can include communal systems for multiple dwellings near one another or in commercial/industrial developments.

For rainwater to be used within a building (e.g. for appliance or toilet flushing) a more complex system is required that treats and stores the collected rainwater. Typically, the components of a system will be:

- A filter to remove leaves and other debris from the roof, which should be easily accessible for cleaning and maintenance
- A storage tank
- A submersible pump which pumps water to the header tank
- A header tank located at high level
- A secondary plumbing system that is clearly labelled as using non-potable water

These systems also require a mains top up to ensure that water is available regardless of the availability of rainfall. Many of the requirements of greywater systems set out below, will be applicable to rainwater treatment and storage systems, including:

- Safe storage of the water to prevent bacterial growth, CIBSE[63] suggest that rainwater can be stored safely for between 10 and 20 days, or longer with treatment
- Reliance on power supply for pumping
- A back up of supply of mains water with back flow prevention for when water levels are low
- Water Regulations Advisory Scheme (WRAS) compliant labelling of non-potable water pipes

Rainwater collection is more variable than grey water, in terms of both quality and volume of the water collected which can present problems for understanding the level of filtration and treatment required. Therefore, developers will need to undertake a site assessment prior to design of a more complex water collection system.

Figure 14: WRAS signage

For rainwater collection contamination from the roof must be addressed. Using appropriate roof materials can assist with this. Materials that contain heavy metals should be avoided, and wood and asphalt tend to collect bacteria, while metal roofs are smoother, cleaner, more impervious and more durable than other types of roofing materials. However, use of metal as a roof material will only be acceptable if it can be demonstrated that the proposal as a whole would accord with Design policies within the development plan as a whole. Discarding the 'first flush' of storm water has also been shown to reduce water contamination.

8.2.2 Greywater Reuse

Greywater is a more reliable and consistent source of non-potable water than rainwater, however it is often more contaminated and in no instances can it be used directly. This means there is greater complexity in the systems for greywater reuse than for rainwater harvesting.

This complexity means that greywater benefits may be best realised in a system with scale, for example a commercial building with reasonably extensive uses for non-

[63] CIBSE Knowledge Series – Reclaimed Water

potable water or a communal system in residential development. This also helps balance the supply and demand profile across the system.

In terms of greywater volumes BS8525 suggests an estimated greywater production per person domestically of 50 litres per day. Greywater can be split in to two categories depending on the source:

- Low load greywater: From the use of hand basins, showers and baths, where the water greatly dilutes the concentrations of detergent and organic soil.
- High load greywater: From appliances such as washing machines and dishwashers, where the water has higher organic and chemical contamination, due to higher soil levels coming from clothes and dishes, and a higher chemical content due to the stronger nature of detergents used.

All greywater must be treated prior to use, which may happen in the storage tank. Treatment of high load greywater will need to be more extensive than low load greywater. CIBSE suggests that grey water can be safely stored for 3 days after treatment. Untreated water should not be stored for more than an hour.

There are a range of treatment technologies for greywater available and systems generally a combination of treatment systems to address both biological and chemical contamination. The main treatment systems available are:

- Sequencing Batch Reactor (SBR)
- Membrane Bioreactor (MBR)
- Membrane Chemical Reactor (MCR)
- Rotating Biological Contactor (RBC)
- Vertical Flow Reed Bed (VFRB)
- Horizontal Flow Reed Bed (HFRB)
- Green Roof Water Recycling system (GROW)

The end of use of the greywater may also affect the type of treatment required, for example it is acceptable for water for flushing toilets to have a higher chemical content than for garden watering, as toilet water is passed on for treatment at a sewage treatment works.

When planning for the storage and treatment of greywater developers should be mindful of how they will prevent legionella bacteria breeding. As such the temperature of stored and delivered water should not exceed 20°C and this should be monitored.

Collection of grey water will require diversion of bath and sink etc. drainage from the foul sewer. This will normally necessitate a new stack for grey water, which will need to be vented. Any pipes transporting grey water will need to be marked accordingly in line with WRAS requirements to prevent accidental contamination of non-grey water sources, such as new WC connections. Any taps should be clearly marked as supplying non-potable water and consideration should be given to using a different size of fitting to prevent accidental contamination.

Greywater storage tanks will require a system for mains top-up to ensure water is supplied even if there is insufficient grey water. This will require a backflow prevention device to prevent contamination of the mains water system. Greywater is a Category 5 fluid under the Water Supply (Water Fittings) Regulations (1999), so the backflow prevention device needs to be appropriate for this classification. For example, unrestricted type ‘AA’ air gaps and, unrestricted type ‘AB’ air gap with a non-circular overflow.

Systems that rely on water being pumped are also sensitive to power failure, and consideration needs to be given to how this will be managed, particularly where the non-potable water supply may be critical to commercial activity.

Water reuse systems may also function as part of an integrated water management approach. Refer to Policy FR2 in Plan:MK for our position on how integrated water management systems should be delivered.

9 Retrofitting

As well as ensuring that new buildings are constructed sustainably, to achieve our ambitions to reduce GHG emissions existing buildings will also need to be improved through retrofitting. This chapter provides further guidance on how the requirements of Policy SC1 N can be met.

Policy SC1: Retrofitting

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

9.1 N. Improvements to Existing Buildings

Existing buildings have a significant amount of embodied carbon. In addition, the construction of new buildings is a major consumer of resources and can produce large quantities of waste and carbon dioxide emissions as well as contribute towards poor air quality. Developers should carefully consider the potential to retain existing buildings, including through their conversion, refurbishment and extension, as set out in section B – Materials and Reuse. Where possible, sustainable measures should be retrofitted into existing buildings.

Retrofitting is the incorporation of new measures or technologies into existing buildings. There are a number of building technologies and fixtures that can be retrofitted to existing buildings in order to considerably improve their energy efficiency, reduce carbon emissions and, in some cases, improve their general suitability, condition and longevity.

Measures vary from treating the fabric of a building with insulation, through to replacement of a new heating system and can include the use of renewable energy technologies such as solar panels.

The conversion or retrofitting of existing buildings is a key element of meeting the commitments set out in Milton Keynes' Sustainability Strategy. It can also reduce the operational costs of building through reducing bills and improve the experience of those using the building (for example by reducing draughts).

9.1.1 Retrofit Technologies

There are various ways to retrofit buildings, some of which will not require planning permission (such as loft and cavity insulation). More substantial measures such as cladding and window replacement would be required to achieve more substantial savings. Examples of measures developers may wish to consider can be found at Energiesprong UK (https://www.energiesprong.uk) and Superhomes (www.superhomes.org.uk).

Table 3 below outlines a wide range of possible retrofit measures, highlighting those that require full planning permission in Milton Keynes. It should be noted that for all measures if the proposed works are to part of, attached to or within a listed building, park or garden a separate listed building consent will be required.

Table 3 – Planning Requirements for Retrofit

Full Planning Permission Required	Other
Planning permission required	Permissions required dependent on permitted development rights and building status
• Air source heat pumps • Biomass heating system, including wood burning stoves • Double and triple glazing • Externally applied solid wall insulation • Green walls and roofs • Mechanical ventilation and heat recovery • Rainwater harvesting • Roof insulation at rafter level • Slim profile double glazing • Solar thermal • Solar photovoltaics • Wind turbines	• Boiler and heating controls • Cavity wall insulation • Chimney draughtproofing balloon • Chimney register plate • Grey water recycling • Ground source heat pump • Internally applied solid wall insulation • Metal framed window draughtproofing • Roof insulation at ceiling level • Secondary glazing • Timber casement window draughtproofing • Timber door draughtproofing • Timber floor draughtproofing • Timber floor insulation • Timber sash window draughtproofing

Depending on the location of the proposed retrofit scheme, and the status of permitted development rights, additional consents may be required. In addition, some retrofit measures will be subject to Building Control. For the most up to date information Developers should refer to the National Planning Policy Guidance[64] and the Planning Portal, as well as Milton Keynes' online Interactive Mapping Website and Conservation Article 4 webpages which note when Permitted Development rights are withdrawn.

If after reviewing these resources applicants are uncertain whether a proposal needs consent, they should contact the planning service to discuss their proposal on 01908 691691 or Planning.Enquiries@Milton-keynes.gov.uk.

We have grouped the retrofit measures depending on the purpose of the intervention. These are:

- Reducing heat loss
- Reducing energy usage for heating
- Renewable energy generation
- Other sustainable technologies

The technologies within each area that require full planning permission are explored in more detail below.

9.1.2 Reducing Heat Loss

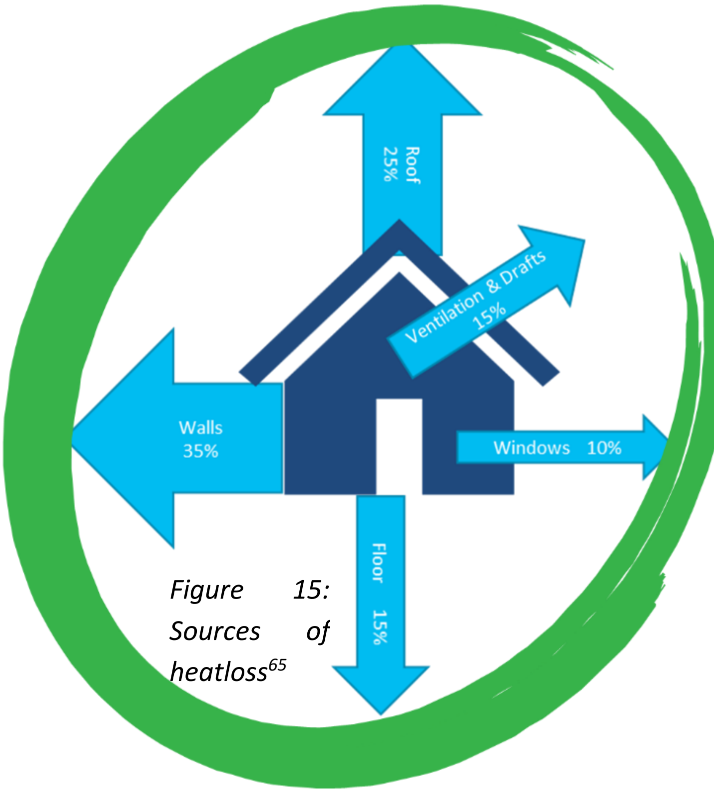


Figure 15: Sources of heatloss[65]

Reducing how much heat a building loses reduces the amount of energy that is required to keep it warm and, particularly when a fossil fuel is the source of energy for heat, this reduces carbon emissions. Reducing building heat loss will also reduce energy bills and make the building more comfortable for users, and can provide financial and health benefits for building occupants.

[64] https://www.gov.uk/guidance/when-is-permission-required

The key sources of home heat loss are shown in Figure. Those areas which are the biggest contributor to heat loss should be addressed first to have the greatest impact from investment in retrofit.

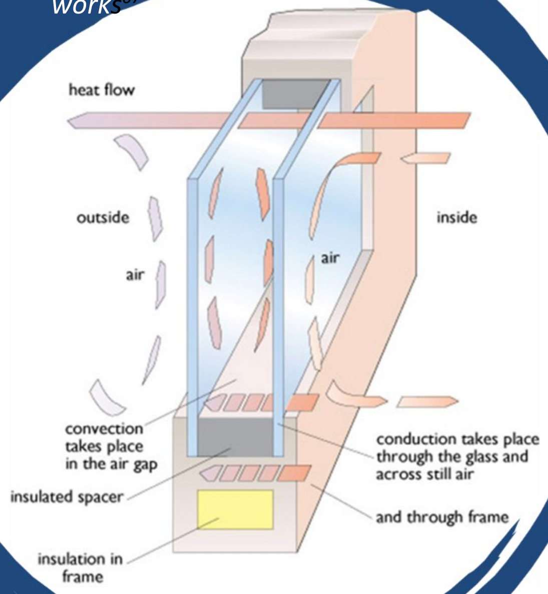
The technologies explored in this section are:

- Double and Triple Glazing
- Slim Profile Double Glazing
- Externally Applied Solid Wall Insulation
- Roof Insulation at Rafter Level

9.1.2.1 Double and triple glazing

Double and triple glazing reduce heat loss through windows, through having an inert gas sandwiched between the window panes which creates an insulating barrier. There are a wide range of double and triple glazing products on the market, which vary in cost and appearance. If the appearance of new windows with double or triple glazing has similar appearance to the existing windows and there are no planning constraints removing Permitted Development rights, then generally planning permission will not be required, although developers should check this particularly if the building is located in Conservation Area. For listed buildings listed building consent will always be required.

Figure 16: How double glazing works[67]



The insulative effect of double or triple glazing will vary depending on how the unit is designed, including factors such as the materials used to separate the panes, and whether the gap between the glass is filled with an inert gas. This is measured through the energy rating of the window, provided by the British Fenestration Rating Council[66].

[65] Macmullan, R (2007) Environmental Science in Building (Sixth Edition)
[66] https://www.bfrc.org/

Windows and doors with an energy rating of 0 or higher (Ratings A to A++) are considered to be energy positive.

9.1.2.2 Slim profile double glazing

Slim profile double glazing using the same mechanism of insulation as double and triple glazing, using an inert gas to reduce heat loss from windows. However, unlike in traditional double or triple glazing where the entire window and frame is replaced, slim double glazing can be installed without the need to change the original window. This is as existing single panes are replaced with new slim-section double-glazed panels, which are set in the original glazing rebates.

This can make slim profile double glazing more suitable for conservation areas and listed buildings although planning permission / listed building consent will still be required and the appropriate materials will need to be used.

As slim double-glazing units must be made to order, and they will generally be more expensive than replacing the window and will likely face more complexity to install.

Slim profile double glazing units achieve an insulation performance to the same level as those achieved by conventional double-glazed windows.

9.1.2.3 Externally applied solid wall insulation

External wall insulation involves fixing an insulating layer to the outside of the building, followed by a render or cladding. External wall insulation is often a more complex solution than internal wall insulation but can be appropriate where internal wall insulation would be disruptive or would alter room sizes, for example where there is no cavity. However, it should be noted that external wall insulation can accelerate issues with damp and condensation, and if these exist, they should be addressed before fitting external wall insulation. A greater thickness of insulation is typically required for external wall insulation compared to internal wall insulation.

External wall insulation will require alterations such as the deepening of window and door reveals and the alteration of eaves lines. These alterations will require scaffolding and possibly a temporary roof to reduce the risk of water penetration during the works.

As walls are the greatest source of heat loss from typical buildings, wall insulation (whether internal or external) has the potential to deliver large savings in heating.

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[67] Image reproduced under creative commons licence from: https://www.open.edu/openlearn/nature-environment/energy-buildings/content-section-2.2.1

While the effectiveness of external wall insulation will vary with the type of insulation chosen, thickness and configuration of the existing buildings, for most buildings an improvement in the thermal performance of walls of 35% can be achieved.

If the building to be insulated is in a Conservation Area additional factors need to be considered, including:

- External wall insulation is generally more suitable on the fronts of modern, rather than traditional buildings, unless the traditional building is currently, or has previously been, rendered
- External Wall Insulation is likely to be more suitable for the side or back elevations of houses in a Conservation Area unless these are prominent or decorative in design
- Insulation which does not create a significant difference in appearance may be more suitable, particularly for traditional buildings
- The thickness of insulation may also be a factor, if it brings the front of the building closer to a highway
- The method of attaching the insulation to the building, and other changes to the building that may be needed (e.g. altering the roof line) will also be considered in view of their potential for damage to the building

9.1.2.4 Roof insulation at rafter level

Roof insulation at rafter level can be newly retrofitted or existing insulation supplemented to further improve performance. The insulation is typically set both between and beneath the rafters in alternate directions to reduce heat loss through the joints. Rigid insulation boards which are self-supporting can be used, or soft insulation can be supported with a net or breathable building membrane.

While rafter level roof insulation may be more complex to install than ceiling level insulation, it benefits from allowing the roof space to be used, and reduces the need to upgrade loft access, water tanks, pipes, etc., as the roof space is ‘warm’. It is also the most appropriate approach where ceilings follow the line of the roof and there is no roof space available.

When installing rafter level roof insulation some adjustments may be required to improve ventilation of the roof above the insulation. Vents, counter-battens, breathable underlays and the like, are basic measures which a builder or roofing contractor could fit. Most rafter level roof insulation systems can be retrofitted in less than a day.

Most roofs can be insulated at rafter level at a reasonable cost. The substantial insulation savings that can be achieved mean that the cost of insulation is usually recovered within two to three years.

Planning permission or Permitted Development rights will need to be secured where the insulation is changing the roof height.

9.1.3 Decarbonising Energy Usage for Heating

Once the amount of energy required for heat has been reduced, for example using insulation measures such as those described above, developers should consider how the remaining heat requirements can be met in a low or no carbon way. There are a number of technologies available to replace or reduce burning of gas, a fossil fuel for heating.

In this section we outline the two measures which would require full planning permissions to implement:

- Air source heat pumps
- Mechanical ventilation and heat recovery

Guidance about the use of heat pumps is provided at 7.2.6 Heat pumps, when retrofitting heat pumps developers will need to consider the size of existing central heating elements (such as radiators) and whether these are suitable for the lower water temperatures produced by heat pumps.

9.1.3.1 Mechanical Ventilation and Heat Recovery

Mechanical Ventilation and Heat Recovery (MVHR) systems use a heat exchanger to reduce the amount of energy lost through air extraction and ventilation in the home. Most homes have mechanical extract fans which remove cooking odours, foul air and humidity from WC's bathrooms and showers. While these fans can be effective at improving ventilation, they also remove hot air from the home, replacing it with cold air which must then be heated. Using MVHR means that the new fresh air provided into the building is able to retain most of the energy that has previously been put into heating the waste air.

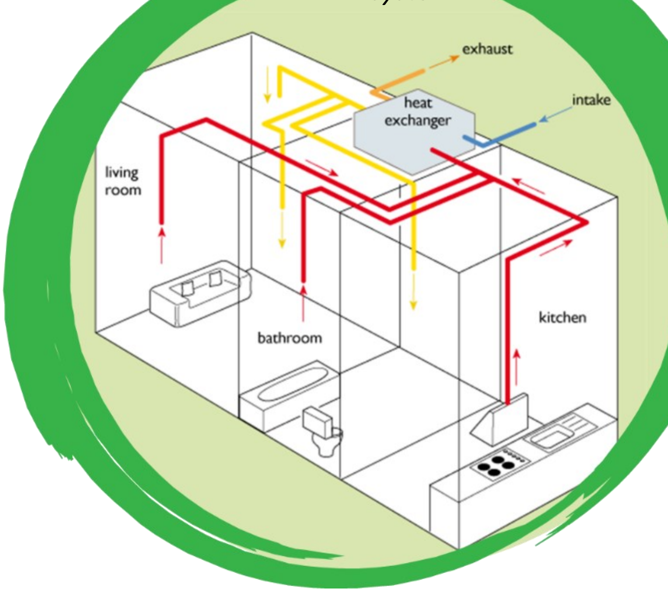

Figure 17: MVHR system[68]

An MVHR system will connect all the extract outlets from the home to a centralised plant, this may mean some alteration to the existing building, finishes and electrical services. The extent of this will vary with the complexity of the building, number of extracts and their location.

When considering whether to install MVHR developers should note that while MVHR can be installed in any building, it is generally considered to require a high level of airtightness and insulation to be worthwhile, or else the building will 'self-ventilate' and there is a risk that the system will draw in cool air from the outside. Additionally, MVHR relies on electricity and will only be carbon neutral if that electricity is generated from renewable sources.[68]

9.1.4 Renewable Energy Generation

Central to reducing CO2 emissions is using zero carbon electricity sources. While work is being undertaken at a grid level to decarbonise electricity, given current and future energy demand this will need to be supplemented by small scale local generation. Local generation also has the benefit of reducing bills and may even in some cases generate income.

Four key renewable energy technologies are likely to be suitable for use alongside buildings, rather than as standalone energy generation projects, and all will require planning permission:

- Biomass heating system, including wood burning stoves
- Solar thermal
- Solar photovoltaics
- Wind turbines

More detail about each of these technologies, and relevant considerations for developers is provided at 7.2 K.2 Onsite renewable energy generation and low carbon community energy schemes.

9.1.5 Other Sustainable Technologies

Other technologies which can be retrofitted to improve the sustainability of an existing building are:

- Green walls and roofs

[68] Image reproduced under creative commons licence from: https://www.open.edu/openlearn/nature-environment/energy-buildings/content-section-2.3.2

- Rainwater harvesting

Guidance on the installation of green walls and roofs is provided at 5.5 E. Green Roofs and Walls. When considering the retrofitting of green roofs or walls developers will need to assess the structural capacity of the building. However, there are a number of lightweight solutions which will be suitable for retrofit in many circumstances.

As described at 8.2.1 Rainwater Harvesting simple rainwater harvesting for garden irrigation can be installed with limited disruption to householders, however more complex systems will create more disruption and require the installation of a secondary plumbing system.

9.1.6 Approach to Undertaking Retrofit

When considering undertaking retrofit, drawing on good practice guides, which make the most of learning from the large number of retrofit projects already undertaken can help improve the projects ease of delivery and overall success. The Technology Strategy Board have produced a guide to making retrofit work, which developers may want to consider.[69]

Key principles that can be adopted to support retrofit include:

- Understanding the integration and interdependence of components into the single building energy system
- Collaborating and communicating across different teams where multiple retrofit installations are being introduced to the building
- Engaging with occupiers to ensure their expectations are managed, and they are able to take handover of the retrofitted technology and achieve the most from it in use
- Creating bespoke solutions which take into account the occupiers needs and the unique features of the building
- Providing controls for services to enable occupiers to adjust the building once in use
- Focusing on detail and undertake up front planning to avoid the need for rework

[69] https://retrofit.innovateuk.org/documents/1524978/2138994/Retrofit+Revealed+-+The+Retrofit+for+the+Future+projects+-+data+analysis+report/280c0c45-57cc-4e75-b020-98052304f002

Annex A. Abbrieviations

A.C.	**Alternating Current**
AECB	Association of Environment Conscious Building
ASHP	Air source heat pump
BEMS	Building Energy Management System
BER	Building Emission Rate
BESS	Battery energy storage system
BMS	Building Management Systems
BMS	Battery management system
BRUKL	Building Regulations UK, Part L
CHP	Combined Heat and Power
CIBSE	Chartered Institution of Building Services Engineers
CIRIA	Construction Industry Research and Information Association
COF	Carbon Offset Fund
CSA	Corporate Sustainability Assessment
D.C.	Direct Current
DER	Dwelling Emission Rate
DfD	Designing for Deconstruction
DS	Design Stage
DSR	Demand Side Response
EV	Electric Vehicles
FSC	Forest Stewardship Council
GHG	Greenhouse Gas
GROW	Green Roof Water Recycling system
GSHP	Ground source heat pump
HFRB	Horizontal Flow Reed Bed
IoT	Internet of Things
kWh	Kilowatt hour
kWp	Kilowatt peak
LPA	Local Planning Authority
LZC	Low or Zero Carbon
MBR	Membrane Bioreactor
MCR	Membrane chemical reactor
MVHR	Mechanical Ventilation and Heat Recovery
NPPF	National Planning Policy Framework
PA	Planning Act (2008)
PCS	Post Construction Stage
PCS	Power conversion system
PEFC	Programme for the Endorsement of Forest Certification

PV	Photovoltaic
RBC	Rotating Biological Contactor
RIBA	Royal Institute of British Architects
SAP	Standard Assessment Procedure
SBR	Sequencing Batch Reactor
SCOP	Seasonal Coefficient of Performance
SEER	Seasonal Energy Efficiency Ratio
SFI	Sustainable Forestry Initiative
SPD	Supplementary Planning Document
SuDS	Sustainable Drainage Systems
SWMP	Site Waste Management Plans
TCPA	Town and Country Planning Act (1990)
TER	Target Emission Rate
UHIE	Urban Heat Island Effect
VFRB	Vertical Flow Reed Bed
VOCs	Volatile Organic Compounds
WRAS	Water Regulations Advisory Scheme
WSHP	Water source heat pump

Annex B. Glossary

Aggregates – Sand, gravel and crushed rock and other bulk materials which are suitable for use in the construction industry as concrete, mortar, finishes, or roadstone, or for use as a construction fill.

Biodiversity – The variety of plant and animal life and ecosystems, it includes diversity both within and between species.

Biophilic Design – An approach to building design that seeks to connect building occupants more closely to nature.

Building Regulations (Part L) – The section of the Building Regulations that covers the conservation of energy and power within buildings. A revised version came into force in April 2016.

Building Emissions Rate (BER) – A term used in the building regulations for non-residential property this is the actual CO2 emission rate of based on the actual building specification.

Carbon Dioxide (CO2) – A gas which occurs naturally, but is also a by-product of human activity, particularly burning fossil fuels. It is the main greenhouse gas which is produced by humans.

Carbon Dioxide Equivalent (CO2e) – As all greenhouse gases have a different global warming potential, they are standardised to CO2e, which is a measure of how much CO2 would produce the same amount of warming.

Carbon Footprint – A measure of the amount of greenhouse gases that are released by an individual, organisation or object over a given period of time, usually a year.

Carbon Efficient Materials – Materials which have a low embodied carbon.

Carbon Neutral – An activity, organisation or object which has no net carbon emissions from any type energy use. The calculation can include carbon offsets to achieve neutrality.

Climate Change – A pattern of change in the global or regional climate which is caused by natural processes, but primarily by human activity. It includes a range of phenomena such as global heating, and changes in the frequency of extreme weather events.

Conservation Area – An area designated (usually by a local authority), as having special architectural and historic interest. Conservation areas have extra planning controls and considerations to protect and enhance them. Details of Milton Keynes' conservation areas can be found at https://www.milton-keynes.gov.uk/planning-and-building/conservation-and-archaeology/conservation-areas-in-milton-keynes

Decarbonisation – The replacement of CO2 intensive sources of energy with those that do not release CO2, such as replacing coal fire electricity generation, with wind powered energy generation.

Dwelling Emissions Rate (DER) – For residential property (excluding common areas) this is the actual CO2 emission rate of self-contained dwellings and individual flats based on their actual specification.

Ecological Footprint - The impact of a person or community on the environment, expressed as the amount of land required to sustain their use of natural resources.

Embodied Carbon – The CO2e emissions caused by the manufacture, transport and construction of a material or product, and its end of life emissions associated recycling and disposal.

Energy Performance – The amount of energy that a product or building uses when in operation.

Functional Adaptability – The structural design of buildings to enable flexibility of internal layouts and the external facade where possible. Ideally, there should be room for expansion of the building or building services to accommodate future changes in use, demand or technology. There should be scope to adapt and refurbish the building to another use or function, where the existing one has become redundant, without the need to demolish and rebuild.

Greenhouse Gases (GHGs) – Atmospheric gases that trap heat from the Earth and warm the surface. The Kyoto Protocol restricts emissions of six greenhouse gases: natural (carbon dioxide, nitrous oxide, and methane) and industrial (perfluorocarbons, hydrofluorocarbons, and sulphur hexafluoride).

Green Roof and Green Walls– A roof or wall completely or partially covered in vegetation, described in more detail at 3.8 Green Roofs and Walls.

Internet of Things – The connection via the internet of everyday objects, enabling them to send and receive data, for example 'smart' light bulbs.

Heritage Asset – A building, monument, site, place, area or landscape (including an archaeological priority area) positively identified as having a degree of significance meriting consideration in planning decisions. The national register is available at: https://historicengland.org.uk/listing/the-list/. In Milton Keynes we are also developing a New Town Heritage Register updates available at: https://www.milton-keynes.gov.uk/planning-and-building/conservation-and-archaeology/new-town-register

Legionella – A bacterium named *Legionalle pneumophila* that can cause legionnaire's disease (lung infection).

Net Zero Carbon – An activity, organisation or object which has no net carbon emissions from any type energy use, including its supply chain. The calculation can include carbon offsets to achieve neutrality.

Operational Carbon – The emissions of CO2e during the operational or in-use phase of a building, such as those from heat and power.

Permitted Development Rights – Permitted development rights are a national grant of planning permission which allow certain building works and changes of use to be carried out without having to make a planning application. Permitted development rights are subject to conditions and limitations to control impacts and to protect local amenity.

Photovoltaic (PV) Cell – Technology which converts sunlight directly into electricity.

Potable Water – Water suitable for human consumption that meets the requirements of Section 67 of the Water Industry Act 1991 [7].

Reclaimed Material – Material that is re-used in its existing state, without need for processing or energy intensive alteration.

Recovery – When reclaimed waste materials are processed or disposed of in a way that creates reusable by-products that replace other materials which would have to be used for that purpose, thereby conserving natural resources (e.g. composting green waste, or incinerating waste to extract usable energy).

Regulated CO2 Emissions – Emissions which arise from heating and lighting within the development as controlled by Building Regulations. They do not include the emissions resulting from the use of appliances by the occupiers of the development.

Regulated Energy –The energy consumption of a building which is a result of the specification of controlled (by building regulations) fixed buildings services and fittings, including space heating and cooling, hot water, ventilation, fans, pumps, and lighting. Such energy uses are inherent in the design of a building.

Renewable Energy – Energy generated from naturally occurring environmental processes for example from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass.

Retrofitting – The addition of new technology or features to older systems.

Sedum Matting – A layer of vegetation from the sedum family which are shallow rooted and therefore do not require a lot of growing medium.

Site Investigation – The process of carrying out investigations on land to determine whether there is contamination present. The investigate on is carried out in several stages.

Smart Charging – shifting the time of day when an EV charges or modulating the rate of charge, with the goal of helping to reduce and manage the impact of EVs on the electricity system, create benefits for consumers and maximise the use of renewable electricity.

Sustainable Drainage systems (SuDS) – A means of managing surface water runoff through storing or reusing surface water and reducing flow rates. Refer to Policy FR2 in Plan:MK for our position on SuDS. SuDS may include green roofs, where demonstrated that such systems will provide effective and reliable water management and flow control.

Target Emission Rate (TER) – A building regulations requirement setting the minimum allowable standard for the energy performance of a building, defined by the annual CO2 emissions of a notional building of same type, size and shape to the proposed building.

Unregulated Energy – The energy consumption of a building which is a result of systems and process which are not controlled (by building regulations). This may include energy consumption from systems integral to the building and its operation, e.g. lifts, escalators, refrigeration systems and ducted fume cupboards; or energy consumption from operational-related equipment e.g. computers, servers, printers, photocopiers, laptops, mobile fume cupboards, cooking, audio-visual equipment and other appliances.

Urban Heat Island Effect – A heating effect in urban areas, which leads to urban areas being warmer than the surrounding rural areas. This due to the manmade urban land surface which absorbs and stores heat., concentrated energy use in urban areas, and lower ventilation than in rural areas.

Waste Recovery – Using materials that would otherwise be considered waste again through reuse and recycling.

Water Stress –When the demand for water exceeds the amount of water available for use.

Whole Life Costs – The total cost of an asset over its lifecycle, taking into account not just the initial capital cost, but also the operational, maintenance, repair, upgrade and eventual disposal costs.

Zero Carbon – An activity, organisation or object which has no carbon emissions, either directly or indirectly.

Annex C. Energy and Climate Statement Template

Find Annex C appended to this document.

Annex D. Battery Energy Storage

Site selection	
Location of battery energy storage system (BESS)	A basic appreciation of the BESS site, including the battery and the Power Conversion System (PCS), switchgear, transformers, metering and the like. This should include any restrictions applying to the site, both within the allocated area BESS, or outside the fence line. Abnormal events, for example flooding risk, can create significant hazards and it may be necessary to raise batteries and other equipment above ground level for this reason. The project also includes work up to the point of connection to the electrical network, and any additional works required outside the site boundary. If the project is to be co-located with other renewable assets, such as a solar or wind installation, the area for the site appreciation should be increased.
Structure of BESS	To date, most large battery storage projects have either been housed in purpose-designed buildings or ISO-style shipping containers (ISO 668:2013). ISO container projects are quick to build, often low cost and are inherently modular. Access to individual containers (unless containers are extensively stacked) offers the option to increase the energy or power of the project later if this option is included in the original design. Adequately spaced containers may mitigate overall fire risk. However, containers have a larger net physical footprint and are perceived to have more adverse visual impact than an existing or new building. Building projects can be designed to fit the surroundings and thus planning permission may be easier to obtain. Some projects have been developed in low-cost, barn-like structures on agricultural sites. Changing the use of an existing farm building may require planning permission; developers should check with the LPA and whether the building is subject to Article 4 directions or other controls.. Regulations and legal requirements must be checked before considering installation of new equipment in an existing building.
Capacity of the required electrical network connection, voltage at point of connection and timescale for connection	Grid connection timescales vary; they heavily depend on status and forward evolution of the local network and can be in excess of 18 months. Larger projects may affect the transmission network, directly or indirectly, and so require the distribution company to liaise with the system operator. The applicant should provide the status of the connection application to the relevant network operator(s) and demonstrate how connection timescales will be managed.

Issues for Design and Planning Applications	
Site Access	Site access for construction, maintenance and decommissioning. The size and weight of the installation can be significant, for example lithium-ion batteries can have mass in excess of 6 tonnes per MWh.
Site security	For example, prevention of theft or vandalism. The project type (free standing, installed in shipping containers or similar enclosures, or installed in an existing or new building) will impact on installation, maintenance, relocation, visual appearance, safety and noise.
On-site vehicular parking	For the construction phase and ongoing maintenance access and facility staff.
Ownership of the land	Land ownership is not a planning consideration, however, you will have to think about: developers interest, and any third-party rights to the land, including ensuring public access if relevant and continued maintenance access.
Noise	The likely impact of noise from the BESS facility in operation
Visual impact and its management	Multi-MW energy installation will be physically large, and its visual impact will need to be considered in the planning process: A 10 MW (5 MWh) battery storage project's approximate footprint is 750 m^2. A 100 MW (100 MWh) lithium-ion project's approximate footprint is 10,000 m^2. A 50 MW (300 MWh) sodium sulphur system has a footprint of 14 000 m^2. Container-based projects are usually housed within standard (8 ft 6 in high), high cube (9 ft 6 in high) or modified ISO containers and may be stacked but, due to spacing and access requirements, may cover twice as much area as a building project. The point of connection to the electricity grid will also have some impact on the planning for the project. A cable joint connection underground would have little visual impact unlike a tie-in to an overhead line or a tower. Connection to 132 kV and above require sub-stations (sometimes loop-in – loop-out) requiring significant equipment. Some battery projects will be located on brownfield or greyfield sites where a new development will have a positive visual impact. Project developers can mitigate their visual impact for example by planting shrubs and trees around the perimeter.

Specific Energy Storage Considerations	
Purpose of the storage	Battery energy storage may be used for single or multiple purposes. Planning applications require the applicant to describe how the intended development will be used. The use(s) of the energy storage may also determine the rateable value of the project with implications on the project's rate of return.
Power and energy rating	The power and energy rating impact on layout, requirements for network connection, and its intended and alternative applications. The connection application to the distribution network operator needs to be carefully aligned with the future operation profile of the battery. Crucial elements to consider are: 1. connection voltage (important for the power rating of the battery); 2. both import and export ratings (MW). In general, symmetric capacities are recommended; 3. ramp rate (MW/sec) to indicate the speed of response the network will have to expect, and 4. power swing (MW). Any constraints indicated by the distribution network operator in their grid connection offer should be carefully assessed by the developer to ensure they would not affect the battery storage business case.
Choice of battery technology and specific chemistry	The Control of Substances Hazardous to Health Regulations 2002 (COSHH) cover the use of substances hazardous to health. The choice of energy storage type, in conjunction with its location, may determine the requirement for environmental impact assessment (EIA)[4], Hazardous Substances Consent, integrated pollution prevention and control (IPPC)[5] or variations, accounting not only for the energy storage medium, but also for the rest of the plant and its interactions with other adjoining or adjacent installations. For example, the presence of fuel tanks or chemical stores could, in combination, take an installation over a threshold limit set by the Control of Major Accident Hazards (COMAH) Regulations, Dangerous Substances (Notification and Marking of Sites) Regulations 1990 (NAMOS)[6], and Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulations. Developers should calculate the total mass of active materials on the sites and refer to the limits given in the legislation. Because battery storage involves chemical/electrochemical reactions, the materials in the charged and uncharged states should be considered. Some battery systems produce hydrogen at certain points in the charge cycle and this possibility should be included in the analysis. Developers should also check that in the event of a fire, explosion or other event, the total mass of released by-product materials is below the threshold limits. Compliance with the Batteries Directives (see references) and associated legislation and regulations which cover the import, use and recycling of the batteries is essential. There is also legislation covering the transport of batteries[7] and

	removal of waste batteries. This may influence the choice of route and selection of carrier for the delivery of batteries.
Choice of supporting equipment	Often referred to as the balance of plant. Consideration should be given to any size and noise implications and the chemical hazards associated with the balance of plant.
Associated civil engineering or building works	Such as cable trenches, cable ways, bunding and blast walls for transformers.

Annex E. Residual Carbon Reduction Calculations and Carbon Offset Fund

Calculations to determine the energy and carbon emissions savings of renewable and low-carbon energy are included in the methodology approved by the Secretary of State for calculating the energy performance of buildings and dwellings and non-domestic buildings, i.e. SAP 2012 for dwellings and Simplified Building Energy Model (SBEM) (or equivalent approved software) for non-domestic buildings.

These should be presented with the application as part of compliance as the definitive calculations. However, details of renewable energy proposals are required in the supporting documentation.

Biomass heating systems, including wood burning stoves

Developers should state the thermal output of biomass boilers (in kW), the fuel source (e.g. pellets, woodchip, etc.) and arrangements for access, storage and maintenance.

A general approach to size a biomass boiler for a domestic property:

Boiler size (kW) = volume of dwelling in cubic metre ÷ 30

A general approach to estimating annual fuel consumption (and storage) for a domestic property:

Fuel (tonnes) = thermal output (kW) ÷ 4

For larger non-domestic biomass heating systems (including community heat networks) developers should follow the requirements of CIBSE AM15 Biomass Heating (October 2014) which covers biomass boilers 5 – 50 MW.

Solar thermal

Solar thermal collectors are usually mounted on the roof of a building and although there a number of designs, the most popular available in the UK are flat plate and evacuated tube types.

Average output from a typical solar thermal system is:

Flat-plate collector

Output in kWh per year (T) = 450 x area of collector m2 (A)

Evacuated tube collector:

Output in kWh per year (T) = 550 x area of collector m2 (A)

Solar photovoltaics

Developers should use Appendix M of SAP 2012 to calculate the projected output of the solar PV installation for the proposed development in kWh per year. Developers should include details of the proposed solar PV installation including:

- Output kWp
- Area of panels or modules in sq. m
- Inclination to horizontal of panels or modules
- Azimuth (orientation) angle

Wind turbines

When estimating the wind resource on-site at turbine height, the use of the UK Wind Speed (NOABL) Database on its own is unlikely to be appropriate. Instead, methodologies that modify the wind resource considering the type of terrain (flat terrain, farmland, suburban, urban etc) and surrounding obstacles should be used.

Combined heat and power (CHP)

The applicant considering CHP should state the following:

- Size of the engine proposed for electricity (kWe) and heat (kWth) produced,
- The provision of any thermal store
- Suitable monthly demand profiles for heating, cooling and electrical loads,
- Cost benefit analysis
- Carbon reduction calculations

The plant efficiencies used when modelling carbon savings should be the gross values rather than the net values often provided by manufacturers. The size of the CHP must be optimised based on the thermal load profile before renewable energy systems are considered for the site.

Heat Pumps

Any proposal to use heat pumps should be supported with details of the Seasonal Coefficient of Performance (SCOP) and Seasonal Energy Efficiency ratio (SEER), which should be used in the energy modelling.

Carbon Offset Fund Calculation

In addition to the Energy and Climate Statement identifying the measures that the developer will use to reduce carbon emissions by improving on Part L emissions (min. 19% reduction) and introducing renewable energy technologies (min. 20% reduction), the Council requires energy demand for regulated emissions sources to be calculated. The projected carbon emissions of the building in occupation will be assessed to establish the required payment into the Carbon Offset Fund (COF) by means of a Section 106 agreement or unilateral undertaking[70].

The COF is spent on energy saving and renewable energy generating technologies elsewhere in the borough which, through the amount of carbon emissions they save, offset the residual carbon emissions from the development.

The payment into the COF is on a per tCO_2 basis, calculated from the difference between the predicted emissions of the building as designed the emissions that the building would have if it was zero carbon. The 'as designed' building calculation should take into account improvements related to K.1 and K.2.

Emissions for dwellings must establish:

- The Dwelling CO_2 Emissions Rate (DER), expressed in $kgCO_2$ per sq. m. of floor area per year and calculated through the latest applicable version of the Building Regulations methodology SAP or equivalent **before** improvements from K.1 and K.2 have been introduced.

Emissions for non-domestic development must establish:

- The Building CO_2 Emissions Rate (BER), expressed in $kgCO_2$ per sq. m. of floor area per year and calculated through the latest applicable version of the Building Regulations methodology based on the most up to date National Calculation Methodology (NCM) and implemented through Simplified Building Energy Model (SBEM) or equivalent software[71], **before** improvements from K.1 and K.2 have been applied.

[70] Unless the development site is party to a Milton Keynes Tariff 1 or 2 Agreement, in which case carbon offset contributions will be managed through the process outlined in the relevant Agreement.

[71] Other building regulation compliance software such as IES or TAS is also acceptable.

In terms of the extent of modelling work required, for residential development the applicant must apply the calculation for all buildings to develop a scheme figure, but only needs to provide supporting information for a representative sample of residential or mixed use developments, i.e. modelling for each type of flat or commercial unit (as applicable) in the development.

For non-residential buildings that are unique, modelling is required but sampling can also be applied if the development contains several of the same type of units, e.g. when developing a business park.

A summary of the modelling work output (i.e. BRUKL reports, DER worksheet for dwellings and relevant outputs of any other software used) must be provided as an appendix of the Energy and Climate Statement assessment for each type of building considered, with an unlocked Excel worksheet for the calculation of the COF contribution.

The CO2 emissions of all dwellings must then be summed to give the total regulated emissions for the domestic element of the development before the additional savings from K.1 and K.2 are applied. The CO2 emissions for each non-domestic building should be summed together to give total non-domestic regulated emissions in the same manner. These figures should be expressed in tonnes per annum (as opposed to kg, which is the metric used in DER and BER). A measurement in kg can be converted to tonnes by dividing by 1,000.

After calculating the emissions for the whole of the development, the percentage savings achieved by improvements over Part L (SC1 K.1) and those attributed to renewable energy technologies (SC1 K.2) can be deducted. The balance, i.e. the annual development's emissions from regulated energy minus what the developer will reduce by implementing SC1 K.1 and K.2, will be multiplied by the current COF rate (£200/tonne established in 2008, with indexation applied[72])[73].

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[72] The type of indexation applied is set out in the Section 106 and is not calculated until the payment due date approaches due to index fluctuations. The indexation to be applied is to be agreed between the parties, and the Council does not limit itself to any particular index.

[73] In preparing this SPD, the Council has considered best practice methods of calculating COF contributions elsewhere in England, which include multiplying the annual development emissions by the estimated lifetime of the building (usually 30 years). We will not be applying an annual multiplier at this stage, but will revisit at the calculation methodology during the next Local Plan review.

To summarise, the calculation of contributions to the Carbon Energy Fund will follow these steps:

1. Domestic emissions calculations

Emissions calculations for each dwelling type must establish:

Regulated energy emissions ($kgCO_2$ pa) =

DER x floor area m^2 x number of properties per dwelling type

Total domestic emissions (tCO_2 pa) =

SUM Total regulated emissions ($kgCO_2$) all dwellings ÷ 1000

2. Non- domestic emissions calculations

Emissions for non-domestic development must establish:

Regulated energy emissions ($kgCO_2$ pa) =

BER x floor area (m^2)

Total non-domestic emissions (tCO_2 pa) =

SUM Total regulated emissions ($kgCO_2$) all buildings ÷ 1000

3. Total development emissions (tCO_2pa) =

Total domestic emissions (tCO_2pa) + Total non-domestic emissions (tCO_2pa)

4. Carbon Offset Fund Contribution (£) =

Total Development Emissions (tCO_2pa) – (Savings over Part L (tCO_2 pa) + Savings attributed to renewable energy (tCO_2pa)) x £200

Annex F. Quality Regimes

This Annex gives some background to the Council's decision to choose BRE, and in particular BREEAM New Construction and its Post Occupancy Assessment, as the basis for the quality regime components and minimum requirements for developments in Milton Keynes.

The team researched the performance gap arena, reviewed the issues at hand (including government recommendations) and considered a number of schemes including QUANTUM, LEED, NABERS, Design for Performance, Soft Landings, Home Quality Mark, BREEAM In-Use, BREEAM New Construction, and of course the Government's Energy Performace Certificates (EPCs).

The table below summarises the schemes considered.

Scheme	Comment	Outcome
BREEAM New Construction	Covers both centrally managed multi-residential developments and non-domestic developments	Included in Planning Policy
BREEAM In-Use	This scheme is post-occupancy independent from BREEAM New Construction, but is a more 'qualitative' assessment that does not directly compare predicted performance with post-occupancy performance	Discounted
QUANTUM	The suite of services and standards has specifically been created to close the performance gap, however there is uncertainty surrounding UK's future relationship with the EU	Discounted
LEED	Successful at closing the performance gap in the United States, however	Discounted

Scheme	Comment	Outcome
	not enough assessors in UK as scheme is currently not very active in the UK	
NABERS	Successful at closing the performance gap in Australia, however not enough assessors in UK as scheme is currently not active in the UK	Discounted
Design for Performance	Better Buildings Partnership scheme, aimed at private sector. Scheme is not yet fully formed or established and leans towards independent design reviews, which are out of scope of SC1 K.5 and K.6	Discounted
BSRIA Soft Landings	The standard scheme requires post- occupation evaluation (POE) three years after project completion that is part of a more complex exercise that is out of scope of SC1 K.5 and K.6. However, BSRIA provides custom suppport and may be able to tailor Soft Landings processes to meet SC1 requirements.	Standard scheme discounted. Custom support may help applicants tailor Soft Landings processes to meet SC1 requirements.
Home Quality Mark	Entire BRE certification tool more focussed on consumers and less common than BREEAM. However, parts of the HQM methodology in isolation would achieve the quality and monitoring regime requirements.	Entire HQM certification process discounted, but sections 9.1, 9.2 and 9.3 provide a good basis for a quality regime, and section 11.4 can form the basis of a monitoring regime.

Scheme	Comment	Outcome
Energy Perfomance Certificates	Does not monitor in use	Discounted

As explained at 7.5 K.5 Quality regime for building performance, the most recent BREEAM standard, BREEAM UK New Construction 2018, has a particular focus on addressing the performance gap, as does HQM. However, the Council wants to allow flexibility for developers by requiring a full BREEAM New Construction Assessment or HQM (or Soft Landings). So, instead, we have taken the principles of BREEAM New Construction's Post Occupancy Assessment and translated them into the requirements for a quality regime, including a Post Occupancy Evaluation at its core.

This Post Occupancy Evaluation and resulting report wil be the basis for the Monitoring Regime required by SC1 K.6 which is due to take place for 5 years after occupancy (with occupancy defined as either 80% occupied or in use for two years, whichever takes place first). Linking the Monitoring Regime and Quality Regime will save developers time and money.