Sustainable Refurbishment:

a Toolkit for Going Green

GROSVENOR

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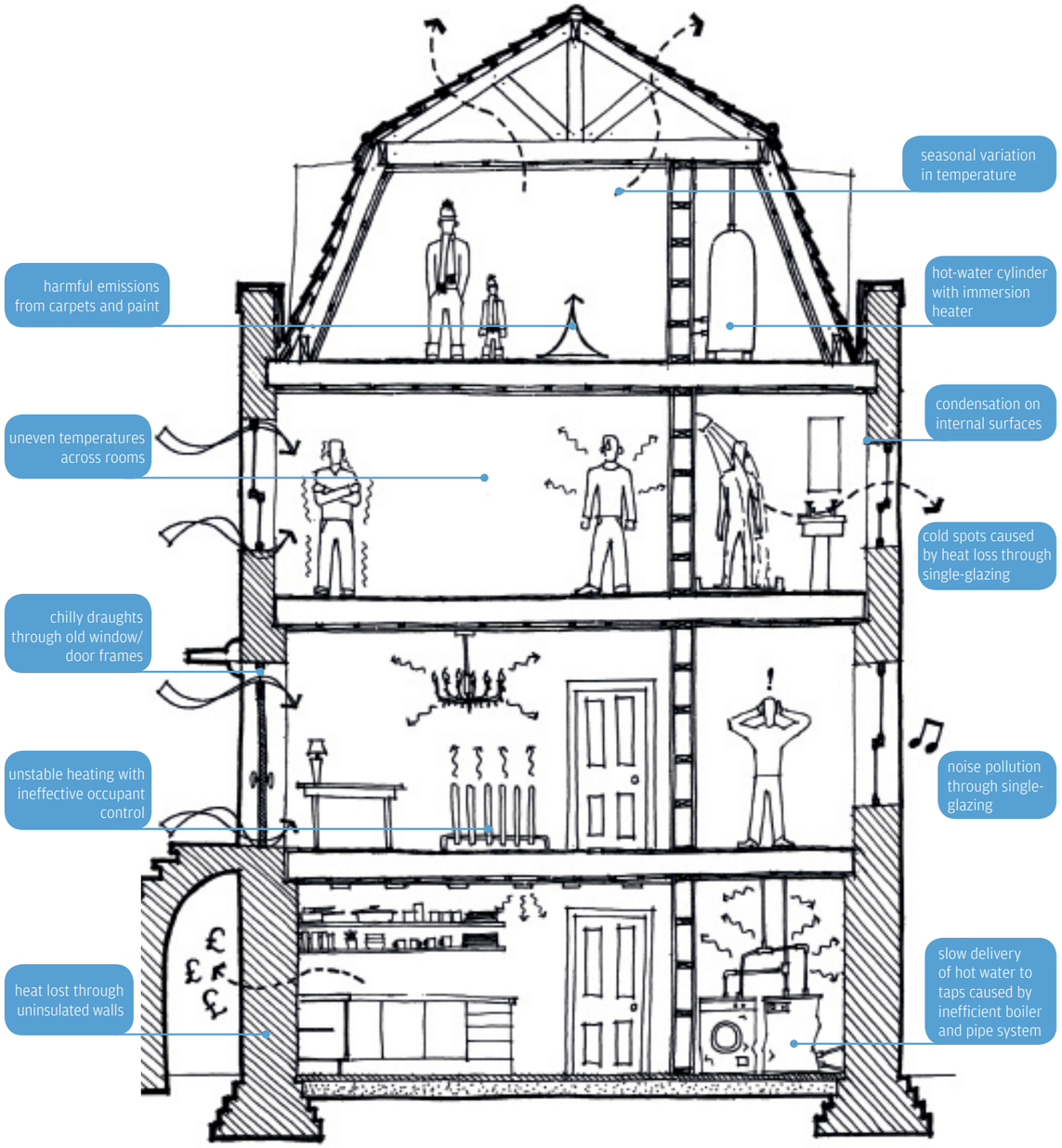
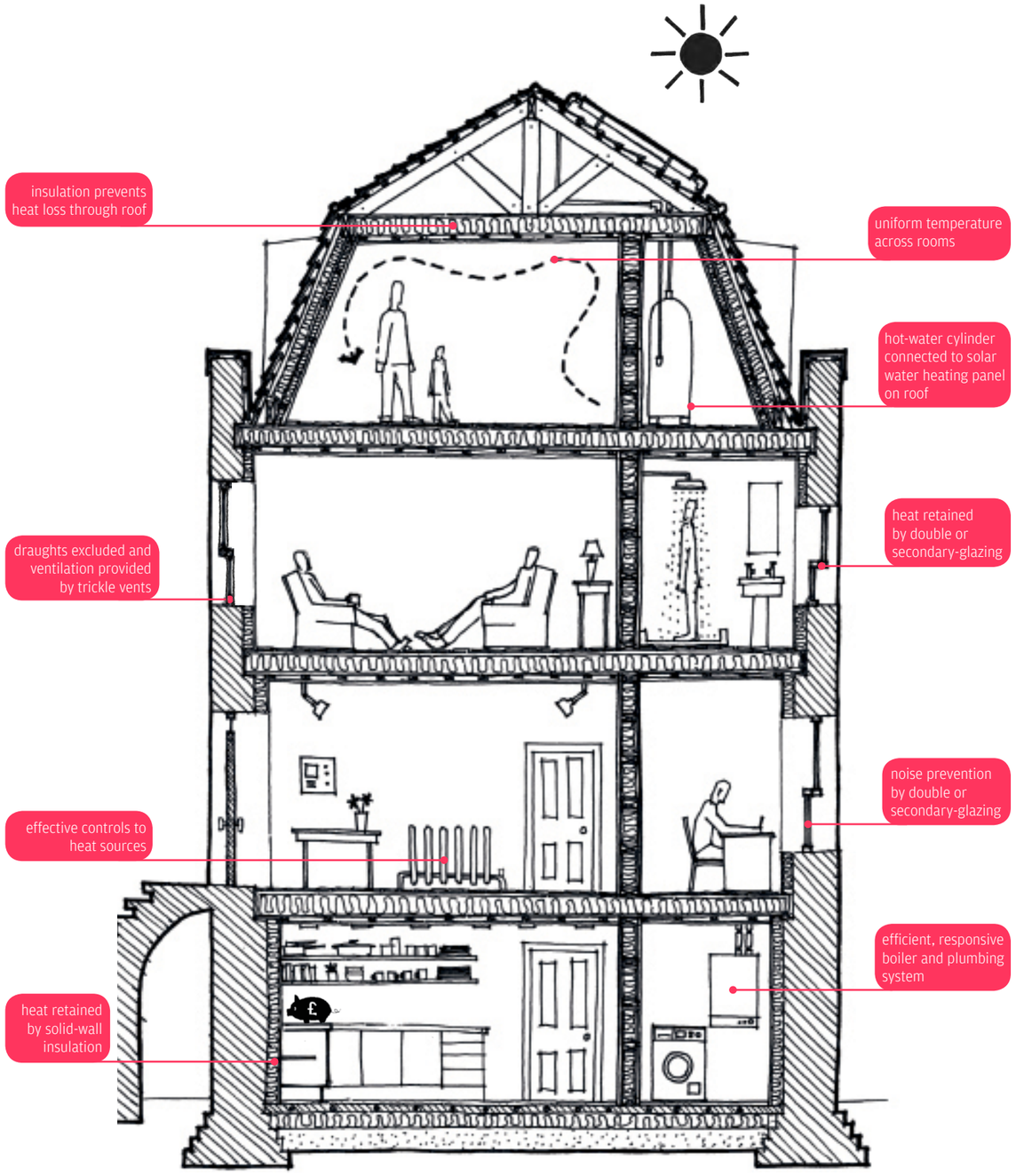
Typical refurbishment:



The sketch above is intended to demonstrate the potential pitfalls to occupant comfort when a refurbishment comprises only minimal interventions to fabric, and where the original services are retained. Inefficient old buildings are of primary concern, especially where existing single-glazed windows are not upgraded, as this can allow for draughts and cold spots. Noise pollution, lack of occupant control over internal temperatures and the presence of harmful emissions from fabrics and finishes are also common problems.

Going green:



This second sketch demonstrates the enhanced environment that can be created through a carefully planned and managed sustainable refurbishment. Unwanted noise, draughts and cold spots are eliminated through high-quality building fabric. Occupant control over internal temperatures is provided through thermostats and local controls. Services have been upgraded to incorporate efficient appliances and renewable technologies, thus reducing the overall energy demand of the home.

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1 Introduction

Refurbishments to properties present ideal opportunities to take advantage of sustainable technologies that not only improve the environmental performance of a building but also benefit the occupants in terms of thermal comfort, user control, lighting, acoustics, aesthetics, health considerations and financial value. The aim of this document is to inform residents of Grosvenor's London Estate of the key sustainable measures to consider when undertaking residential refurbishments.

The document is broken down into a 'toolkit', with advice specific to building elements such as windows and walls, as well as lighting and electrical systems. For each element, design considerations and sustainable product solutions are provided, incorporating best-practice guidelines for sourcing where relevant. Case studies describing Grosvenor schemes that have taken advantage of sustainable solutions have also been provided, to convey how these can be implemented in historic properties within conservation areas such as Mayfair and Belgravia.

For a site-specific solution, design development with qualified professionals is necessary to ensure that the approach is appropriate to the location and site-specific factors such as occupant profile and historic features. The refurbishment of residential property on the estate is also subject to the Grosvenor approvals process as well as a large number of local and national regulations, the most relevant of which are outlined in the appendices at the end of the guide. A glossary and references to relevant publications have been provided, as well as a sustainable-refurbishment questionnaire in an attempt to quantify the potential carbon emission savings from the proposed alterations.

This document is to be treated as a guide only; it is not prescriptive. Its employment does not guarantee approval of alterations from Grosvenor or any other statutory body. Grosvenor does not take any responsibility for the effectiveness of measures outlined in this document.

Grosvenor is committed to reducing the carbon emissions of the London Estate by 50% by 2030. A large proportion of these emissions is 'tied' within the non-directly-managed properties, where Grosvenor does not have a clear view of the carbon-reduction achievements for many ongoing or completed refurbishments. To assist us in understanding the current performance of your building/unit and to quantify potential carbon reduction from the proposed retrofit works, we have developed a questionnaire (please follow the link at the end of next page). Your architect is invited to complete the questionnaire and, depending on the answers, we will be able to offer you some free and valuable advice from our experts, consultants and agents. Our aim is to help you get the most from your refurbishment works, proposing the most cost-efficient measures tailor-made for your property, which will reduce both your energy bills and carbon emissions.

Seek professional advice

Please ensure that professional advice is sought when indicated to help avoid unintended consequences from retrofit and that details are undertaken in the right way to preserve and enhance historic fabric.

If in doubt, please contact longleaseholders@sturgis.co.uk or Grosvenor's Building Surveyors, who will be able to point you in the right direction.

Sustainable Refurbishment Questionnaire

To access the online survey, please click here

2 Sustainable refurbishment made simple

Introduction

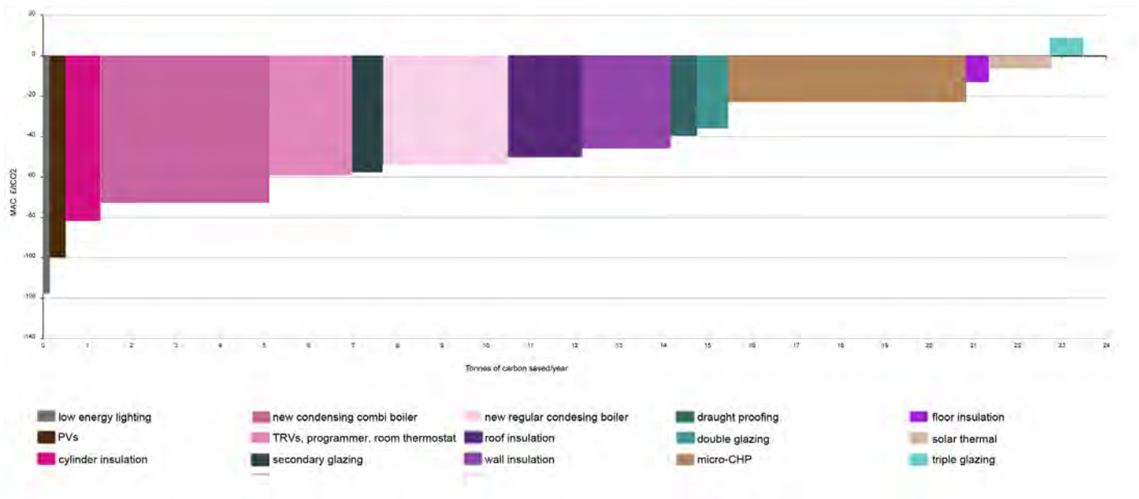
The following section is broken down into the key elements of refurbishment and describes the opportunities available for making improvements that will benefit the occupant – in terms of reduced energy bills and increased comfort, for instance – while improving the environmental performance of the building. For each topic (see opposite), a flow chart of considerations is provided, leading to a set of product solutions where relevant. In some instances, permission from the Local Authority is required for undertaking certain works; this has been highlighted where applicable. With respect to listed buildings, the Local Authority treats each case on merit and it is important to consult with the local planning officer when making alterations beyond simple cosmetic maintenance.

Where appropriate, the options have been split into 'passive' and 'active' measures. 'Passive' measures are changes to the building that can generally work without an energy supply, such as insulation; 'active' measures usually require a form of energy to function, such as a gas boiler and radiators. It is often preferable to implement passive measures first, as this enables the building to stabilise and self-regulate, as opposed to relying heavily on an energy source.

Furthermore, examples of suppliers are listed together with examples within the Grosvenor Estate where the considered option has been successfully applied with the associated risks highlighted. In order to guide you in choosing which option is more suitable for your property, indicative payback time and annual cost-reduction figures have been calculated (for more information, please see Appendix 4.3).

Marginal Abatement Cost (MAC) curve

A Marginal Abatement Cost (MAC) curve was produced to assess the cost effectiveness of the potentially implemented measures. The curve ranks energy-saving options in terms of financial and carbon efficiency. The items placed below the line are financially viable opposite to the ones above the line. The wider the 'block', the more carbon saved.



Case Studies

Case studies have been included to provide examples of where sustainable measures have been incorporated into refurbishment works. All are located on the Grosvenor Estate and have achieved certification under the BREEAM, Passivhaus Institut or EcoHomes* environmental assessment schemes, a description of which can be found on page 46. The case studies are located on the following pages:

Section contents:

The diagram above lists the pages covering the key aspects of refurbishment in the report. Interspersed within these are case studies of various Grosvenor and non-Grosvenor properties.

* Succeeded by the Code for Sustainable Homes, which was discontinued in May 2015

Switched on: upgrade your lighting systems

Lighting and electrical solutions have evolved rapidly, such that there are now systems that not only allow for greater user control of lighting, but also create brighter and warmer living environments that use far less energy than conventional circuits.

Myth: Switching lights on and off uses more energy than leaving them running.
Fact: Switching on an energy-saving bulb uses the same amount of power as leaving it on for a minute or two. Turning the bulb on and off repeatedly may shorten its life, but normal household use shouldn't cause any adverse effects. Energy Saving Trust recommended bulbs are tested through thousands of cycles of switching.

When working with electrical wiring, the skills of a qualified professional can be sought for complex tasks involving live circuitry. Part P of the UK Building Regulations covers Electrical Safety, as do the Electricity Safety, Quality and Continuity Regulations 2002.

The living room at 12 Wilton Mews benefits from LED lighting, which is both energy efficient and effective at producing a comfortable light. Lighting levels are controlled via an iPad app.

Maximise your home's lighting and electrical efficiency with these simple steps:

Passive measures

1

Using daylight

Aside from saving energy, daylight is known to have a positive impact on health and wellbeing. It is possible to optimise daylight levels by painting window sills and openings white and by ensuring window openings are free from obstruction. Consider installing conservation-style roof lights to bring daylight into stairwells and roof spaces and using light-reflecting paint on walls to reduce the need for electrical lighting.

2

Monitor usage

Real-time electricity consumption can be easily determined through the installation of a fixed energy monitor in a visible location within the property.

Devices can display current and historic energy use in kilowatt-hours, as well as current and projected costs and associated levels of carbon emission. Packages are now available that also allow users to view their consumption data online.

3

Smart controls

Introducing a central switching unit for the household lighting and electrical system can allow increased occupant-control over lighting and energy and reduce waste levels. These 'power down' switches can be located at the front door to enable users to turn off non-essential electricals when exiting the home, leaving important appliances such as fridges and freezers on.

Active measures

4

Replacement of lighting

Consider replacing traditional household bulbs with high-performance, energy-efficient alternatives.

Traditional filament bulbs and halogens can easily be replaced with highly efficient LED lamps, with consumption as low as nine watts. These products give the same colour rendering and dimmability of traditional bulbs, but use much less power.

5

Get the right mix

Choose lighting carefully, or consult a lighting designer to ensure the right combination of task, feature and ambient lighting is created.

Look for products with a colour rendering index (CRI) of 80+ for a warm light in living and bedrooms, and around 70 for a cooler light in kitchens and bathrooms. On light-bulb packaging this information is displayed as a colour scale, with an indicator showing the Kelvin value of the bulb. The lower this value, the warmer the light.

6

Efficient appliances

The EU Energy Efficiency label gives information on a product's performance, with a rating from A+++ to D. Best-practice appliances come with the following ratings:

Fridge-freezers: A++

Dishwashers: A+

Washing machines: A+++

Washer-dryers: A

Dryers: A

Ovens: A

Microwaves: A

Surface view: making the most of your materials

Current supply-chains mean that products are available not only to accommodate personal taste but also to minimise environmental impacts; an example of this is the wide availability of sustainably sourced timber. In addition, modern labelling conventions can enable consumer awareness of the presence of potentially harmful Volatile Organic Compounds (VOCs).

Repair and renewal works do not normally require consent from Grosvenor where identical materials and finishes are being used. Minor alterations including new kitchens, bathrooms and cupboards are also exempt from the approvals process.

For listed buildings, permission is required for any internal works beyond simple redecoration. The removal or alteration of historic features such as panelling, cornicing or ceiling roses is generally prohibited and their maintenance should be carried out by an experienced professional. In addition, Grosvenor's External Appearance Policy outlines the requirements for external paint finishes on the estate; see page 42 for more information.

The staircase at 11 Grosvenor Crescent Mews was manufactured from FSC (Forest Stewardship Council) certified timber. The contractor was required to supply proof of sourcing in the form of a receipt specific to the staircase, documenting its FSC certification from source to supply.

A guide to redecorating and selecting the best materials with the least environmental impact:

Internal finishes

1

Paint

Microporous paints are ideal for use in older houses, where they will help prevent high internal moisture levels. They are also safe for use in children's and family rooms due to their low VOC (see glossary) content.

Consider both plant-based water-borne and plant-based solvent-borne paints for best results. These paints can also be used for woodwork and metal.

2

Floor finishes

Select floor finishes made from natural or recycled materials and that have a low VOC content. Low-VOC adhesives are also widely available.

Natural coverings made from wool, coir, jute and seagrass are among the best available options. Consider those that demonstrate quantifiable environmental data, based on ISO 14040:2006. Note that where synthetic materials are used, VOC emissions from finishes and adhesives are at their highest in the days immediately following installation.

3

Joinery

Timber finishes and furniture that come FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification) certified are sourced legally and sustainably. Where MDF (medium-density fibreboard), plywood or particle board is used in joinery, specify products that have low VOC contents and are pre-cut to avoid high levels of dust or harmful irritants inside the property.

Structural materials

4

Timber

When specifying timber products, it is possible to ensure they come from legal and sustainable sources by requesting a copy of the Chain of Custody Certificate from the contractor.

This certificate is the paperwork that traces the handling of the timber back to its origin, through the various stages of felling, manufacturing, sales and distribution, and proves that the timber was sourced legally.

5

Concrete

The carbon emissions associated with concrete production can be reduced through various measures.

Concrete that uses recycled aggregates is a lower carbon option than that which uses virgin aggregates. In addition, industrial by-products such as fly-ash from power stations can be used in concrete mixes as a cement-replacement product, for example GGBS or PFA.

6

Stone

Consider purchasing recycled/reclaimed stone for use as a building material within the structure of an extension or rebuild, or as a finishing material either internally or externally.

Recycled aggregates are ideal as a sub-base for larger building projects and have the same properties as freshly extracted minerals. Often, reclamation yards or architectural salvage companies offer reclaimed stone products.

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Case Study: 15 Passmore Street

Client or developer: Grosvenor Britain & Ireland
Architect: GRA Architecture
Contractor: Grangewood
Environmental consultant: Eight Associates

This terraced house on Passmore Street has achieved an 'Excellent' EcoHomes rating (see glossary). The scheme benefits from secondary glazing to the front windows and extensive insulation to the roof, where eight photovoltaic (PV) panels are also sited to generate a substantial amount of the household's electricity.

Lighting and appliances were carefully selected to marry comfort and energy efficiency. The luxurious sanitaryware is water-efficient and a discrete water butt collects rainwater for use in the garden.

All the timber used on site was responsibly sourced and certified by the FSC. In addition, the contractor diverted 95% of waste from landfill by recycling or re-using 'waste' materials on nearby sites.

The image below shows the discrete location of the photovoltaic panels on the roof of the property, carefully angled to optimise their exposure to the sun.

Eight photovoltaic panels mounted on the roof of 15 Passmore Street have generated 1000 kWh of electricity worth £460 in one year, saving 591 kilograms of carbon dioxide.

"Grosvenor implemented green solutions throughout the house, including solar panels, LED lights and energy-saving exhaust fans."

-resident of 15 Passmore Street

The rear extension at 15 Passmore Street benefits from high-performance insulation, double-glazed doors and a skylight. A water butt collects rainwater for use within the garden.

"The higher-quality insulation keeps it cool in summer and warm in winter."

- resident of 15 Passmore Street

The flooring in the living area of 15 Passmore Street was constructed using FSC-certified timber. Energy-efficient LED lighting was used to create a soft, warm glow and paints and varnishes from Dulux contained low levels of VOCs.

"It also makes me feel good to reduce my carbon footprint."

-resident of 15 Passmore Street

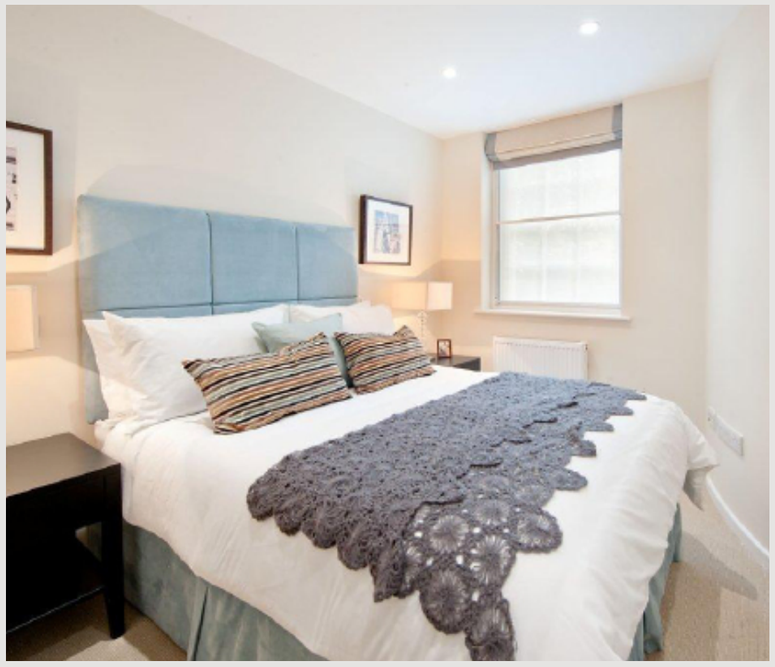
How to improve heating and plumbing systems

Eventually, central-heating systems need replacing due to the installation of new pipework alongside old and tinkering over time. When replacing boilers and pipework, it is possible to implement measures that give greater user control of temperatures in rooms, as well as improving the efficiency of the overall system.

Central heating is a post-war invention. In 1955, only 5% of UK homes had central-heating systems. By 1975, central heating was present in 50% of homes, and by 2001, the figure stood at over 90% (source: BRE report BR435, 2001).

The addition of a boiler flue constitutes an alteration to the external appearance of a building in a conservation area. Planning permission from the Local Authority is required for new boiler flues, as is direct consent from Grosvenor.

This flat at 1 Lochmore House, Cundy Street, implemented a greywater recycling system that purifies and stores water from the wash-hand basin and showers for use in the WC. In addition, the internal walls are insulated to reduce heat loss. The specification included further water efficiency and energy-efficiency measures. PV panels on the roof provide electricity to the communal parts of the building. The scheme achieved an EcoHomes 'Excellent' rating.



A sustainable approach to updating and choosing plumbing and heating systems for your home:

1 Reducing demand

There are a number of passive measures that can be introduced without building works to reduce heat loss. Consider installing draught-proofing to windows, doors and chimneys and fitting draught excluders to letter boxes to retain heat and reduce the need for central heating.

2 Insulating hot-water elements

Think about adding insulation to hot-water cylinders and pipework to make sure heat is being delivered only where it is needed, reducing levels of wasted energy.

Installing a 75mm-thick insulating jacket to the hot-water cylinder and insulating direct hot-water pipework will cut heat loss and reduce waiting times for hot water to be delivered to the taps.

3 Walls, floors and roof alterations

If considering more invasive work as part of a refurbishment, such as structural alterations, investigate the possibility of upgrading windows or installing insulation to walls, floors and roofs in order to improve the property's overall thermal performance. See sections 2.8, 2.9, 2.14 and 2.15 for further information.

4 Metering

It is possible to install heat meters to the gas supply. This will allow monitoring of usage over time and identify any periods of unusually high consumption, which could indicate a leak or fault within the system. Energy monitors will also serve to verify that the energy company's meter is functioning correctly.

Devices can display current and projected consumption and associated levels of carbon emission.

5 Controls

Look into improving heating controls to ensure heat is being generated at the right time of day and the right zones/floors for the occupants. In addition, consider having the heating system serviced by a Gas Safe-registered engineer to ensure that it is functioning correctly and that no energy is being wasted.

Controls such as Thermostatic Radiator Valves (TRVs) or programmable room thermostats ensure constant heating levels that are tailored to each room.

6 Replacement

Consider replacing the existing boiler with an A-rated condensing system boiler, or, for small properties, a combi-bolier to supply hot water on-demand. At the same time, consider installing solar water-heating panels to the roof; these connect to the hot-water tank and can provide a significant portion of a household's hot-water demand.

Choose a boiler with an efficiency of at least 87% and Nitrous Oxide (NOX) emissions of less than 50 mg/kWh.

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Waterworks: upgrading water fixtures and fittings

A common expectation is that water efficiency is compromised by the requirements of high-quality bathrooms. By combining carefully chosen sanitaryware and appliances that incorporate water-saving technologies, together with sensible occupant usage, the needs for both comfort and water efficiency can be satisfied.

Reducing water at the point of use is much better for the environment than trying to treat it afterwards. In the UK we use an average of 150 litres of drinking-quality water, per person, per day. This equates to just under 274,000 litres a year for a family of five.

Part G of the UK Building Regulations is the section concerned with water efficiency, as well as sanitation and hot-water safety. For new properties, the document stipulates that water use should not exceed 125 litres per person, per day. Special consideration is given to listed buildings and those within conservation areas such as Mayfair and Belgravia; however, where the aim should be to improve sanitation and hot-water safety as far as possible without adversely affecting the property's appearance or historic significance.

Water-efficiency measures at this high-end bathroom at 11 Grosvenor Crescent Mews include an efficient aerated shower from Hansgrohe, a low-flow dual-flush WC and aerated taps with flow limiters.

Water-saving tips and treatments that will help improve the efficiency of your appliances:

Water efficiency:

1

Taps & showers

Consider selecting water-efficient products for sinks and showers.

A five-minute power shower can use as much water as an average bath. Efficient, aerated shower heads can have a flow rate of as little as nine litres per minute (even with a large showerhead of 240mm diameter), compared to 18 litres for a traditional fitting. Aerated, low-flow taps can have a flow rate of as little as five litres per minute, compared to 12 litres for a traditional tap.

2

WCs

Low-flush/dual-flush WCs reduce the average volume of water used for flushing. Alternatively, installing a cistern displacement device in an existing WC will save on average one to two litres per flush.

Low-flush/dual-flush WCs enable a lower flushing volume of three litres, as well as the standard six litres of non-dual flush models.

3

Domestic appliances

When replacing appliances, consider water-efficient products recognised by the Energy Saving Trust Recommended labelling scheme.

Recommended washing machines can have a maximum consumption of 40 litres per cycle. Recommended dishwashers can use a maximum of 12 litres per cycle for a standard-sized machine; this can be over 85% less than hand washing.

Water supply:

4

Water butts

Where properties feature external space, rainwater can be collected for external irrigation by attaching a water butt to the downpipe of a property's guttering.

Water butts can have a capacity of between 100 and 200 litres, dependent on the size of the area to be irrigated. Units can lie flat against a wall, or be located within a planter. As well as plant irrigation, the water can be used for car washing and cleaning outdoor areas.

5

Water recycling

More advanced forms of water recycling can provide sufficient water for a large portion of internal as well as external use. 'Greywater' systems use waste water from the bath, shower and wash hand basin, and redistribute it to non-drinking water outlets such as WC flushing, plant irrigation and clothes washing.

Rainwater systems are preferable to greywater, which use disinfectants that can overburden the sewage system.

6

Water metering

To monitor water consumption, a water meter can usually be installed by the water company in a visible location in the property. Water meters provide a visible display of water consumption to allow levels to be monitored over time. They can display the volume of water used instantaneously, or historically at 30-minute intervals.

Note that installation of a water meter may have an effect on the tariff used to determine bills.

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Choosing the right contractor

As a potential client, it is possible to choose the contractor who will undertake the building works based on their track record for environmental awareness and experience. In addition, requirements can be placed on the contractor to reduce wastage, recycle, and minimise energy and water usage, all of which will have a positive financial impact on the scheme.

In March 2012, the UK construction industry employed around 2.04 million people; equivalent to around 6.4% of all workforce jobs nationwide. Of the contracts that create this level of employment, around a fifth came from private housing projects, such as the refurbishments we are concerned with in this document.

Since 2008, it has been a legal requirement that all contracts in England with a value of over £300,000 have a Site Waste Management Plan (SWMP) in place. For those over £500,000, a more detailed set of procedures is required. The implementation of SWMPs ensures that waste is dealt with in a responsible manner, thereby reducing the cost of waste disposal and subsequent levels of fly-tipping. See the section on Waste Management opposite for more information.

An example of an insulated roof space. The area is kept tidy, with well-placed wiring and materials.

How to choose a contractor that will give you best service and what they can be asked to carry out:

Design stages

1

Initial questions

Consider writing up a list of questions to ask potential contractors at the initial stages. These might include the following:

- How do they minimise/recycle demolition and site waste?
- How do they take steps to prevent pollution?
- Do they operate an Environmental Management System (EMS) such as ISO 14001?
- Do they employ local labour?
- How do they train their staff to be environmentally responsible?

2

Assess experience

At the same time, look at potential contractors' portfolios to assess their expertise/experience in conducting sustainable refurbishments. For example, those with relevant experience in sustainable refurbishments may have worked on insulating solid-walled houses, or on new-build sustainable projects.

3

Third-party audit

Consider contractors who are registered with the Considerate Constructors Scheme. The CCS is an independent, not-for-profit organisation whose code of practice covers environmental considerations, as well as management, efficiency and neighbourliness. Where contractors are not registered themselves, the site can be registered before the commencement of works with the same implications.

Construction requirements

4

Best practice

It is possible to make sure contractors are following best-practice pollution-prevention guidelines by looking at guidance from the Environment Agency.

Their publication 'Working at Construction and Demolition Sites', PPG6, details the steps that can be taken to ensure minimal risks to health and the environment. This includes reporting on energy and water usage during site works.

5

Waste management

Contractors are legally required to produce a Site Waste Management Plan (SWMP) to show which materials are being sent to landfill, and which are being re-used and recycled.

Request that at least 85% of waste is diverted from landfill and re-used or recycled. This can be reviewed by an assessor during the course of site works by requesting the Site Waste Management Plan every two to three months, a legal requirement on all projects.

6

Commissioning and testing

Following completion, the 'as-built' performance of the project can be tested to ensure projected levels of efficiency are being achieved. Proper commissioning of services, followed by airtightness testing and thermographic imaging, will ensure the correct settings and demonstrate the building's performance.

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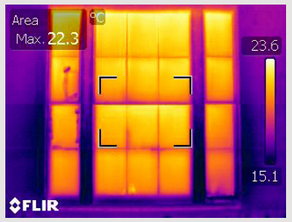
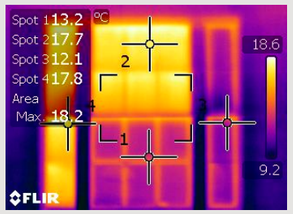
Case study: heritage windows

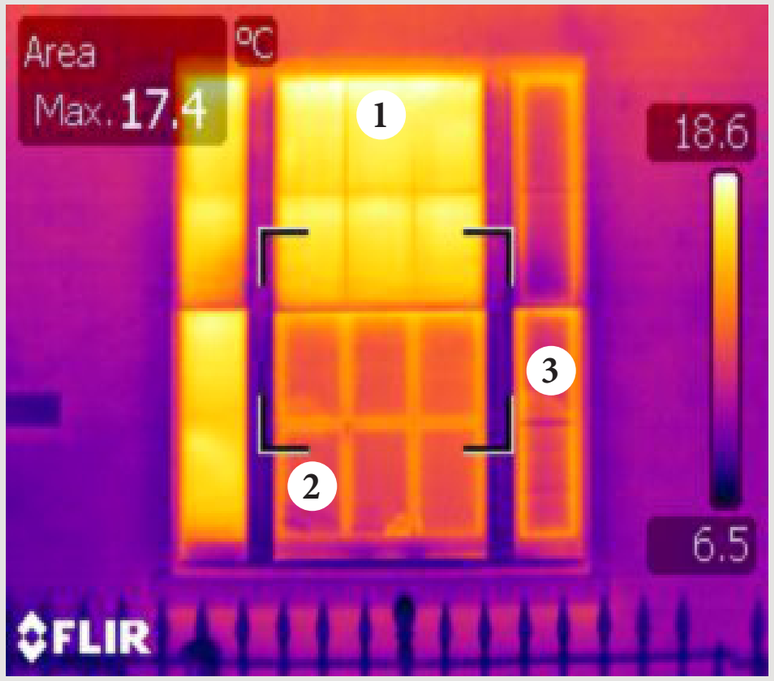
Client: Grosvenor Britain & Ireland
Architect: David Morley Architects
Contractor: Grangewood
Sustainability consultant: Eight Associates

The window of a ground-floor room of this mid-terrace Georgian property has been upgraded with three different types of glazing – single glazing with new panes, slimline double glazing and vacuum double glazing – in order to compare their performance in a heritage setting.

The large image below shows the thermal performance of the three types of glazing. The single glazing (1) has the brightest colour, signifying higher heat transmittance therefore a greater degree of heat loss. The double glazing systems, (2) and (3) have darker colours, indicating lower heat losses than the single glazing. The smaller images below left show the window before refurbishment, the surface temperature readings of the glazing and the window in its surrounding context.







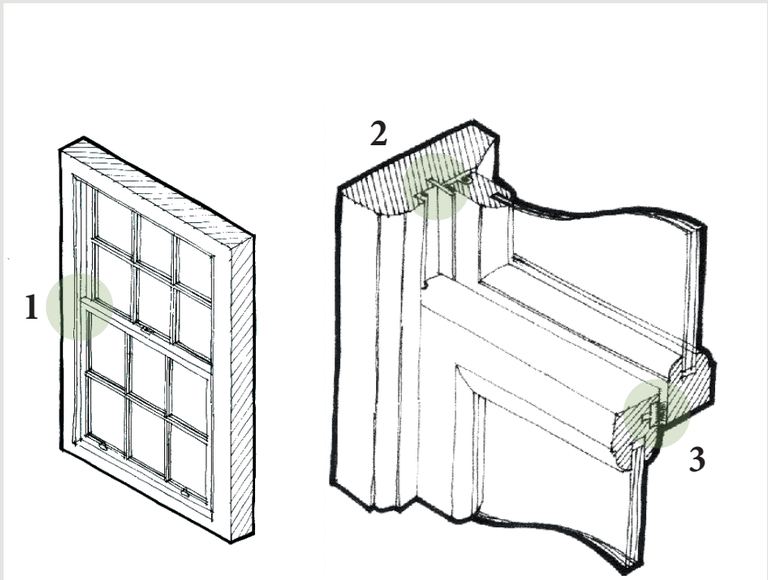
Draught-proofing

The diagram to the right demonstrates the location of draught-proofing within a traditional timber sash window.

The first image shows the location of the detail, highlighted in green.

The detail to the right shows the location of draught-proofing both within the upper bar of the lower sash at mid-rail, and a weatherfin set within the sash box itself.

1. Location of detail within the sash window
2. Location of fin set into window frame between sliding elements
3. Location of mid-rail brush



The top-floor apartment at 117E Eaton Square benefited from a range of environmental upgrades, including extensive draught-proofing to the windows using the Ventrolla perimeter sealing system.

Upgrading windows in a conservation area

Windows play a vital role in buildings by providing natural light and acting as the main source of fresh air. However, their noise and heat-loss properties create potential weak spots in the building with regards to occupant comfort. Windows are also a vital part of historic streetscapes; upgrading them with regard to their heritage context is vital and consultation with the Local Planning Authority is required before making changes.

It is possible to determine the approximate age of Georgian terraced houses by the position of the sash windows within the brickwork. Those with a visible sash box (outer frame) that is flush with the façade were generally built before 1709, after which time the building regulations prescribed that windows should be set back by 4 inches, as this would help prevent the spread of fire. A further revision to the regulations in 1774 required the sash box to be hidden behind the brickwork altogether; these examples also tend to exhibit thinner glazing bars.

For flats or maisonettes in a non-listed building within a conservation area, planning permission will be required for alterations where the appearance of the building is affected. Double glazing is permitted development for unlisted houses, although confirmation is to be sought from the Local Authority prior to commencement, and Grosvenor approval will be required. Replacement windows within existing brickwork should be timber-framed, and the glazing bars should match the pattern of the original windows.

Achieving an EcoHomes 'Very Good' rating, the scheme at 147 and 149 Ebury Street saw the upgrading of windows to the main elevation. Where windows were retained, secondary glazing was applied to the interior surface to reduce heat loss and noise pollution.

Points to consider when upgrading windows in a conservation area and what your options are:

Design considerations

1

Understand the location

Mayfair and Belgravia are both conservation areas and thus have their own specific planning restrictions. It is important therefore to gain an understanding of local characteristics and to evaluate the condition of existing windows both on the property and in the surrounding area, to gain an awareness of suitable solutions.

2

Identify criteria

What are the main reasons for upgrading the windows? Possible selection criteria can include: acoustic properties, heat-loss properties, security considerations, openability and aesthetic appearance. Solutions can be tailored according to these priorities.

3

Ventilation

Traditional buildings typically require greater levels of air infiltration to deliver fresh air and remove moisture. Replacing traditional, single-glazed windows with double glazing can reduce the ability of air to permeate the external envelope. Where this is the case, double glazing that incorporates trickle vents in the frame can be installed to provide low-level 'background' ventilation.

Product solutions:

Slimline double glazing

These units are constructed using narrower spaces (between the two panes of glass) than standard double-glazing units and are an effective solution for achieving high thermal and acoustic performance standards within a heritage context.

Glazing with an air gap of 3mm can achieve a thermal transmittance, or 'U-Value', of 1.4W/m^{2}K; a value similar to that of a standard wide-framed, double-glazed unit. Note that the lower the U-Value, the better its insulating properties.

Slimline double glazing in existing frames

This option uses the same slim double glazing as the previous option, but individual panes are inserted into existing frames without noticeably changing the appearance of the glazing bars. This is a high-performance option for situations where the existing frames are to be retained, although the sashes may require re-balancing with additional weights.

Systems of this kind typically achieve U-Values of 1.9W/m^{2}K.

Triple glazing

Although triple glazing alone is not likely to be cost effective unless it is part of a high-scope refurbishment that includes low airtightness, high-specification triple glazing can reduce heat loss by up to a third in comparison with double glazing, as well as providing excellent acoustic properties. These units use three panes of glass and two air gaps filled with an inert gas such as argon to achieve the best possible insulating properties, while still allowing high levels of daylight into the property. Currently, this solution is unlikely to be approved on the Grosvenor Estate, but there are cases where permission has been granted, including 19 Passmore Street and 13 Adam's Row (EnerPHit developments).

High-performing triple glazing will typically achieve a U-Value of 0.8W/m^{2}K or below.

Upgrading windows in a listed property

It is recognised that listed buildings used for residential purposes will change over time, as opposed to monuments, which will be preserved as far as possible in their existing state. On this basis, it is possible to upgrade windows and enjoy the associated benefits, in conjunction with respecting and conserving the historic environment.

The UK's oldest functioning window frame is estimated to have been constructed around a thousand years ago. Located in the wall of a Saxon church in Berkshire, the window had been concealed by Victorian renovations until it was discovered by a workman in 2010.

Listed-building consent must be sought from the Local Authority to legally proceed with the installation of secondary glazing, and approval from Grosvenor is also required. This is looked on favourably in a residential context, so long as the glazing bars/divisions on the secondary glazing system align with those of the existing window. Currently, replacement with double glazing is accepted only in special cases, and is generally not permissible on listed properties.

The image to the right demonstrates how secondary glazing is designed to match the pattern of glazing bars on the original, single-glazed window. In this case, the secondary glazing itself is double-glazed to ensure maximum insulation from noise and protection against heat loss.

Points to consider when upgrading the windows of a listed property and what your options are:

Design considerations

1

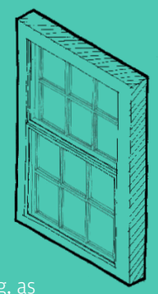
Planning requirements

In general, secondary glazing is the only alteration to windows permissible in listed properties. Other options for the rear, such as double glazing, may be possible in some circumstances, depending on the condition of nearby properties. Contact the local planning officer for site-specific guidance on what is allowable.

2

Secondary glazing

Secondary glazing retains the original single glazing, while giving the thermal performance of double glazing. Its installation also negates the need for draught-proofing, as systems are made to fit the existing frames perfectly.



3

Identify criteria

Consider the range of secondary glazing options and identify the attachment mechanism that is most suitable for the property. Important questions to ask are: can the windows be opened for fresh air? Do the shutters maintain functionality or are they permanently closed? Do the windows exhibit any unique features such as ironmongery that will obstruct secondary glazing?

Product solutions

Draught-proofing

The simplest and least invasive method of upgrading listed windows is by installing draught-proofing. This can take the form of removable products attached to the beading, or permanent 'brushes' fitted to the inside of the frame opening by way of grooves routed into the timber. Products can also be sourced and fitted to doors, letter boxes and other openings to increase comfort and reduce heating demand. Avoid self-adhesive draught-proofing, as this comes off very easily.

Removable secondary glazing

Secondary glazing refers to the installation of an additional layer of transparent material behind the existing window pane. Where conservation issues prevent nails or screws being used to attach systems to the window frame itself, removable panes can be applied using magnetic strips or other adhesive, and can be used during the winter months and removed when the weather gets warmer.

Fixed secondary glazing

Where allowable, secondary glazing can be fixed using nails or screws to the sash box or beading of a window, and can be single or double glazed. Systems can be designed so that the rails and bars align with the existing window, preserving the external appearance and giving high thermal-performance values.

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Case study: 13 Adam's Row

Client: Grosvenor GBI
Architect: Sturgis Carbon Profiling LLP
Contractor: Gaysha Ltd
Passivhaus designer: Sturgis Carbon Profiling LLP

This Victorian stable house was built in 1720 and was converted to a three-bed dwelling circa 1880. In 2015, 13 Adam's Row was extensively refurbished to EnerPHit Standard. The challenging task was to maintain all its existing historical features while delivering an efficient building to the highest standards.

EnerPHit is the highest energy standard for refurbishments in the UK, based on the German Passivhaus quality certification criteria. The EnerPHit approach included:

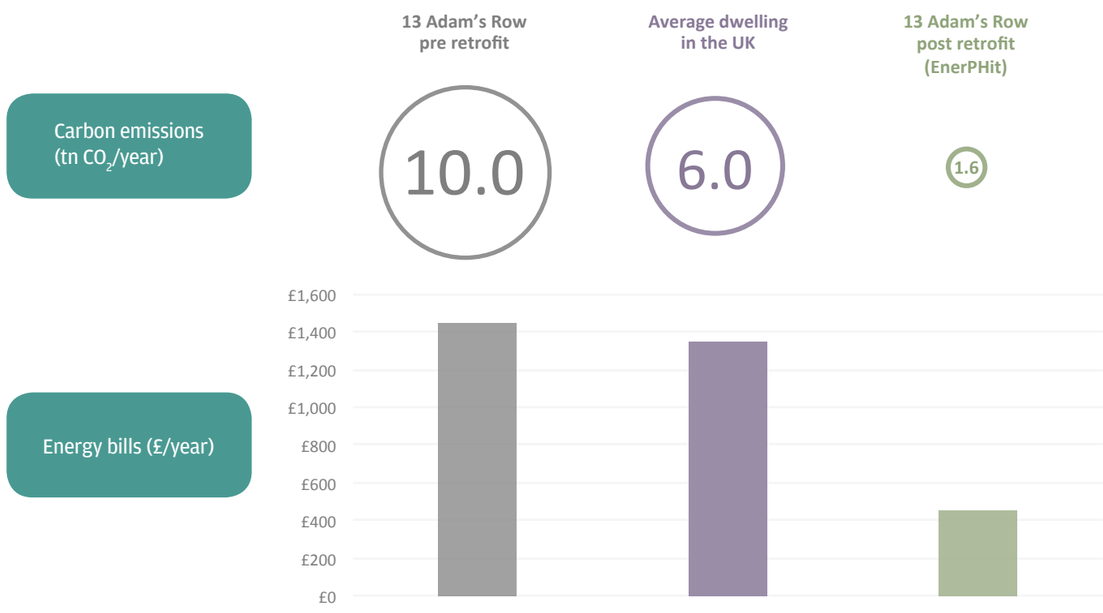
- super-efficient internal insulation
- new triple-glazed windows
- low airtightness
- mechanical ventilation with heat recovery (MVHR)

The house at 13 Adam's Row was retrofitted to the highest standards. The implemented measures have not significantly altered the appearance of the streetscape. The occupiers will benefit from reduced energy bills of up to 68% when compared to the building before works began, and improved thermal comfort as well as wellbeing.

Post-occupancy monitoring at 13 Adam's Row

Passivhaus and EnerPHit dwellings benefit from reduced energy demand and carbon emissions, as well as improvements in:

1. **Thermal comfort:** airtight dwellings are kept warm for longer and experience no draughts, cold bridging or temperature stratification
2. **Wellbeing:** MVHR systems guarantee a clean, fresh filtered air supply, cutting out up to 80% of pollution, pollen and dust particles
3. **Sound insulation:** the triple glazing, in combination with the super-insulated building envelope, makes the dwelling soundproof



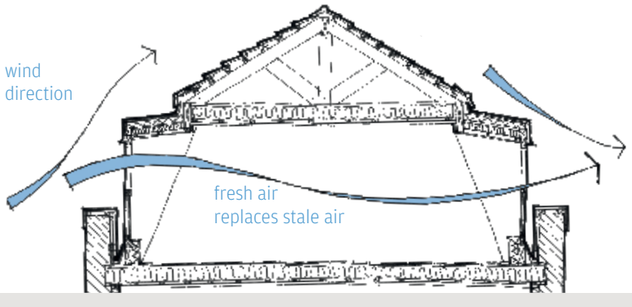
Breathing space: effective ventilation

A supply of fresh air is important to the wellbeing of building occupants, particularly during the summer, when temperatures are high, but also during winter, when inside air can become stale. There are a number of options for bringing fresh air inside. Mechanical Ventilation with Heat Recovery (MVHR) is an advanced, low-energy system that ensures constant internal temperatures. However, this system should be combined with super-airtight building fabric to be energy and cost efficient.

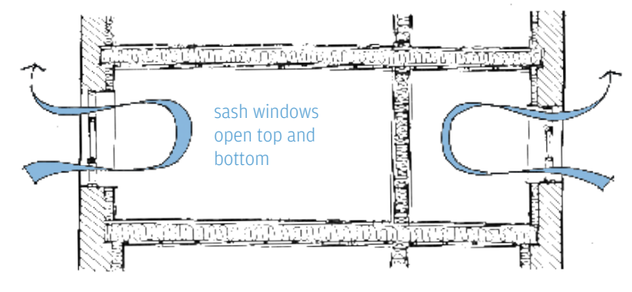
One of the very first 'forced air' ventilation systems is still in existence at St. George's Hall in Liverpool. Designed by Scottish scientist and inventor David Boswell Reid, the system used coke and steam-fired boilers to warm and circulate fresh air through a series of ducts and tunnels, hidden within the building's floor and walls.

Standards regarding levels of ventilation are covered by Part F of the UK Building Regulations. Where work is being done to historic buildings and those within conservation areas, the aim should be to improve ventilation levels as far as reasonably possible with regards to the property's significance. Guidance can be sought from English Heritage and through the BS 7913 document Principles of the Conservation of Historic Buildings in the development of appropriate ventilation strategies.

Where a room has windows on more than one side, these can be opened to take advantage of wind-driven cross-ventilation. This is particularly useful on upper floors, where open windows will provide an easy route for air to move through the building.



Although not quite as effective as cross-ventilation, rooms with only one aspect can use single-sided ventilation for the delivery of fresh air. Opening both top and bottom sashes will allow for air circulation; on warmer days buoyancy will encourage air movement.



A sustainable guide to effectively maintaining and providing fresh air in your home:

Passive measures

1

Single-sided and cross ventilation

Ensuring a clear passage of air through opening windows on two sides of a property may provide adequate ventilation. Where the building has only one aspect, sash windows that open top and bottom allow a certain degree of control. This is useful in evacuating water vapour from kitchens and bathrooms quickly (see opposite).

2

Trickle ventilation

Where windows are being replaced, consider installing frames with built-in trickle vents, which are an effective means of supplying background ventilation where rooms are already fitted with sealed chimneys, new doors and double glazing. It should be noted that while this measure is compatible with continuous mechanical extract (see below), trickle vents will reduce the effectiveness of mechanical ventilation with heat recovery.

3

Passive stack ventilation (PSV)

A PSV system draws air through the house by means of wind cowls installed on the roof, which 'pull' stale air out of the house through ducts in the walls and ceilings, to be replaced by fresh air drawn in through vents in the walls without the need for electricity. In historic buildings these systems can be integrated with existing chimney flues, and the cowl made to resemble a traditional chimney pot.

Active measures

4

Mechanical extract (ME)

Mechanically driven, localised ventilation is particularly beneficial in areas such as kitchens and bathrooms, where it removes high levels of moisture and other pollutants. Systems can be manually controlled or automated, tiggered by heat, pollutant or humidity sensors.

To comply with building regulations, extractors in kitchens should be capable of drawing air out at a rate of 30 litres per second. For bathrooms, this is 15 litres per second.

5

Continuous mechanical extract (CME)

This system uses an 'always on', centrally located ventilator to draw fresh air in through trickle vents in the building's external envelope, expelling the exhaust air through ducting in the roof and walls. CME can be combined with passive stack to create an 'Assisted Passive Stack Ventilation' system, where the mechanical unit is activated when wind levels are too low to be effective.

6

Mechanical ventilation with heat recovery (MVHR)

This system uses a centrally located unit to transfer the heat from extracted air to incoming fresh air, thereby creating a pleasant environment with a constant internal temperature.

Domestic heat exchangers can have an efficiency of 88%, meaning the majority of exhausted heat is recovered by the unit for the purpose of warming the incoming air.

Installing a comfort cooling system

The aim of installing comfort cooling is to control internal temperatures for thermal comfort purposes. Typically, a user will set a temperature of 21 degrees centigrade, plus or minus two degrees, although we would recommend a higher setting on warmer days to reduce energy consumption and promote quick adaptation to the higher temperature. Traditional buildings have variations in temperature depending on external environments that exceed this range by three or four degrees.

Before installing comfort cooling, there are a number of passive measures that can be implemented to reduce, or even eliminate, the demand for it (see opposite page). Once these have been addressed, consider installing comfort cooling to the main rooms only, such as living rooms and bedrooms. In addition, consider using a prominently placed energy meter to monitor the amount of electricity used.

Planning permission will be required when installing comfort cooling equipment externally and listed buildings will require consent for any internal alterations. Internal alterations to non-listed buildings in conservation areas are permitted development. A Grosvenor license will also be required.

Internal shutters at 3-10 Grosvenor Crescent, refurbished and developed by Grosvenor, can be used to keep direct sunlight out during prolonged periods of hot weather, thereby reducing the need for active cooling within the property.

Alternatives to comfort cooling systems to keep your home cool naturally:

Passive measures

1

Natural ventilation

Often, a good supply of fresh air will be sufficient to cool down an interior on warm days. This can be achieved through ensuring adequate levels of single-sided or cross ventilation. See the previous section for more information on how to make ventilation work effectively using sash windows.

2

Shading

Consider restoring existing shutters to south-facing windows to block heat gains in the summer months. Venetian blinds angled so as to block the sun's rays will have the same effect and will also allow a degree of daylight into the room. In addition, planting trees in back gardens can block heat gains during the summer, while allowing light through in the winter, when the leaves have fallen. Note that external shutters are generally not allowable on the estate.

3

Passive internal gains

Consider installing energy-efficient lighting and appliances, as traditional or outdated installations often emit a lot of heat, thus increasing the need for cooling. In addition, switching off computing and audiovisual equipment at the wall will prevent unwanted heat gains caused while devices are left on standby.

Active measures

4

Phase change board

Phase change material absorbs heat energy when the ambient temperature increases, and releases it again when the temperature falls. At between five and 15mm thick, these materials can be applied to ceilings, and help to maintain a constant internal temperature during the summer, when outdoor temperatures can be high.

5

System performance

If you do choose to install a refrigerant cooling system, consider those that incorporate thermostats and time switches to ensure it is only used when needed.

Look at units with a high coefficient of performance (COP) of 3.5, a low global warming potential (GWP) and a refrigerant leak-detection system.

6

External equipment

Refrigerant cooling systems require equipment to be sited both in and outside the property. Close consultation with a design professional can ensure the equipment is located where it will neither cause an adverse visual impact on the building/ surroundings nor contribute to noise pollution.

Under cover: improving roofs and mansards

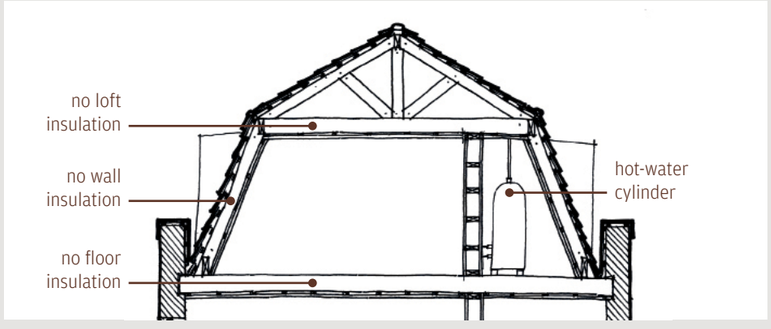
Homes without sufficient insulation lose around a quarter of their heat through the roof. In addition, inhabitable roof spaces (such as a mansard or loft conversion) can become uncomfortably warm in the summer months. Installing insulation is an excellent way to improve a property's efficiency, resulting in a more stable internal temperature and a reduced reliance on heating sources or comfort cooling.

The roof can be used as an area to locate renewable-energy technologies such as solar thermal and photovoltaic panels. Although these can be installed in many different orientations, they will work most efficiently when situated on a south-facing roof with a pitch of 30 degrees, where the sun's rays are not obstructed by trees or other buildings.

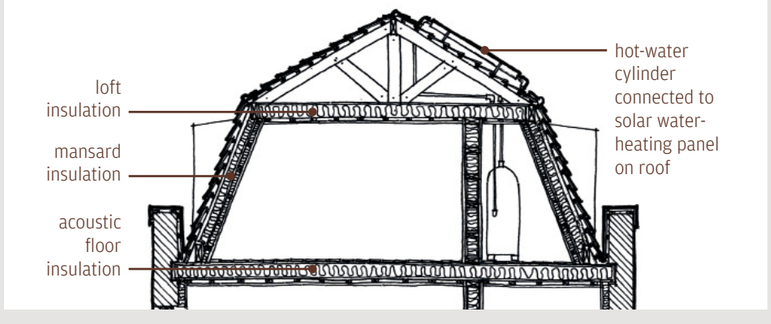
Local Authority advice is required for installation of equipment, which can be an issue for listed buildings and those within conservation areas such as Mayfair and Belgravia. Listed buildings will require permission for alterations of any kind, and planning permission is required when installing solar panels that add 150mm over the existing building line on a non-listed building in a conservation area.

The diagrams below demonstrate the issues presented by traditional mansard roof construction, and how these issues can be addressed through good design.

The diagram to the right demonstrates the design of a traditional mansard roof without insulation, and with a hot-water cylinder located in the roof space.



This second diagram demonstrates how a mansard roof can be refurbished to incorporate insulation, and how a solar water-heating panel can be used with the cylinder, for the provision of hot water.



Additional eco-friendly measures to consider when upgrading a roof or building a mansard:

Passive measures

1

Slate reclamation

Retaining original slate or sourcing second-hand tiles from reclamation yards reduces the impact of mining, and preserves the historic character of conservation areas.

Reclamation yards are also an excellent source of heritage building elements such as brick and stone, as well as period features such as porcelainware and ironmongery.

2

Roof lights

As mentioned in the section on upgrading the lighting and electrical systems, roof lights are an excellent way to bring natural light into hallways, corridors and rooms in the roof. Units can be installed at both pitched and 'flat' orientations, and be operated both manually and automatically by switches and rain sensors. Special 'conservation roof lights' are available, which are designed to replicate traditional Victorian units and are more suited to heritage projects.

3

Green roofs

These can vary from simple grass/sedum coverings to elaborate roof gardens. Green roofs offer a range of advantages, including improved thermal insulation, better acoustic properties and improved rainfall run-off attenuation, reducing demand on drainage systems. They are also aesthetically pleasing and improve levels of biodiversity.

Typically, a substrate of 100mm is required to absorb sufficient water and allow plants other than sedum to thrive.

Active measures

4

Air source heat pump

Air source heat pumps can be used for both heating and cooling the internal environment. As a heater, this technology is able to produce several units of heat for every unit of electricity it consumes. Equipment is sited both inside the building and outside at roof level. Note also that the external equipment generates a degree of noise, and can be troublesome for neighbours.

Consider units with a high coefficient of performance (COP) of at least 3.5.

5

Solar thermal panels

These are an effective means of supplementing a home's hot-water demand. Water is pumped through roof-mounted panels, where it is heated by the sun's rays before being passed through a coil in the property's hot-water cylinder.

5m2 of solar thermal panels will provide a significant portion of the hot-water demand of a three-bedroom house. There are two types of thermal panel: flat and evacuated tube. The latter can be used where the roof orientation is not ideal, as the fins can be turned towards the sun.

6

Photovoltaics (PVs)

Roof-mounted solar panels can provide a property with its own on-site energy supply. An array of cells convert sunlight into electricity, and can even work on cloudy days.

A 15m2 photovoltaic array will provide a significant portion of the electricity demand of a three-bedroom house. Where the generated electricity is not used, this is exported into the national grid. In addition, the owner of the panels is paid a set number of pence per killowatt hour through the Feed-in Tariff (see glossary).

Thermally upgrading the external walls

Achieving stable thermal comfort levels is beneficial in all rooms, and of particular importance in areas where vulnerable people, such as the elderly or small children, spend time. Insulating a room will enable stable temperatures across the whole space and prevent the occurrence of cold spots, whilst reducing reliance on heat sources.

Due to their age, the vast majority of properties in Mayfair and Belgravia are of solid-brick-wall construction, and do not feature cavity walls like modern buildings. Insulation must therefore be applied directly to the wall, generally on the inside. In terms of heat loss, an insulated solid-brick wall will perform five times better than an un-insulated one. In addition, a double-glazed window loses half the heat of a single-glazed window, which in turn loses 17 times more heat than an insulated wall.

In solid-brick-walled buildings, the introduction of internal insulation makes a significant change to how the building fabric is able to respond to variable internal and external environments. The use of products that are 'vapour closed' (which means that water vapour cannot pass through) creates a vapour barrier in the building that had not previously existed. Their installation is therefore to be carried out following either a condensation risk analysis by an expert, or with regard to the relevant Agreement Board's instructions and standards. The use of vapour open, hygroscopic and capillary active insulation is an alternative option for internal insulation; these products work with the building fabric by allowing vapour to move within the material while retaining heat.

The top-floor apartment at 58 Park Street, developed by Grosvenor, benefits from whole-house insulation, including the existing walls and roof.

The floor was acoustically insulated as a further apartment is located below. Secondary glazing was added to the existing windows to ensure an efficient fabric throughout. Energy-efficient lighting and appliances were provided. Water-efficient and high-comfort showers were provided. The contractor recycled contractor waste and achieved a score of 30 out of 40 on the Considerate Constructors Scheme. The scheme achieved an EcoHomes 'Excellent' rating.

Selecting the best options for upgrading external walls to keep your home well insulated:

Design considerations

1

Are you insulating a single room or the whole house?

If it is not practical to insulate the whole property simultaneously, there are significant benefits to be gained from insulating a single room. This is particularly true of spaces where thermal comfort is an issue, such as family rooms and children's bedrooms.

2

Designer's brief

Before going to planning, it is important to be confident that the designer's brief is clearly defined to include wall insulation at an early stage in order to effectively address technical issues.

Ensure that reasonable consideration is given to the impact on existing features, loss of floor area, cold bridges, ventilation, and both surface and structural moisture levels.

3

Specialist insulation contractors

The process of insulating internally requires specialist skills that a small to medium-sized contractor may not be able to provide. Insulation specialists can be sub-contracted to effectively install insulation and ensure it performs to its full specification, and minimise thermal bridging (see glossary).

Request either BBA approval, a guarantee or a condensation risk analysis.

Product solutions

Wood fibre insulation

Solid wood fibre insulation is manufactured into rigid boards through the compression of processed wood; its breathable properties make it a good choice for historic buildings.

Typically, an additional wall thickness of 75mm is required for a solid brick wall to achieve heat-loss values compliant with Building Regulations.

Aerogel insulation

Available as either a flexible 'blanket' or composite boards, aerogel is an extremely thin insulation and an excellent solution where reduced thicknesses are required, or where bulkier products such as wood fibre would not be appropriate.

An additional thickness of 30mm is required to comply with Building Regulations.

Spray-foam insulation (polyurethane/PU)

For small spaces where manoeuvrability is an issue, such as small gaps around windows, polyurethane spray foam provides a useful insulation solution. This insulation is sprayed from a flexible nozzle connected to a pressurised container, and slowly expands to fill the gap, hardening within a few minutes.

Where used in bulk, an additional thickness of 50mm of polyurethane is required to comply with Building Regulations.

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A holistic approach to sustainable refurbishment

Taking a holistic approach to refurbishment is the ideal way to implement sustainability measures that complement each other. As a client, it is possible at early stages to analyse the potential benefits of environmental measures in terms of thermal comfort, acoustic performance, health considerations and monetary value, to make informed decisions.

Buildings with an Energy Performance Certificate Rating of F and G will no longer be rentable following the introduction of new legislation in 2011, with effect from 2018. Currently, around 700,000 rented homes fall under these ratings, and will need to be refurbished if they are to be suitable for letting.

Go the extra mile: consider embodied carbon. Embodied carbon is the carbon emitted by the construction of a building: how the materials are sourced, how far they come from and if they can be recycled. All these have an impact on the building's carbon footprint. Cutting the energy consumption of your property will reduce your energy bills and carbon emissions. However, your embodied carbon will remain the same. Tackling embodied carbon can be a cost-free way to reduce your carbon footprint even further and improve your wellbeing. In most cases, it is just a matter of a simple choice; for example, choosing a carpet with recycled content instead of a regular carpet.

The Local Authority planning officer will look favourably on applications with supporting evidence that environmental improvements are being made. In certain instances, typically for major developments, there are planning requirements for sustainability such as meeting a BREEAM (Building Research Establishment Environmental Assessment Methodology) target. For further information on Westminster City Council and the Royal Borough of Kensington and Chelsea's requirements, see section 4.4.

Completed in 2009 by Grosvenor Britain & Ireland. The whole-house refurbishment of 11 Grosvenor Crescent Mews was the first to achieve an EcoHomes 'Excellent' rating on the Mayfair and Belgravia estate. The building fabric was upgraded with internal wall insulation to the front and rear elevations, secondary glazing throughout and floor and roof insulation. The heating and hot water is provided by an efficient gas boiler. The lighting is energy efficient with compact fluorescent lamps (CFLs) used for 75% of all lighting. The ventilation is provided by extractor fans in the kitchen and bathrooms, as well as openable windows. All appliances are energy efficient. All timber is FSC certified.

Initial steps to take when undertaking a complete and sustainable home-renovation project:

Preparation

1

Set a brief

When considering such a project, the first port of call is likely to be an architect, a building surveyor or an accredited designer. Prepare a project brief with their guidance and ensure that this is tailored towards achieving a sustainable refurbishment, with broad objectives for where improvements should be made. They will also act as 'agent' when it comes to consulting additional professionals.

2

Sustainability workshop

Shortly after, it is possible to hold a sustainability workshop to discuss sustainability strategies with the designers. Consider bringing in a sustainability consultant to facilitate the meeting, and assess together the feasibility of implementing a wide variety of measures in the property.

3

Investigate options

Together, the design team are likely to come up with a series of options for combinations of sustainable measures, which will deliver various levels of increased sustainability at a range of costs. Spend some time assessing which options are right for the property, and whether or not to proceed.

Design

4

Set specific targets

With the range of options in mind, it can then be decided down which avenue to proceed. Be clear with the design team on what targets should be met such as specific reductions in energy demand or carbon emissions. It is also possible to use an external assessment method such as BREEAM to set a holistic performance target. See page 46 for further information.

5

Planning

It is important to decide upon all sustainability measures pre-planning, so as to be able to inform Grosvenor and the Local Authority of any proposed changes in the external appearance of the building that may take place.

6

Design development

It may be advantageous to use a sustainability tracker, to ensure that the targets that have been set are being met by the design team. This will detail all sustainability measured with the objective of ensuring it is implemented and retained throughout the project.

Case Study: 33 St Barnabas Street

Executive summary
Sustainable refurbishment
Windows in traditional buildings
Advanced measures
Standards, regulations and appendices
Appendices

Client: Grosvenor GBI
Architect: GRA Architecture Interiors
Contractor: Grangewood Builders Ltd
BREEAM Assessor: Sturgis Carbon Profiling LLP

Located within St Barnabas Street conservation area, this two-bedroom, end-of-terrace house was extensively refurbished, achieving BREEAM 'Excellent'. The aim of the project was to cut carbon emissions and improve the property's energy efficiency and thermal performance, while respecting the character of the conservation area. The property features:

- Super-efficient internal insulation
- Secondary glazing retaining the existing timber sash windows
- New high-efficiency combination boiler
- Use of low-carbon sustainable materials
- Low water consumption sanitary fittings
- Installation of eight Photovoltaic panels

The sustainable improvements to 33 St Barnabas Street achieved 90% reduction in CO_2 emissions compared to the building before retrofit.

3 Standards, regulations and appendices

Introduction

The following section provides a summary of the standards and regulations applicable to sustainable refurbishments.

Contents

The apartment at 121 Mount Street, developed by Grosvenor, achieved an EcoHomes 'Very Good' rating. The refurbishment involved upgrading the heating and plumbing systems with a new Vaillant system boiler along with thermostats and thermostatic radiator valves. The building fabric was repaired and secondary glazing was installed to all the windows. All lighting and appliances are energy efficient.

3.1 Grosvenor's Approvals Process

Background

The standard Grosvenor lease for flats and houses prohibits any alterations that affect the structure or architectural appearance of the property. Notwithstanding this restriction, alterations may be permitted subject to certain procedures and conditions. For freehold properties, Grosvenor approval to alterations is required under the terms of the Grosvenor Belgravia (or Grosvenor Mayfair) Estate Management Scheme.

The reason alterations are controlled and regulated is for the long-term preservation of the external appearance of the buildings, to ensure the highest standards of workmanship are implemented and that the buildings remain structurally sound.

Criteria

Works which do not require consent are those of repair or renewal where identical materials are being used, internal or external redecorations (in line with Grosvenor's requirements regarding the colour and type of paints used externally), new cupboards and new kitchens or bathrooms where the existing service connections are re-used.

Consent is always required for the following:

- Submitting a planning or listed building application. For freehold properties, prior consent to submitting an application is not required but a written copy of the application should be sent to Grosvenor
- Works that affect the exterior of the building: extensions, conservatories, alterations to or new windows (including security grilles), walls, roofs, external pipework
- Roof terraces, air conditioning or comfort cooling
- Security cameras, satellite aerials, burglar alarm boxes, external signage/lighting and boiler flues
- Any change of use of any part of the house or flat
- Internal alterations that affect the structure of the building including, for flats, the installation of timber/ stone or other form of solid floor finish
- Pruning or felling trees
- For flats managed directly by Grosvenor, the installation of gas fires

Consent is unlikely to be granted for the following:

- Converting pavement vaults or underground rooms into living accommodation (other than utility rooms, bathrooms, stores etc.)
- Converting a garage into a living room if it is the only garage at the property and capable of taking a medium-sized car
- Installing or adapting windows or doors (including garage doors) that are unsympathetic to the Conservation Area
- Building on more than 50% of the original size of the garden
- Erecting mansard extensions in certain mews
- Works that adversely affect the light or amenity of neighbouring properties
- Linking two houses laterally to create a single house (mews houses may be linked to the main house – as in Chester Square and Eaton Mews South)
- Constructing sub-basements generally, save swimming pool excavations below lower ground-floor level

Approvals process

The first step is normally to appoint an architect, chartered building surveyor or accredited designer to prepare concept drawings. Once these have been prepared, contact with Grosvenor can be made to establish whether the principles of the proposal are likely to be acceptable. If they are, or agreed modifications are made, then suitable architectural drawings of a scale of not less than 1:50 should be prepared and submitted for formal approval, together with an estimate of the cost of works up to builder's finish, i.e. without decorations or furnishings. In the case of leasehold properties, the drawings should be submitted to Grosvenor prior to making contact with the Local Authority for planning and listed building consents, along with the Application Form for Landlord's Consent to Carry Out Alterations. In determining whether and upon what conditions consent should be granted, Grosvenor will take into account not only the proposed works themselves, but also the extent and nature of recent works carried out at the property and any current or proposed works in the vicinity. This may mean that if approved, works may need to be phased or delayed in order not to cause unnecessary disturbance to nearby occupiers.

If the flat or house in question has an intermediate landlord between the residents and Grosvenor, residents must obtain their agreement before discussing with or submitting approvals to Grosvenor. This is because the occupation is an agreement between the resident and the head lessee and not a direct agreement with Grosvenor. Normally, the intermediate landlord will agree to the resident discussing proposals directly with Grosvenor, but this is not always the case.

If the proposals involve adding floor area or substantially enhancing the value of the property, there may be a capital payment implication. In this case the Grosvenor Asset Manager will assess any appropriate payments before approval to the works is granted.

If the works are acceptable in principle, Grosvenor may forward the application to their retained surveyors, Murray Birrell Limited (MBL) for them to grant a formal conditional approval. Details are as follows:

Murray Birrell Ltd.,
207-215 High Street, Orpington, Kent BR6 OPF
Telephone: 01689 898 288

The letter that they send will give conditional consent, subject to compliance with certain conditions, which must be dealt with before the works start (conditions precedent) such as approval fees, insurance and planning consent, and other conditions that are relevant once the work has started, such as compliance with statutory health and safety regulations, working hours and behaviour on the building site. If a license for alterations is required, then this must be completed before works start.

Depending on the type of works there are three different types of approval:

- Letter and approved drawings – used for straightforward works that do not involve an increase in floor area, change of use, terraces or air conditioning.
- Grosvenor license (prepared by Murray Birrell Ltd.) – this is used where there are reinstatement or revocation provisions: for roof terraces, air conditioning or temporary works. Licenses may also be required for freehold approvals.
- Solicitor's license – for major works (including those smaller ones involving additional floor areas), any change of use or where a premium is payable.

Timetable

The issuing of these licenses will take between four and six weeks, depending on how quickly the necessary information regarding the scheme is provided. Once all the conditions precedent have been complied with, work can start. Murray Birrell Ltd. or Grosvenor surveyors will make occasional inspections until the works have been completed.

Fees

Approval fees are based on a scale, whereby changes are based on the cost of proposed works to a builder's first fix finish (e.g. plasterboard but not decorated, without cover plates to light switches and socket outlets).

If the property in question is within a privately owned Grosvenor Mews, there will also be a minimum £500 (excl. VAT) fee to cover additional costs incurred for the cleaning of surface water gullies at the end of the works.

Depending on the complexity of the works, fees will also be payable to a Grosvenor-appointed structural engineer, services engineer or acoustic engineer, who will assess, review and comment on the proposals prior to commencement of the works. All of these fees are paid directly to the individual consultant and are based on the cost of works.

If a license for Alterations is required there will be additional fees. For in-house licenses (e.g. for the use of a roof terrace of a/c plan) an additional fee of between £150-£250 is required. For all other Licenses for Alterations, our solicitor's, Boodle Hatfield, bespoke fees must be met.

A refundable deposit of £500 is required for all approvals. The deposit, plus interest, is returned once 'as-built' drawings have been provided at the completion of the works. Depending on the complexity of the proposed works, a further damage deposit may be requested. The deposit, plus interest, will be refunded after the works have been completed. However, if the works are poorly managed and damage occurs, we may compensate neighbours for such sums as we estimate to be the loss they suffer.

A variety of standard literature is available upon request from the local Grosvenor Office Contact, including:

- The Grosvenor Specification, with which all works should comply;
- Fee scales applicable to approvals;
- Guides for scaffolding, 'soft strip' satellite dishes, external decorations and colour schemes for mews properties;
- The freehold Estate Management Schemes.

3.2 Planning and Listed Buildings Consent

Background

Combined, Westminster City Council and the Royal Borough of Kensington and Chelsea cover an area of over 3,000 hectares, and are home to some of the most socially, politically and architecturally significant sites in the country, including the Portman, Cadogan, Crown and Grosvenor Estates. Over three quarters of both boroughs fall within conservation areas, and around 20,000 buildings listed form the make-up of their built environment.

The districts of Belgravia and Mayfair were designated as conservation areas in the late 1960s, and are together home to around 10% of Westminster's listed buildings, with a significant number in the Royal Borough of Kensington and Chelsea. A building's listed status or location within a conservation area has a dramatic effect on the freedom the owner has to make alterations. Being within conservation areas, the Grosvenor Estate is subject to stringent planning regulations, which aim to ensure the long-term survival of the area's specific atmosphere.

Conservation areas

Conservation area status is principally designated in order to prevent the whole or part-demolition of unlisted buildings and the felling of trees. However, applications for planning permission in such regions are also subject to additional scrutiny.

Listed buildings

Where a building is listed, the Local Authority must grant permission before any modification, extension or demolition works can legally be carried out. In many cases, specialist knowledge must also be sought prior to commencement to ensure the proper preservation of historic architectural detailing. Building works must safeguard historic fabric and features of interest and restore any significant features damaged in the course of alterations. See the further reading section at the end of this document for links to additional information.

Westminster Environmental Policy

Whilst keen to preserve the borough's historic character, Westminster City Council is also aware of the environmental issues facing its residents. The Westminster City Council Environment Policy was first drafted in 2007, and stipulates the application of "high standards of sustainability to building developments and refurbishments," as well as clauses referring to improvements in pollution levels, low-carbon transport, the protection of biodiversity and compliance with environmental laws.

Westminster makes specific reference to high-quality alterations and extensions to existing buildings in its Policy CS27, Design of the Local Development Framework Core Strategy:

"Development must incorporate exemplary standards of sustainable and inclusive urban design and architecture. In the correct context, imaginative modern architecture is encouraged provided that it respects Westminster's heritage and local distinctiveness and enriches its world-class city environment.

Development should:

- Reduce energy use and emissions that contribute to climate change during the lifecycle of the development, in line with national and regional standards as a minimum; and
- Ensure the reduction, reuse or recycling of resources and materials, including water, waste and aggregates

This will include providing for an extended life-time of the building itself through excellence in design quality, high quality durable materials, efficient operation, and the provision of high quality floorspace that can adapt to changing circumstances over time."

The City Council also published a supplementary guidance document entitled "Retrofitting Historic Buildings for Sustainability" in March 2012, which details various approaches to adapting listed buildings and those located in conservation areas. The document can be viewed online at http://transact.westminster.gov.uk, and includes maps outlining the location of conservation areas.

RBKC Environment Strategy

The Royal Borough of Kensington and Chelsea (RBKC), which is home to a number of streets in Belgravia, also acknowledges the need to address environmental sustainability. The RBKC's Environment Strategy document focuses on development and construction among several areas.

The RBKC's Policy CE1: Climate Change addresses the environmental criteria to be considered when determining planning applications. All subterranean development must now achieve an EcoHomes 'Very Good' rating, comprising at least 40% of energy and water credits, or equivalent under BREEAM Domestic Refurbishment.

3.3 Building Regulations Part L

Introduction

The Building Regulations are a set of legal, government-approved documents, which set out the requirements for building works in terms of their construction, performance and safety standards; there are 14 documents in all, labelled Part A to Part P. Part L aims to ensure that works to existing or new-built dwellings and buildings other than dwellings promote the conservation of fuel and power and mitigate the levels of CO_2 emissions they could potentially cause. Part L is divided into four Approved Documents tailored to different building types:

Part L1A: Conservation of fuel and power in new dwellings (2013)
Part L1B: Conservation of fuel and power in existing dwellings (2010)
Part L2A: Conservation of fuel and power in new buildings other than dwellings (2013)
Part L2B: Conservation of fuel and power in existing buildings other than dwellings (2010)

Technical information

Part L documents specify different criteria of compliance depending on the use and the state of the building/dwelling; existing or new built. The criteria may include constraints on: energy-performance rates, building fabric thermal-transmittance values, infiltration levels, building services specifications, as well as solar gains limitations. The Local Authority's Building Control Department, to whom application for Building Control Approval is made to verify the compliance of architectural details and specifications, oversees implementation of the regulations. In most cases, both Planning Approval and Building Control Approval must be granted for works to proceed legally.

Regulations and traditional buildings

The Building Regulations make allowances for listed properties or those located in conservation areas such as Mayfair and Belgravia. As stated in the Communities and Local Government (DCLG) guidance document Planning for the Historic Environment, in such cases Local Authorities should assist applications for alteration in finding feasible solutions, which enhance energy efficiency and increase resilience to climate change, whilst preserving historic fabric as far as practicable.

Future updates to the Building Regulations

Following the evolution of the Building Regulations to date, as new Regulations come into force these call for raised standards of thermal transmittance and airtightness, as well as the introduction of additional sustainable measures to buildings where other works are being carried out.
The new regulations are likely to set out more specific requirements with regards to historic and listed buildings, which will no longer be classed as exemptions from the regulations; guidance on energy standards will be provided by English Heritage. For full details of the proposed changes, please consult the latest Building Regulations in force, which can be found at http://www.planningportal.gov.uk/.

BREEAM Certification

Introduction

Covering a wide range of environmental issues such as energy use, water conservation and the responsible sourcing of materials, BREEAM (Building Research Establishment Environmental Assessment Method) is an internationally recognised measure of a building's environmental performance. BREEAM UK is divided into three schemes tailored to different building types:

BREEAM Domestic Refurbishment (2014): to assess works on existing dwellings
BREEAM Refurbishment and Fit-Out (2014): to assess works on existing buildings other than dwellings
BREEAM New Construction (2014): to assess works on new-built buildings other than dwellings:

The required standards for BREEAM are formulated using up-to-date science, and in all cases go above and beyond current Building Regulations.

The scheme acts as an environmental auditing system and is applied from project inception to completion, with third party certification being issued at design and post-construction stages.

Process

Starting at early design stage, a licensed professional will consult with the design team to advise on what environmental measures are achievable, based on the scope of the project. A target rating will be chosen from the five benchmarks, which range from 'pass' to 'outstanding', and a design stage certificate will be issued in anticipation of the work.

Throughout the project, the assessor will liaise with the design team to obtain information on the project specification, and conduct site visits to ensure the intended measures have been implemented. Following completion, the assessor will conduct a post-completion review and issue the final certificate in recognition of the building's overall performance.

Benefits

As a widely used third-party assessment method, BREEAM has created a common language for construction professionals working in sustainability. The introduction of the BREEAM Domestic Refurbishment scheme means that listed and historic buildings can now benefit from this mode of evaluation, and can attain the same environmental credentials as new buildings.

The increasing popularity of BREEAM certification has given rise to a mode of comparison for sustainable buildings, giving recognition to environmental innovation and potentially increasing a property's resale value: Chegut A, Eicholtz P and Kok N (2012) Supply, Demand and the Value of Green Buildings, available at: www.rics.org/research.

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Passivhaus Standard

Introduction

The Passivhaus Standard is an energy efficiency standard successfully applied to many domestic and non-domestic buildings. The Passivhaus approach requires:

- super-insulated building fabric
- high level of airtightness
- ventilation controlled by mechanical system with heat recovery (MVHR)
- passive solar gains and internal heat sources

EnerPHit Standard

For an existing building to reach the Passivhaus Standard, considerable improvements are most likely going to be required, making it often difficult to achieve the required criteria with reasonable effort. For that reason, a slightly relaxed standard has been developed - the EnerPHit Standard.

The certification criteria for both standards are shown here:

Criteria	Passivhaus	EnerPHit
Space Heating & Cooling Demand	≤ 15 kWh/m² per year	≤ 25 kWh/m² per year
Primary Energy Demand	≤ 120 kWh/m² per year	≤ 120 kWh/m² per year
Airtightness	0.6 ach (@ 50 Pa)	1 ach (@ 50 Pa)

Benefits for tenants

1. **Low heating bills:** The average annual energy bills in a Passivhaus range between £70 and £120 for heating and hot water while maintaining 20°C internal temperature (subject to user behaviour)
2. **Zero-carbon home:** Passivhaus homes can be truly zero-carbon when integrated with renewable systems. For example, an average PV installation of 3.5 kW will pay for the average energy bills of the home
3. **Comfort:** Passivhaus homes integrate high-performance triple-glazed windows and super-airtight building fabric, eliminating the temperature gradience in the room as well as possible draughts
4. **Health:** Passivhaus homes incorporate Mechanical Ventilation with Heat Recovery (MVHR) system that guarantees clean fresh filtered air supply to all rooms. Recent studies suggest less potential for asthma, allergies and other lung ailments in Passivhaus homes
5. **Sound:** Super insulation and triple glazing provide excellent sound insulation against unwanted street noise

For more information, please visit www.passivhaus.org.uk/

4 Appendices

Introduction

For those considering upgrading their unit, the sustainable refurbishment questionnaire and the constructive details database may prove to be a useful tool in determining which measures to target first when undertaking a refurbishment and help us quantify the potential carbon savings. For those looking to gain approval from Grosvenor for alteration to a property on the Estate, we ask that this questionnaire is completed and submitted along with the application form. For those seeking further information, references to useful books, technical publications, regulatory guidance documents and websites are provided over the following pages. Finally, a glossary has also been provided to define the more technical language in this document.

Contents

Appendix 4.1
Understanding your building: a questionnaire approach

Grosvenor is committed to reducing the carbon emissions of the London Estate by 50% by 2030. A large proportion of these emissions is 'tied' within the non-directly managed properties, where Grosvenor does not have a clear view of the carbon-reduction achievements for many ongoing or completed refurbishments.

To assist us in understanding the current performance of your building/unit and to quantify potential carbon reduction from the proposed retrofit works, we have developed a questionnaire (please see link below).

Your architect is invited to complete the questionnaire and, depending on the answers, we will be able to offer you some free and valuable advice from our experts, consultants and agents.

Our aim is to help you get the most from your refurbishment works, proposing the most cost-efficient measures tailor-made for your property, which will reduce both your energy bills and carbon emissions.

The following possible areas of a refurbishment scope are included in the questionnaire:

- Lighting
- Heating system
- Hot water system
- Windows
- Ventilation
- Renewables
- Building fabric (walls, roof, floor)

You are invited to complete as much information as possible for your proposed alterations. However, it should be noted that information on the current state of the building/unit, even in areas where you are not planning to make any changes, will help us to quantify more accurately your carbon savings.

Before completing the questionnaire, you may go through appendix 4.2 to browse different product solutions available, including information about payback times, potential energy-bill savings, as well as cases with the Estate where the corresponding product has been approved. Please click here to complete the questionnaire.

Appendix 4.2
Constructive details: product solutions

The following section presents some available product solutions to be considered, based on the aspect and scope of the refurbishment. For each product solution the following information is provided:

- General information about the product
- Suitability for conservation area
- Suitability for listed buildings
- Payback time*
- Annual bill savings*
- Associated risks
- Example of suppliers
- Address (where applicable) within The Estate where the particular product solution has been applied

*to see the assumptions behind the payback and bill savings calculations, please see appendix 4.3

Improving insulation from the outside

Aerogel Insulation

- ☐ Available as "blanket" or panel boards, aerogel is an excellent insulation option for internal placement
- ☐ Aerogel insulation is very effective in thin thickness, hence, small internal area will be lost
- ☐ Aerogel is breathable, fire resistant and durable
- ☐ This type of insulation has good acoustical properties and does not support mould growth

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	25-30	£740 (50 mm thick)*	or	33%	high capital cost dust production	Thermablock Spacetherm	54P Eaton Square St Mark's Mansions

* required thickness to reach Part L of Building Regulations

EPS Insulation

- ☐ EPS (expanded polystyrene) is a widely used rigid foamed insulation suited for roof, floor and wall application
- ☐ EPS is low-cost, effective and lightweight
- ☐ EPS is easy to install and does not support mould growth

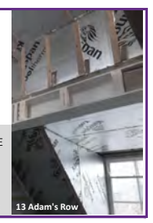
CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	5-8	£740 (115 mm thick)*	or	33%	is flammable during installation loss of internal area	Baumit Knauf	19 Passmore Street

* required thickness to reach Part L of Building Regulations

PIR Insulation

- ☐ PIR (polyisocyanurate) thermal insulation boards require low thickness to reach Part L thermal requirements
- ☐ PIR is low weight, easy to install and suitable for damp areas
- ☐ PIR offers sound reduction and is resistant to extreme weather and fire

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	12-15	£740 (70 mm thick)*	or	33%	high capital cost loss of internal area	Kingspan EcoTherm	13 Adam's Row St Barnabas Street

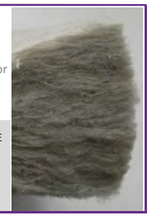


* required thickness to reach Part L of Building Regulations

Improving insulation from the outside (continued)

Mineral Wool Insulation

- ☐ Mineral wool insulation consists of fibers that can include glass, wool and ceramic
- ☐ This type of insulation can be found in a range of products including loose granular material for cavity walls, slabs for walls or rolls for loft insulation
- ☐ Mineral wool offers exceptional thermal, fire and acoustic properties

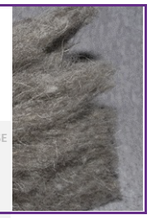


CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	5-8	£740 (125 mm thick)*	or 33%	if wet, mould may grow loss of internal area	Knauf Kingspan	Passmore Street St Barnabas Street

* required thickness to reach Part L of Building Regulations

Natural Wool Insulation

- ☐ Natural wool insulation is produced from sheep's wool and can be used in loft, rafter, internal wall and floor application
- ☐ Its thermal, fire and mould resistance properties match Part L Building Standards
- ☐ Natural wool insulation is ideal for breathable wall construction, drawing the moisture out of the building fabric



CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	8-12	£740 (130 mm thick)*	or 33%	loss of internal area increased insulation depth	Black Mountain Therma Fleece	

* required thickness to reach Part L of Building Regulations

Wood Fiber Insulation

- ☐ Wood fiber insulation can be used to fill cavity walls or for internal and external applications in rigid board form
- ☐ Wood fiber can absorb and release moisture making it ideal for breathable structures
- ☐ This type of insulation can prevent condensation and summertime overheating

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	7-10	£740 (140 mm thick)*	or 33%	loss of internal area increased insulation depth	NaturePRO Steico	

* required thickness to reach Part L of Building Regulations

Hemp Fiber Insulation

- ☐ Hemp fiber insulation is produced from the hemp straw of the hemp plant
- ☐ It can be easily installed in roofs, walls and floors, offering fire resistant and acoustic properties
- ☐ This type of insulation can absorb and release humidity making it ideal for timber frame constructions

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	8-11	£740 (130 mm thick)*	or 33%	loss of internal area increased insulation depth	Isonat Therma Fleece	

* required thickness to reach Part L of Building Regulations

Spray Foam Insulation

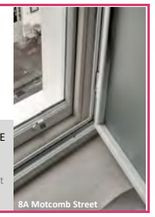
- ☐ Spray foam (polyurethane) insulation, consists of a two-component mixture, forming an expanding foam that can be sprayed as required
- ☐ This type of insulation is ideal for small spaces where manoeuvrability is an issue
- ☐ The insulation is sprayed slowly expanding to fill a gap hardening within minutes

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	varies	varies	only applied by specially trained professionals	Warmite Walltite	

Upgrading windows in a conservation area

Secondary Glazing

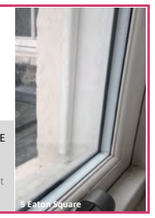
- ☐ Usually the only permissible solution for the front facade for listed buildings, a secondary pane of glass and frame can be fitted (fixed or removable) inside the existing window reveal
- ☐ To increase the performance of secondary glazing consider using low emissivity glass
- ☐ Secondary glazing pane can be double or triple glazed to increase its thermal performance



CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	10-15	£200	or 9%	condensation risk less effective than double glazing	Selectaglaze Clearview	4a Motcomb Street 45 Eaton Square

Double Glazing (slim line)

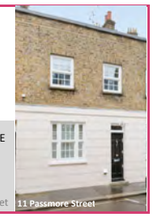
- ☐ Double glazing frames consist of two panes of glass, with an air or argon filled cavity between them
- ☐ In the slim line version, the air gap can be as little as 3mm with a similar thermal transmittance as the regular double glazing (6 to 16 mm)
- ☐ The benefits of double glazing include soundproofing, reduction of condensation, fewer draughts and cold spots, smaller energy bills and increased security



CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	15-20	£250	or 11%	high capital cost installed by trained professionals	Ecowin Livingwood	13 Passmore Street 5 Eaton Square

Triple Glazing

- ☐ Triple glazing frames consist of three panes of glass, with two air or argon filled cavities between them
- ☐ Triple glazed windows can reduce heat losses by up to a third in comparison with double glazing units and at the same time provide excellent acoustic properties
- ☐ This type of glazing, typically reaches a U-Value of 0.8 W/m^{2}K or below
- ☐ Choose **Passivhaus Certified** triple glazed windows to achieve even greater savings, as the window frame is insulated



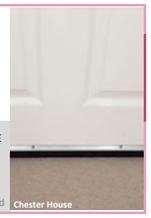
CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)		RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	20-25	£280	or 13%	high capital cost installed by trained professionals	Ecowin Livingwood	13 Adam's Row 29 St Barnanas Street

How to improve heating and plumbing systems

Draught Proofing Existing Windows & Doors

- ☐ Draught proofing is a low cost way to save energy
- ☐ Draught proofing can be installed to be removable or fixed permanently to the inside of the frame
- ☐ Products can also be fitted to doors, letter boxes and other openings to increase comfort and reduce heating demand

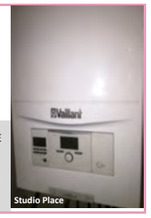
CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	15-20	£85 or 4%	requires frequent maintenance slightly increases comfort	Lorient Astrodraft	20 Ebury Street 20 Ebury Bridge Road


Chester House

Upgrading your Boiler to Combination Boiler

- ☐ Choose gas condensing combination boiler for high quality performance and efficiency
- ☐ Combi boiler includes an integrated hot water storage device at the back of the boiler
- ☐ The boiler is capable of delivering hot water without the need of a separate hot water cylinder or cold water tank
- ☐ This boiler type can support up to 2 bathrooms without the need for hot water cylinder

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	4-7	£630 or 28%	thermostat, programmer & TRVs are required	Vaillant Baxi	St Mark's Mansions 11 Passmore Street



Studio Place

Upgrading your Boiler to High Efficient Boiler

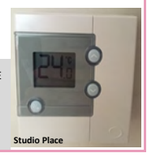
- ☐ Choose gas condensing regular boiler for high efficiency levels if a water cylinder is required to meet the hot water needs of the unit
- ☐ No cold water tank is required as it can be directly connected with the water main

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	4-7	£470 or 21%	thermostat, programmer & TRVs are required	Vaillant Baxi	11 West Halkin Street 24B Motcomb Street

Temperature Controls | Room Thermostat

- ☐ Room thermostats provide temperature control within the unit, by switching the heating on and off when the temperature is below or above a certain temperature setting respectively
- ☐ Room thermostats require free flow of air, hence, they must not be blocked by curtains and furniture or put near heat sources

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	£100 or 4%		Honeywell Nest	8 Ann's Close Studio Place


Studio Place

Temperature Controls | Thermostatic Radiator Valves

- ☐ Thermostatic Radiator Valves (TRVs) reduce the flow of water through the radiator they are fitted to, according to a certain setting
- ☐ TRVs can significantly reduce your energy bill by limiting the temperature within each room they are fitted
- ☐ TRVs can be a measure to prevent overheating

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	£140 or 6%	will prevent boiler interlock if fitted in the same room with the room thermostat	Honeywell Drayton	Chester House Clarendon Flats


Chester House

Timing Controls | Programmer

- ☐ A programmer will automatically switch your heating on and off depending on if it is required or not
- ☐ Programmers allow you to set 'on' and 'off' time periods

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies		Honeywell Danfoss	36 Ebury Bridge Road 1A Ranelagh Cottage


Motcomb Street

Boiler Controls | Boiler Interlock

- ☐ This is not a control system but a system of wiring that turns the boiler off when neither the room thermostat nor the cylinder needs it
- ☐ Without the interlock the boiler can continue to operate wasting energy
- ☐ Never fit a TRV in the same room with the room thermostat, as this would prevent the boiler interlock

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies	will prevent boiler interlock if fitted in the same room with the room thermostat		

Boiler Controls | Boiler Thermostat

- ☐ The higher the temperature of the water through the radiators that heat your home, the quicker and more effectively your home will be heated
- ☐ If your boiler thermostat is separate to the cylinder thermostat, your boiler should always be set to a higher temperature than the cylinder thermostat

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies		Drayton Salus	

11 Kinnerton Place South

Insulating Hot Water Cylinder

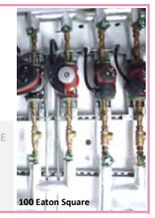
- ☐ Add insulation to your hot water cylinder to make sure there are minimum heat losses so that wasted energy is reduced
- ☐ Installing a 50 to 80 mm thick insulating jacket to the hot water cylinder will also reduce the waiting time for hot water to be delivered to the taps

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	£90 or 4%		your local home store	

Insulating Pipework

- ☐ Pipe insulation consists of a foam tube that covers the exposed pipes between your hot water cylinder and boiler
- ☐ Heat losses are reduced and the water is maintained hot for longer period

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies		Kingspan Armacell	


100 Eaton Square

Electricity | Switch to Economy 7 Tariff

- ☐ Economy 7, is an electricity tariff where you pay different price for your electricity at different times of day
- ☐ The electricity you use at night costs about a 1/3 of the price of the electricity you use during the day, giving you 7 hours of cheaper electricity at night
- ☐ For the remaining 17 hours the electricity costs more than the standard tariff

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies	most likely to be beneficial to units with electric heating	check with your electricity supplier	Chester House 15 Eaton Square


41-43 Eaton Square

Smart Meters

- ☐ Smart meters help you keep track of the energy you use in your home without the need for actual meter readings
- ☐ These meters apart from measuring the total energy you use can also tell you how much it costs and when you have used it
- ☐ The UK Government plans for every home and business in the UK to have a smart meter for electricity and gas by the end of 2020

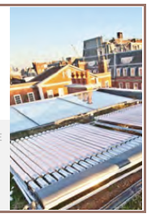
CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies		Geo Owl	38 Ebury Bridge Road 33 Eaton Square

Under cover: Improving roofs and mansards

Solar Thermal Panels

- ☐ Solar thermal panels can meet up to 60% of your hot water demand, reducing your carbon footprint as well as your energy bill
- ☐ There are 2 types of panels, **flat** and **evacuated tube** with the latter ideally used when the roof orientation is not ideal

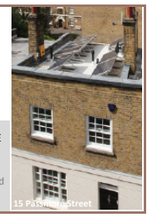
CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	15-19	£240	or	11%	high capital cost requires back-up heating system	Vaillant Viridian	



Solar Photovoltaics (PVs)

- ☐ PVs capture sun's energy using photovoltaic cells converting the sunlight into electricity
- ☐ Apart from reducing your energy bill, you will be paid for every kWh you generate (feed-in tariff)
- ☐ Any extra kWh that is not used by you will be sold back to the grid (export tariff) achieving even greater savings
- ☐ Your carbon emissions will be greatly reduced

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	9-13	£200	or	9%	generation depends on many factors e.g. orientation & tilt	Sunpower Solar World	20 Ebury Bridge Road Laxford House



Green Roofs

- ☐ Green roofs can be 2 to 5 times heavier than ceramic roof tiles depending on their type
- ☐ There are mainly two types: **extensive** (up to 0.35m thickness) and **intensive** (up to 1.7m thickness),with only the latter capable of supporting leisure use
- ☐ Green roofs can reduce extreme fluctuation of temperature, reduce storm water run-off, offer sound insulation and support biodiversity

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	varies	varies	high capital cost may require support works	LivingGreenCity Sedum Green Roof	

Air Source Heat Pump

- ☐ Air source heat pumps absorb heat from the outside air, using this heat for both heating and cooling
- ☐ If your heating is supplied by electricity it can greatly reduce your energy bills
- ☐ Extra potential income through the UK government's Renewable Heat Incentive (RHI).

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	7-10	£1,500	or	67%	space for the equipment mostly for high-insulated units	Daikin Halton	25P Eaton Square

Micro CHP

- ☐ Micro Combined Heat and Power is a technology that generates heat and electricity simultaneously from the same energy source (gas or LPG)
- ☐ Micro CHP is ideal for existing units that is difficult to insulate
- ☐ As in the case of the PVs you can benefit from feed-in and export tariffs
- ☐ A typical domestic installation is the size of a washing machine

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)			RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	8-11	£990	or	44%	potentially not sensible in terms of carbon savings due to grid decarbonazion	BAXI Remeha	

Breathing space: effective ventilation

Single Sided Ventilation wih Single Opening

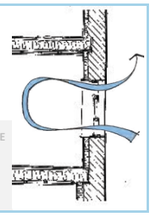
- ☐ Singe sided ventilation with one single opening is the least efficient natural ventilation solution
- ☐ It is characterized by low ventilation rate and limited air penetration depth usually between 4 and 6 meters
- ☐ Air penetration depth can be up to 2 times the floor to ceiling height

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	not capable of achieving 100% comfort levels		

Single Sided Ventilation wih Double Opening

- ☐ Singe sided ventilation with one double opening has increased efficiency compared to the one single opening ventilation strategy, due to the pressure differences between the two openings
- ☐ The air penetration depth is typically between 7 and 8 meters
- ☐ Air Penetration depth can be up to 2.5 times the floor to ceiling height

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	not capable of achieving 100% comfort levels		



Cross Ventilation

- ☐ Cross ventilation occurs due to wind generated pressure differences, with the air penetration depth typically up to 15 meters
- ☐ Air penetration depth can be up to 5 times the floor to ceiling height
- ☐ To achieve this type of natural ventilation and to prevent heat and pollutant build-up, a relatively narrow plan is required

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	not capable of achieving 100% comfort levels		

Stack Ventilation

- ☐ For increased ventilation penetration depth, consider stack ventilation
- ☐ As the air gets warmer it becomes less dense and rises up whereas cold air is denser and heavier and stays at lower level
- ☐ Stack ventilation relies on these density differences to draw denser and cooler outdoor air via low level vents and to exhaust less dense and warm air via high level vents (e.g. staircase skylight)

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	if the internal temperature is lower than the external the effect will reverse		

Trickle Ventilation

- ☐ When replacing the windows, consider installing frames with built-in trickle vents
- ☐ Trickle ventilation is an effective and secure way of supplying background ventilation even if you are not in the building

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	varies	not capable of achieving 100% comfort levels	Titon Renson	

Mechanical Ventilation with Heat Recovery

- ☐ MVHR is an air heat exchanger which uses hot internal air to heat cold external air
- ☐ With domestic heat exchangers achieving efficiency of up to 88%, the majority of exhausted heat is recovered by the MVHR unit
- ☐ MVHR should only be used in super-insulated and airtight buildings

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies	filters to be changed often high capital cost	PAUL Nuaire	13 Adam's Row 11 Passmore Street

Switched on: upgrade your lighting systems

Low Energy Lighting | CFLs

- ☐ Compact Fluorescent Lamps (CFLs) technology uses gas inside a glass tube which is charged with electricity to give off light
- ☐ CFLs use about 80% less electricity and can last up to 10 times longer than an equivalent traditional bulb

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	4-7	£55 or 2%		Phillips GE	39/41 Davies Street Chester House

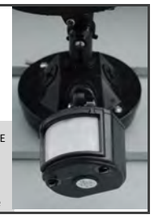
Low Energy Lighting | LEDs

- ☐ Light Emitting Diodes (LEDs) are simple solid state electronic devices that allow electricity to flow through them in one direction to produce a small amount of light
- ☐ LEDs can be expensive, but are the most efficient option and pay for themselves several times over before they need replacing

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	7-9	£55 or 2%		Phillips Samsung	Kinnerton Street 86P Eaton Square

Lighting Controls | Movement Sensors

- ☐ Movement sensors turn the lights of a room on and off, depending on if its occupied or not
- ☐ In frequently used rooms the benefits are small since lights left on unnecessarily, are soon noticed and turned off
- ☐ For less frequently used rooms (bathrooms, garage, storage etc.) the benefits can be great and the lighting demand can be reduced up to 50%



CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies	need careful planning in the position of the sensors	Green-i Honeywell	Laxford House Kylestrome House

Lighting Controls | Daylight Sensors

- ☐ Daylight sensors take advantage of the natural light automatically, dimming or turning off the lights when there is enough daylight
- ☐ These sensors, continuously adjust lights so occupants don't have to manually adjust them as daylight levels change
- ☐ Lighting demand can be reduced up to 60%.

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies	need careful planning in the position of the sensors	Phillips Lutron	Lochmore House 34 Grosvenor Gardens

Lighting Controls | Dimming

- ☐ The more dimmed the lighting the less energy is used and the greater the reduction in the energy bill
- ☐ When the bulb is dimmed down there is less wear on the bulb which makes its lifetime longer
- ☐ Dimming can reduce lighting demand by 20%

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies		Leviton Legrand	24B Motcomb Steet Chester House

Lighting Controls | Smart Controls

- ☐ Introducing a central switch for the lighting and electrical system located at the front door can enable users to turn off non-essential electrical when exiting the home
- ☐ Only important appliances such as fridges will be left on, reducing waste levels

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies			

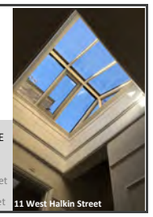
Efficient Appliances

- ☐ Domestic appliances can account for 20% of a household's energy use
- ☐ Energy efficient appliances use less energy reducing your energy bill
- ☐ They often include components surpassing in quality those found in standard appliances which can result in fewer mechanical problems and longer equipment life

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	varies	varies		Bosch Samsung	

Using Daylight

- ☐ Optimizing the use of daylight will help maintain comfort and reduce the need for artificial heating and cooling depending on climate conditions
- ☐ Poorly designed windows and skylights can cause overheating
- ☐ Skylights let in three times more daylight than a vertical window
- ☐ Using light reflecting paint on walls can also reduce the need for artificial lighting



CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	check with Westminster	varies	varies	Overheating Careful selection of location	Velux Rooflight Company	11 West Halkin Street 24B Motcomb Street

Waterworks: upgrading water fixtures and fittings

Greywater Re-use

- ☐ Greywater is water deriving from bathroom sinks, showers and washing machines
- ☐ It is a safe and beneficial source of irrigation water in a yard or used for toilet flushing
- ☐ In most situations, 100% of flushing can be met from greywater which can be up to 40% of the total water of the household
- ☐ It is essential to put nothing toxic down the drain and to use natural and biogradable soap

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	10-15	varies	Don't store greywater for long to avoid bacteria build up	Aquaco Aquality	

Rainwater Harvesting

- ☐ Rainwater can be harvested for toilet flushing, landscape irrigation and washing machines
- ☐ This depends on the size of your catchment area and the amount of rainfall
- ☐ Typically, domestic systems will reduce water consumption by up to 50%

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	10-15	varies	Rainfall is unpredicted Regular maintenance	Aquaco Graf	

Toilets | Dual Flush

- ☐ Dual flush toilet has a two setting mechanism that allows you to flush either a low volume or a high volume flush
- ☐ This type of toilet flush can save up to 40% of the water used for flushing, reducing the water bill and your carbon emissions

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	4-6	varies		your local home store	

Taps & Showers | Low Flow Shower Head

- ☐ Shower water accounts for 30% of the overall household water usage
- ☐ Low flow shower heads can reduce water consumption by 40%, conserving water and reducing the water bill
- ☐ There are two types of low flow shower heads, **aerated** and **non-aerated**
- ☐ Water pressure is maintained in both cases

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies		your local home store	

Install Water Meter

- ☐ With water meters your bill reflects the actual amount of water used instead of a rate-based tariff
- ☐ If you don't know how much water you use you can't set reduction goals
- ☐ A water meter is the best way to identify if you are a high or low water use and help you set and check your goals

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	< 1	varies		contact your water supplier	

Installing a comfort cooling system

Comfort Cooling | Natural Ventilation

- ☐ Due to predicted hotter summers in the UK, the building design should focus on combating overheating
- ☐ If not, active cooling (air conditioning) will be required to maintain comfortable conditions, increasing energy bills and carbon emissions
- ☐ Enhancing the use of natural ventilation is essential and some proposed strategies can be found in "Effective ventilation" part of the guide

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa or %)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	not capable of achieving 100% comfort levels		

Comfort Cooling | Exposed Thermal Mass

- ☐ Consider exposing thermal mass areas e.g. brick, concrete
- ☐ Thermal mass can absorb heat during the day and release it during the night
- ☐ Thermal mass should always be combined with night ventilation to use the cold night air to cool down the structure of the building so that it can absorb heat gains during the day

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	overheating can occur if not combined with night time ventilation		

Shading | Internal shutters & Heavy Blinds

- ☐ Protecting South facing windows from solar gains during the summer can reduce overheating
- ☐ Consider restoring internal shutters and combining with heavy blinds to keep direct sunlight out, reducing the need for active cooling
- ☐ Block out curtains can reduce heat gains by 30%
- ☐ This percentage can be increased by combining block out curtains with internal shutters

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A			Grosvenor Crescent Motcomb Street

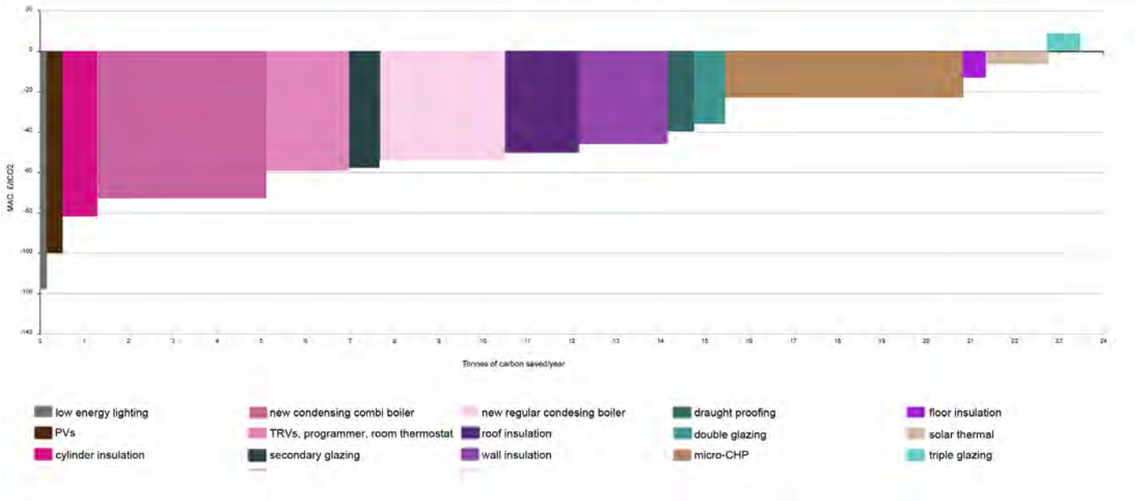
Shading | Trees

- ☐ Deciduous trees block unwanted solar gains in the summer but allow them in the winter
- ☐ Trees will be at full shading capacity when mature
- ☐ Choose between beech, birch, horse chestnut and oak

CONSERVATION AREA	LISTED BUILDING	PAYBACK TIME (years)	YEARLY SAVINGS (£ pa)	RISKS	EXAMPLE OF SUPPLIER	GROSVENOR CASE STUDY
✓	✓	N/A	N/A	trees require time to grow to be effective		

Appendix 4.3 Case Study: applying different energy-reduction strategies to an existing dwelling

To assist you in choosing which option of refurbishment might suit your building, a typical dwelling has been modelled in FSAP software (Stroma Certification © version 2012), a Government-approved software for the production of Energy Performance Certificates (EPC) for dwellings. By testing different options, the energy-saving potential for each case was evaluated and by considering average market costs the payback time and cost benefit for each option have been calculated. It should be noted that these figures refer on the specific type of the dwelling that was modelled (see details below) and the figures reported in the MAC curve are indicative and for your guidance only to assist you in comparing different available options.



More specifically, a typical two-storey, 125 m², two-bed, end-of-terrace Victorian house was selected with the following characteristics:

Fabric and openings construction:
- Ground Floor: suspended timber - not insulated
- External Walls: solid brick (210 mm) - not insulated
- Roof: pitched, slate-covered - not insulated
- Windows: single glazing (30% glazing ratio)

Heating system:
- Regular, non-condensing gas boiler pre-1998
- Space heating provided by radiators - no temperature controls
- Hot water powered by the gas boiler with water stored in a non-insulated cylinder

Ventilation:
- Natural ventilation
- No draught-proofing

Lighting:
- No low-energy lighting

Renewables:
- No renewables

Comments:

1. To evaluate air source heat pump, the base heating system was electricity powered (old storage radiators)
2. In the case of 'Upgrading Water Fittings', the payback time is based on literature review

Assumptions:

1. Average residential market costs were assumed in the calculation
2. Capital costs do not include installation costs

4.4 Further Reading

Grosvenor Environment Review 2011

by Grosvenor
A guide to Grosvenor's commitment to creating and managing well-designed environmentally-sustainable buildings and places.

Recommended books

Environmental Design Pocketbook

by Sofie Pelsmaker (2012)
This book provides a useful one-stop summary of sustainable, low-energy building design.

Residential Retrofit - 20 Case Studies

by Marion Baeli (2013)
This book is a collection of case studies that were part of the Retrofit for the Future competition.

Sustainable Construction

by Sandy Hallidy (2007)
Sustainable Construction is a groundbreaking book to help achieve practical, inexpensive, sustainable buildings.

Websites: consents

English Heritage

www.english-heritage.org.uk
The website has information on Conservation Areas and Listed Buildings.
English Heritage advises on how to get the most out of our heritage for the current generation, while also ensuring its protection for the next generation.

The Royal Borough of Kensington and Chelsea

www.rbkc.gov.uk
The Royal Borough of Kensington and Chelsea Council website with useful links on planning, conservation and sustainability.

Westminster City Council

www.westminster.gov.uk
Westminster City Council has extensive information on residential advice, planning and refurbishment.

Your responsibilities

www.planningportal.gov.uk
The Planning Portal is the Government's online Planning and Building Regulations resource for anyone who wants to learn about the planning system in England and Wales.

Websites: sustainable refurbishment

BREEAM Domestic Refurbishment

www.breeam.org
BREEAM is a design and assessment method for sustainable buildings (See section 3).

Changeworks Heritage

www.changeworks.org.uk
Changeworks is a leading environmental charity that helps people to live and work in a more sustainable way.

Department of Energy and Climate Change (DECC)

www.decc.gov.uk
DECC is the government's department that is responsible for national energy provisions and the country's policy responses to climate change.

Energy Saving Trust

www.energysavingtrust.org.uk
Energy Saving Trust is a non-profit organisation that helps the promotion of sustainable energy including energy efficiency measures.

Environment Agency

www.environment-agency.gov.uk
Environment Agency is a non-departmental public body that has the responsibility for the environment, food and rural affairs.

Forest Stewardship Council (FSC)

www.fsc.org
FSC is a non-governmental organisation that has been established to promote sustainable management of forest globally.

Good Homes Alliance

www.goodhomes.org.uk
Good Homes Alliance is made up of companies, professionals and experts in the built environment that build and promote sustainable home and communities.

Prince's Foundation

www.princes-foundation.org
The Prince's Foundation is an educational charity that promotes the practice of traditional urban design and architecture whilst also putting the communities at the heart of the design process.

Retrofit for the Future

www.retrofitforthefuture.org
The Technology Strategy Board's Retrofit for the Future programme was designed to kick-start the retrofitting of the UK's social housing stock. Their website includes a database of low-energy building information, created to assist in the planning and development of sustainable housing schemes, be they new build or refurbishment.

Waterwise

www.waterwise.org.uk
Waterwise is an NGO whose purpose is to promote the reduction of the amount of water we use in the UK.

Local Authority guidance

Westminster City Council

www.westminster.gov.uk
Retrofitting Historic Buildings for Sustainability (2012)
This report is a guide to the importance of sensitive and sustainable refurbishments of historic buildings in Westminster.

Sustainable Traditional Buildings Alliance

http://stbauk.org/
The STBA is a not-for-profit alliance of historic building groups and environmental and professional building organisations, working to promote and deliver a more sustainable traditionally built environment in the UK. Their guidance document, Responsible Retrofit of Traditional Buildings (available at the above address) provides information on the key aspects of the refurbishment of historic buildings on behalf of the Department of Energy and Climate Change.

Technical guidance

Centre for Sustainable Energy (CSE) & Bath Preservation Trust (BPT)

Warmer Bath: A guide to improving the energy efficiency of traditional homes in the city of Bath by Will Anderson CSE, & Joanna Robinson BPT (2011) www.cse.org.uk
This guide is was product from the Low Carbon Bath project and is a guidance to respond to how low carbon future may be achieved by owners of properties built before 1919.

The Jewson Sustainable Building Guide (2011)

http://blog.jewson.co.uk
This guide offers information and advice on upcoming legislation, government incentives and sustainable products and practices.

Low Carbon Domestic Retrofit Guides

www.instituteforsustainability.co.uk/retrofitguides
This collection of documents draw on leading academic and industry experts, and provide practical and commercially focused advice and best practice to both trades and professions including architects, surveyors, builders, project managers, plumbers and electricians.

Changeworks Heritage

Energy Heritage
This is guide in how to improve the energy efficiency in traditional homes.

English Heritage

Energy Efficiency and Historic Buildings: Application of Part L of the Building Regulations to historic and traditionally constructed buildings.
This guidance was written to prevent the conflicts when planning a refurbishment between energy efficiency requirements and the conservation of buildings.

Historic Scotland

Slim-profile Double-Glazing**:** Technical Paper 9 by Nicolas Heath, Paul Baker & Gillian Menzies (2010)
This paper highlights the results of three research reports on the energy efficiency performance of slim-profile double glazing.

Conferences

100% Design

www.100percentdesign.co.uk
100% Design is the UK's biggest design show held annually at Earl's Court, London in September.

Ecobuild

www.ecobuild.co.uk
Ecobuild is the world's largest sustainable design event held every spring at the ExCel in London.

Retro Expo

www.retro-expo.co.uk
Retro Expo is an annual exhibition and conference dedicated to low-carbon retrofit of existing buildings held at the end of October at the NEC Birmingham.

4.5 Glossary of Terms

Aerated water fittings

These allow air to flow in with the water to reduce the amount of water flowing though the tap or shower head, reducing water demand and creating a softer, more even spray.

BREEAM

The Building Research Establishment Environmental Assessment Method is designed to help construction professionals understand and mitigate the environmental impact of the developments they design and build. Certified buildings are awarded a pass, good, very good, excellent or outstanding rating.

Building Regulations Part B

The part of the Building Regulations concerned with fire safety, ensuring considerations such as the spread of fire and means of escape are addressed.

Building Regulations Part F

Part F of the UK Building Regulations gives standards for ventilation and air quality, comprising rates for the extraction of stale air from the building's interior.

Building Regulations Part G

Part G of the Building Regulations sets the standards for sanitary and washing facilities, as well as bathrooms and the provision of hot water. The document also provides safety requirements with regard to unvented hot water systems.

Building Regulations Part L

The part of the Building Regulations concerned with the conservation of fuel and power. The document is divided into four sections, with Part L1B being that concerned with residential refurbishment projects.

Chain of Custody (CoC) Certification

This method verifies that timber has been sustainably sourced; certification means that products can be tracked from one supplier to another, back through the supply chain to a forest that is certified by the Forestry Stewardship Council (FSC).

Conservation Area

An area of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance, protected by English Heritage. If a building is within a conservation area, then certain rules apply on what works can be legally carried out.

Considerate Constructors Scheme

A voluntary nationwide plan set up by the construction industry to improve its performance. Sites and companies that register with the Scheme are monitored alongside a Code of Considerate Practice, designed to promote best practice that goes beyond statutory requirements.

Decent Homes

Government scheme that intends to ensure all homes are weather tight, warm and have modern facilities.

EcoHomes

An Environmental rating system for homes in the UK and part of the Building Research Establishment's suite of environmental tools. The scheme was replaced by BREEAM Domestic Refurbishment in 2012.

EMS ISO 14001

The Environmental Management Standard of the International Standards Organisation.

Energy Performance Certificate (EPC)

A document that gives information on how much energy supplied to the building is used and how much is wasted. Can be used to make a home more energy efficient and reduce energy costs. All homes bought, sold or rented require an EPC.

Energy Saving Trust Recommended

This is a product labelling scheme, which recognises products that are the most energy efficient on the market. The scheme is designed to allow consumers to make an informed decision when choosing new domestic appliances.

Environment Agency

Part of the Department for Environment, Food and Rural Affairs (DEFRA), the Environment Agency is concerned with environmental improvements and protection in England and Wales, and also promotes sustainable development.

Environmental Management System (EMS)

A framework used to manage environmental impacts through organisational policies.

Feed-in Tariff (FiT)

This is an energy policy by which renewable energy producers are paid a certain number of pence per kilowatt hour of electricity they generate and 'feed into' the national grid.

Listed Buildings

Properties considered to be of significant historic or architectural interest, protected by English Heritage. If a building is listed, then the Local Authority must grant permission for any changes to the building before they can legally be carried out. For more information see www.english-heritage.org.uk.

Passivhaus Scheme

A voluntary standard devised by the German Passivhaus Institut for homes with particularly low energy requirements. The Passivhaus scheme takes a 'fabric first' approach, paying particular attention to insulation and airtightness. For more information see www.passivhaus.org.uk.

Photovoltaic Panels

Roof-mounted panels that convert solar radiation into electrical power.

Planning Permission

A form of approval, which must be sought from the Local Authority for planned developments to legally go ahead. Please note that Planning Permission is different from Building Regulations Approval, which is also generally required.

Structural Moisture

Otherwise known as structural damping or interstitial condensation, this occurs when moisture accumulates within the fabric of a building, giving rise to a number of issues such as damp or rot. This in turn can compromise the stability of structural elements.

Thermal Bridge

A point in a building's external envelope, through which heat can be transferred by conduction from inside to outside, or vice versa.

Thermal Comfort

A person's perceived contentment with the temperature levels in their immediate environment.

Thermal Performance

Otherwise known as the U-Value, thermal performance is a measure of how quickly a building element (roof, floor, wall, window or door) loses heat to the outside.

Thermostatic Radiator Valve (TRV)

A self-regulating valve that is fitted to a radiator to regulate the temperature of a room by changing the flow of water to the radiator according to the air temperature.

Underground Heat Exchanger

Equipment which transfers the energy in the ground directly underneath (or adjacent to) a property into the heating and ventilation systems, reducing the need for active heating.

Volatile Organic Compounds (VOCs)

Organic chemicals contained within myriad building products, which release easily into the atmosphere and can in some cases cause health problems. An example compound is formaldehyde.

Acknowledgments

eight associates

Content and drawings provided by Eight Associates Sustainability Consultants.

Eight Associates specialise in the delivery of sustainable buildings, both in the UK and abroad. They are BREEAM Accredited Professionals and have unparalleled experience in eco-ratings, while their interactive approach to sustainable design, energy modelling and renewable energy technologies results in truly low-impact buildings.

InArc Ltd.

Photography provided by Nick Ingram at InArc Ltd.

Nick Ingram is a photographer specialising in architecture and interiors. His current client base includes some of the UK's premier architects, interior designers, surveyors, property developers and high-end estate agents, as well as a number of design and PR agencies.

sturgis carbon profiling

Carbon savings questionnaire and constructive detail database provided by Sturgis Carbon Profiling LLP.

Sturgis Carbon Profiling (SCP) provides consultancy services for delivering a sustainable, low-carbon built environment. SCP takes a holistic, economically driven approach to real estate carbon emissions analysis and has a reputation as thought leader and innovator in the search for a low-carbon future. SCP are BREEAM Accredited Processionals, Certified Passivhaus Designers as well as ESOS (Energy Savings Opportunity Scheme) and Energy certified Assessors.

GROSVENOR

Grosvenor is a privately owned property group, with offices in 19 of the world's most dynamic cities. Our future success is tied to the sustainable growth of the cities in which we have a presence. We have a vested interest in the future shape of the urban landscape and aim to help create and manage attractive and vibrant cities in which people choose to work and live.

With thanks also to:

Peter Guthrie	Professor of Engineering for Sustainable Development, University of Cambridge
Michael Popper	Director of P³r Engineers Ltd, Consulting Building Services Engineers
Lucy Pedler	Architect and Director of the Green Register, a not-for-profit organisation which offers training on sustainable building practices to all disciplines of the construction industry.

"This is an impressive document that manages to combine readability with technical substance -which is a rare feat."

Peter Guthrie, Professor of Engineering for Sustainable Development, University of Cambridge

"I'm delighted to support this very practical guide to improving the environmental performance of period residential property. The sector is without doubt a difficult one to tackle, however Grosvenor are certainly best placed to do so and have managed to address the varied and often complex issues in an easily understood, practical way."

Keith Budgen, Executive Programme Director, Better Buildings Partnership

"The Grosvenor estate's 'Toolkit for Going Green' stands out amongst the growing number of guides for sustainable refurbishment. With its emphasis on tackling the refurbishment of historic buildings, the Toolkit gives clear, concise and practical advice to both developers and residents of Grosvenor's large estate of properties in conservation areas."

Lucy Pedler, Director of the Green Register and Archipeleco Architects

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