Zero Carbon Westminster

A Focus on Retrofit in Historic Buildings

December 2021

WPA
Westminster Property Association

Acknowledgements

Westminster Property Association (WPA) is the not-for-profit membership body and advocacy group representing the leading owners, investors, professional advisors, and developers of real estate operating in the City of Westminster.

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Foreword

In the year since the Westminster Property Association published its Zero Carbon Westminster white paper on decarbonising the built environment, the importance of tackling climate change has come into even sharper relief.

In August, the latest IPPC report left us in no doubt about the extreme impacts of climate change and the case for ambitious action. While last month, at the COP26 climate summit in Glasgow, we all witnessed national leaders grapple with the challenges of tackling our greatest global threat.

Here in Westminster, the Council was pleased to publish the first iteration of a Climate Emergency Action Plan to kick start local action and build a collaborative framework to achieve net zero emissions across the city by 2040 together.

There is no doubt that our ability to achieve this will depend on how far we can reduce the energy demand of our buildings. This is particularly challenging in Westminster, where our heritage buildings contribute so much to the unique character and pull of the city.

This is where the WPA research report into retrofitting heritage buildings is so vitally important: it demonstrates how building upgrades can both conserve these important historical assets and adapt them to meet changing needs, whilst improving their climate resilience and sustainability.

It makes clear the broad case for retrofit – including the non-carbon benefits of investment – and sets out the practical interventions that can be taken by property owners to achieve them.

We recognise the role the council needs to play in enabling and supporting these changes, and we are fully committed to playing our part. We will shortly be publishing our new Environmental SPD which includes practical advice on a range of retrofit options, and we are upskilling all our staff on sustainability, with the aim of becoming a recognised net zero leader on planning and the built environment.

There is a huge opportunity for property owners and the Council as a planning authority to work together to find creative ways to give our older properties a new lease of life in a zero-carbon future, and to ensure they can continue to enhance our city for decades to come.

We very much welcome this report and look forward to continuing to work closely with the WPA as together we face head-on the challenge of making our buildings fit for a thriving, low carbon future.

Amy Jones
Director for Environment
Westminster City Council

Foreword

Despite the inevitable compromises, COP26, the recent international climate conference hosted in Glasgow, produced the most progressive governmental pledges to date.

The sheer volume of different voices in attendance, from youth demanding change for their futures, to indigenous communities sharing their experiences, was both sobering and motivating.

However, the discussions and commitments lack meaning if they are not effectively converted into urgent action. For the UK to reach net zero by 2050, the property industry must play a key role in decarbonising the economy.

In Westminster alone, the built environment contributes to 86% of emissions, against a UK average of 40%, making this challenge uniquely pertinent to the area.

While we can make new developments less impactful and more energy efficient, 80% of buildings that will exist in 2050 have already been built. Therefore meeting net zero in Westminster, or anywhere, demands a clear strategy to decarbonise existing buildings at an unprecedented rate, regardless of age or heritage. Taking a whole life approach considering operational and embodied carbon will be vital.

Furthermore, the borough has the UK's largest number of listed buildings and the second highest concentration of any local authority. Westminster's historic buildings, a key part of its character and identity, need to be sensitively adapted. This will not only ensure these special places are resilient to climate change but will also enable the emissions reductions we need whilst preserving our history.

This report provides a comprehensive and practical guide for property owners and policymakers, helping them navigate the challenges of retrofitting heritage assets. By highlighting best practice examples, practical steps, policy and cultural changes we can enable greater collaboration between owners, occupiers, planning authorities and stakeholders to deliver retrofit at the scale required.

I hope this guide will help support Westminster's vision for a cleaner, healthier and more sustainable future, whilst ensuring it retains its status as one of the UK's most characterful and historic areas.

Tor Burrows
Executive Director Sustainability & Innovation, Grosvenor Britain & Ireland.
Chair, Westminster Property Association, Senior Advisory Group

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Executive Summary

Bold and ambitious action is needed from both property owners and policymakers to enable heritage buildings to play a leading role in our collective fight against climate change – the greatest challenge facing humankind.

Retrofitting historic buildings to achieve a 'Net Zero Carbon' (NZC) built environment is a **significant opportunity for Westminster**. The area has the largest number of listed buildings in London, and the highest concentration of any local authority in England – excluding the City of London's Square Mile.

More than

90%

of non-domestic properties may require upgrades before 2028

More than 90% of non-domestic properties and almost **half of homes in Westminster which are privately rented may require upgrades before 2028** to meet statutory requirements: creating risks of an unlettable building or a **'stranded asset'** if unaddressed.*

The adaptation of heritage buildings is important in Westminster's NZC journey. However, such interventions, especially 'deep' retrofit projects, can incur high costs for the building owner, but **the business case for green investment is clear.** Retrofitting for sustainability can have material commercial benefits, including creating better-quality assets; future-proofing buildings by aligning with increasingly ambitious regulations from local and national bodies; and mitigating against the risks of climate change.

We have identified **common typologies of heritage buildings** in the City of Westminster with a particular focus on those which have been converted to commercial: mid-18th Century townhouse; early to mid-19th Century townhouse**; and Edwardian institutional/commercial properties. This paper sets out the unique challenges and opportunities for retrofitting each of these building typologies (Appendix A). The report also includes general improvement interventions that will be common across all properties in Westminster.

There is scope for implementing sustainable measures in all buildings. Whilst every building is different, and there will be occasions when a balance between retrofit and redevelopment will need to be made, adopting a retrofirst approach must be the starting point if we are to help tackle climate change. Taking a whole life approach considering operational and embodied carbon will be vital.

Owners can also help minimise the emissions of their historic buildings by implementing a range of measures, from **low-cost and 'light touch' interventions** through to a **comprehensive or 'deep' retrofit.**

Image: Howard de Walden Estate

While we encourage bolder action where possible, this paper explores 12 key light touch measures (section 3ai and Appendix C) taking into account the cost, level of disruption to the building and improvement in energy efficiency. The paper sets out a number of **'easy wins' for property owners** to reduce the emissions of heritage buildings across asset classes.

This report also sets out the **lessons learned** from six major adaptation projects in or near Westminster, which have successfully achieved a balance of heritage protection and significant environmental improvements (section 3aii and Appendix D).

However, to help **avoid a performance gap** between how a building is designed and used, **tenant engagement is vital.** The report looks at the different key touch points of landlord/tenant engagement and provides advice on how to more effectively engage with occupiers at each stage to improve the building's operational energy performance.

Planning policy and regulation has significant implications on the role that historic buildings can play in the fight against climate change. We have made a series of recommendations for both the relevant authorities and applicants to better enable collaboration, the adaptation of buildings and the reduction of carbon emissions across Westminster's older building stock.

• Minimum energy efficiency standards (MEES) of an EPC E rating of E by 1 April 2023, potentially moving to a B rating by 2028. Changes to the EPC framework are currently under review.

•• While these properties were originally designed as housing, many will have been converted to commercial use.

Our key recommendations

For property owners

1. Establish **Net Zero Carbon (NZC) pathways** for every building, ensuring all future refurbishment opportunities align with a transition to NZC emissions. Undertake a thorough assessment of the building from a sustainability and heritage perspective, including a calculation of the current carbon footprint, so that the range of retrofit options are well considered in advance of discussions with Westminster City Council/Historic England. Use carbon offsetting as a last resort.

2. Implement **'light touch' interventions** for your buildings which can help improve the energy performance in a cost-effective way, as a first step. Many of these technologies and actions require minimal building intervention. This could include:
   - LED lighting
   - Data monitoring
   - Heating and cooling optimisation
   - Considering 'deeper' interventions where appropriate, such as air source heat pumps
   - Fabric interventions, e.g. insulation/secondly glazing

3. Consider **'deep' retrofit** of your buildings where possible. We recommend that you:
   - Consider embodied energy of deep retrofit measures
   - Understand the building
   - Understand the business case for taking positive steps to protect and enhance heritage
   - Get the project team right and start early
   - Engage with Westminster City Council and Historic England
   - Implement both established and new solutions to minimise carbon emissions, mitigate climate change and avoid 'maladaptation'
   - Engage with your tenants and building management/facilities team
   - Learn from and share your experiences

4. When submitting your proposals to Westminster City Council and Historic England:
   - Provide early evidence that demonstrates the specific sustainability challenges and opportunities of the building, and how heritage protection is being taken into account
   - Ensure all appropriate carbon saving interventions are thoroughly explored and justified

5. Use the various 'touch points' (marketing, leasing, fit-outs, and on-going operation) as opportunities for the property owner, agent and occupier to engage and encourage behavioural changes that would improve the building's sustainability and operational energy performance. Some of the key principles are:
   - Engage early
   - Communicate clearly
   - Provide support
   - Recognise and maintain the on-going relationship

For applicants, policy and decision makers

- Have due regard to Westminster's new Environmental SPD
- Undertake a detailed assessment of the property in advance of discussions with WCC/HE
- Make timely reviews of policy guidance to reflect best practice
- Recognise and put more emphasis upon the importance of sustainability improvements when making planning decisions, alongside embedding and upskilling staff
- Introduce a 'sustainability champion' within the planning department
- Provide training and CPD opportunities for staff to raise awareness of the climate agenda and to ensure it is integrated across the organisation
- Make greater use of Carbon Offset funds for retrofitting projects

Image: Howard de Walden Estate

Introduction & Context

The maintenance and adaptation of heritage buildings is vital in Westminster's fight against climate change. However, planning and regulatory requirements need to have greater regard for low carbon and low energy interventions. Such interventions can incur high costs for the building owner, which are difficult to justify at a time of post-Covid economic uncertainty.

The WPA believes that the business case for green investment is clear. A 'climate first' approach to upgrading buildings has material commercial benefits, including creating better quality assets, attracting green finance, driving occupier interest and future-proofing buildings by aligning with increasingly ambitious rules from national and local bodies – and therefore avoiding having a costly 'stranded asset'. Please refer to WPA's Zero Carbon Westminster report for further reading.

In this section, we explain the scope and objectives of the report; set out the scale of the opportunity for retrofitting Westminster's heritage building stock; and list the three most common typologies of heritage buildings.

86%

of Westminster's carbon emissions comes from the built environment

Westminster City Council (WCC) has declared a climate emergency. The local authority has pledged that the City Council's activities will be carbon neutral by 2030, with the wider city following suit by 2040: 10 years ahead of UK Government targets. As identified in the Council's 'Climate Emergency Action Plan'[1], the built environment is the leading contributor to carbon emissions – being responsible for 86% of Westminster's emissions.

Both the City Council and Westminster's property industry seek to deliver a Net Zero Carbon (NZC) built environment. This means maximising whole life carbon emission savings and responsibly offsetting any unavoidable emissions.

Upgrading heritage buildings to reach improved energy and sustainability standards is critical to achieve this ambition, as is climate change mitigation.

Westminster is home to an exceptional range, quality and number of historic buildings which contribute to the City's economy, character and environment. There are sensitivities to overcome when adapting heritage buildings. High upfront costs and sensitive navigation through planning policies are shared factors for the City Council and WPA members. To achieve a balance between heritage protection and climate resilience, creative collaboration between industry and the public sector is essential.

This research report identifies opportunities and proposes recommendations to enable Westminster's heritage buildings to play their part in reducing the carbon impact of Westminster's built environment in our shared fight against climate change – whilst enabling owners to protect and enhance their historic assets. It aims to build upon WCC's ambitious climate action strategy and policymaking, such as the draft Environmental Supplementary Planning Document(SPD)[2], and the existing advances towards these goals by WPA members.

The potential impact is huge. A recent paper[3] by Grosvenor Britain & Ireland showed that the energy efficiency opportunity of listed buildings and unlisted historic dwellings in conservation areas in England and Wales would equate to approximately 5% of the UK's total carbon emissions associated with the built environment.

This carbon saving opportunity is expected to be much higher in the City of Westminster, which has the highest concentration of listed buildings of any local English authority (after the City of London).

The report is aimed at two primary audiences: Westminster's property industry, represented by WPA members; and the policymakers and decisionmakers at Westminster City Council and Historic England. We would also welcome engagement and discussion of our ideas with a wider network of stakeholders, including local residents, businesses and other statutory bodies.

As the majority of WPA members are involved with commercial real estate, we have focused on these types of buildings – including older residential properties converted for offices, retail and hospitality uses. However, the large-scale upgrading of Westminster's housing stock will be necessary for achieving WCC's NZC ambitions, and so we have included a number of case studies and recommendations which apply to residential landlords.

Image: 119 Ebury Street

Opportunities and challenges for retrofitting Westminster's heritage

A
B
C

54%

54% of Westminster's buildings have an EPC (energy performance certificate)* rating of C or below: meaning these buildings require upgrades before 2028[A].

92%

***92% of non-domestic properties** and **48% of homes** have an EPC rating of C or below. This rises to 99% when looking at homes with a heritage listing[B]

4%

4% of the City's total building stock has an EPC rating of F or below: an energy performance rating so poor that residential properties can't be let - creating the risk of a 'stranded asset'[A]

81K

More than 81,000 buildings rely on gas boilers for heating. That equates to 18,800,000m2 of floorspace which requires switching to electric heating if we are to meet WCC's NZC ambitions[A]

7x

Westminster has the **highest number of listed buildings** of any London local authority: more than double that of closest borough (Camden) and almost seven times the London average[C]

per sqm

Westminster has the largest number of listed buildings per sq km **of any English local authority***[C]
*Excluding the City of London, which is a single square mile.

11k

Westminster has **11,000** listed buildings and structures[D]

56

56 conservation areas cover **78% of the City's footprint** [C]

86%

86% of Westminster's carbon emissions are produced from the energy used in our homes, hospitals, shops, offices, hotels and other buildings[E]

Sources

A: Analysis by Savills, based on a sample of 115,000 buildings across the City of Westminster
B: Analysis by Savills, based on a sample of 1,939 buildings across the City of Westminster (1,456 of which are domestic)
C: Historic England data analysed by WPA[4]
D: Westminster City Plan, 2019-2040[5]
E: Westminster City Council Climate Emergency Action Plan

* We acknowledge that EPCs are an imperfect measure and welcome new methodologies for understanding building performance.

Heritage typologies

In this paper we are defining heritage buildings as those which are listed, or are older properties within conservation areas. To help identify common issues and potential carbon saving measures for this research, Savills has set out the three most common typologies of heritage buildings in the City of Westminster. While a significant proportion of these properties were originally designed as housing, many will have been converted to commercial use.

Mid-18th Century townhouse

Example: Chandos House (Grade I listed); Harley Street Conservation Area

Unique challenge/opportunity

Loss of traditional windows is seen as a major threat by Historic England. Shutters can be reinstated for improving thermal performance.

Early to mid-19th Century townhouse

Example: 83-102 Eaton Square (Grade II* listed); Belgravia Conservation Area

Unique challenge

Improving the thermal performance of windows and roof.

Edwardian institutional and commercial

Example: 106-130 Regent Street (Grade II listed); Regent Street Conservation Area

Unique challenge

Retention of historic fabric and layout.

Common challenges

- Improving window performance
- Retrofitting/upgrading heating and electrical systems
- Installing appropriate renewable energy generation

Common opportunities

- Improving insulation
- Installing low energy lighting
- Considering air or ground source heat pumps for heating

There is a more detailed analysis of these typologies, including their unique challenges and opportunities for retrofit set out in Appendix A and a map of their geographic locations in Appendix B.

Unlocking delivery: Recommendations for property owners

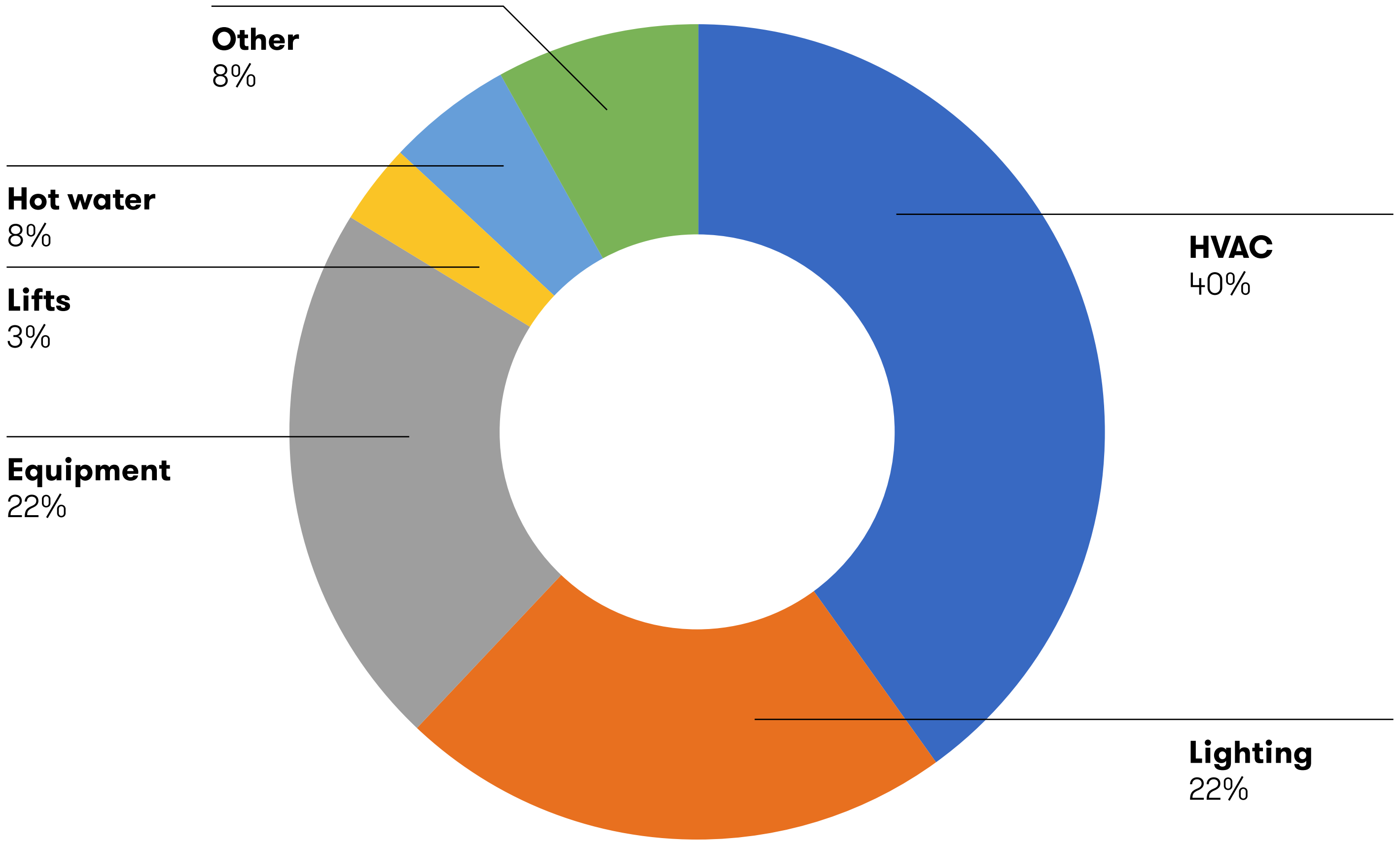
To help reduce the carbon emissions associated with Westminster's building stock, property owners should calculate the carbon footprint and establish NZC pathways for all their buildings that respond to their unique needs and opportunities – and ensure all future refurbishment opportunities align with a transition to NZC emissions. For further advice on this, see WPA's Zero Carbon Westminster[6] report and Better Buildings Partnership's Net Zero Carbon Pathway Framework[7].

The energy efficiency and sustainability of heritage buildings can be improved through a range of actions, from low-cost and 'light touch' interventions, through to a comprehensive or 'deep' retrofit. In addition, tenant engagement is vital if we are to make sure that retrofitted spaces are used efficiently and effectively. This will help avoid the so-called 'performance gap' between building design and use.

Following the previous analysis of the scale of the challenge, and an understanding of the most common building typologies in Westminster, we explore ways for landlords to 'unlock delivery'. This section of the report sets out recommendations for property owners to:

- As a first step, implement light touch retrofit measures taking into account the cost, level of disruption to the building, and improvement in energy efficiency. The 12 recommendations include 'easy wins' for landlords to reduce the emissions of heritage buildings across asset classes
- Consider lessons learned from six major adaptation projects in or near Westminster, which have successfully achieved a balance of heritage protection and significant environmental improvements. Strive for bold ambition that responds to the needs and opportunities of your historic buildings
- Engage more effectively with occupiers across four key touch-points in the building leasing process; encouraging behavioural change that improves a building's operational energy performance

Light touch interventions



This pie chart shows the typical breakdown of energy use* in a mixed-use office and retail building. As you can see, there is a relatively even split between heating and cooling (HVAC) and electrical loads (lighting and other equipment).

With this understanding, the following table sets out 12 low-cost interventions that can reduce energy and carbon emissions in a typical building focusing on lighting, heating and cooling. It also explores opportunities for building performance improvement through monitoring, and where appropriate, fabric interventions and other 'deeper' interventions.

The interventions have been selected by JLL and rated with a red, amber or green ranking to reflect their overall effectiveness in energy/carbon reduction relative to cost and ease of implementation.

Given the pace of technological change, where possible, any technology implemented into a building should be specified to have an 'open' API (Application Programming Interface) to allow the future integration of new technology that may assist in generating even greater energy and carbon savings. Property owners should follow a process of implementing measures that maximise the building's overall efficiency, for example, making improvements to the building fabric 'first' through insulation (where appropriate) before introducing new heating and cooling technologies.

A more detailed table including further technical information on the benefits and steps required for implementation is provided at Appendix C; there are recommended measures set out in WCC's draft Environmental SPD[8] and Historic England provides guidance as to whether or not interventions typically require listed building consent or not[9].

*The majority of this energy usage would be within a property's 'lettable space' e.g. retail units, workspaces, and meeting rooms. This makes occupier engagement and behavioural change (see section 3c) of utmost importance and should be prioritised alongside any physical interventions.

Light touch intervention	Typology	Impact	Ease of application	Cost*	Rating
Lighting					
Upgrade all internal lighting to LED	Commercial & residential	Up to 75% energy saving compared to older lighting systems.	Straightforward to implement in landlord areas. Occupiers incentivised to co-operate by reduced energy costs.	Low – average costs per LED bulb is around £15-£20 while LED tubes would be between £20-£30.	Cost effective relative to energy saving and simple to implement.
Install PIR sensors to control lighting	Predominantly commercial, but useful for residential common parts	5-30% energy saving - user dependent.	Easy to implement in Landlord areas. Building-wide approach will require occupier co-operation.	Average costs per PIR sensor circa £35-£150 depending on type and manufacturer.	Cost effective relative to energy saving, especially if implemented with lighting upgrade.
Monitoring					
Install Automated Meter Reader (AMR) on main incoming meters to allow use data to be collected.	Commercial & Residential	AMRs collect accurate energy data and can enable users to identify opportunities for energy reduction. E.g. turn systems off when not required.	Easy – can be implemented with minimal disruption.	Upgrading main (landlord) meters to AMRs would cost £500 - £1,000 per meter – some energy suppliers embed this into ongoing service.	Low expense for output – value of data in reducing energy use is high.
Install AMR sub-meters	Commercial & residential	Improves quality of data collection and provides a platform from which to engage with key stakeholders and occupiers.	Easy to implement on landlord main plant. Harder to implement in occupied areas, though potential energy costs savings is a useful incentive.	Submeters cost circa £350 -£500 depending on type and manufacturer.	Low expense, but ease of implementation depends on occupier co-operation. Higher quality data helps to drive further energy savings.
CO2 sensors Install on air handling units so fresh air is provided when required, rather than at all times.	Commercial – Not applicable for residential properties as it will not have an impact on energy efficiency.	Contributes to energy savings through operational optimisation and also makes this process simpler and more accurate.	Easy to implement on landlord main plant, but requires occupier co-operation for tenanted areas.	Cost per CO2 sensor is circa £250.	Provides higher accuracy in optimising system at relatively low cost – reduces energy use by providing fresh air when needed, rather than constantly, regardless of occupation levels.
Smart building platform Allows for BMS analytics	Commercial & Residential, though relies on property having BMS installed	Contributes to achieving the 5-20% savings produced by the above measures by maximising efficiency of systems.	Easy and can be implemented with minimal disruption, so long as existing BMS is in place.	Cost varies, but typically equates to circa £1.30 / m2. (annual licence cost) depending on which platform is used.	Smart building platforms are relatively cheap and can often be embedded into the service charge as it falls under improving building operation.
Building Energy Management Systems (BEMS analytics)	Commercial & Residential, though relies on property having a metering system installed	Contributes to achieving the 5-20% savings produced by the above measures by maximising efficiency of systems.	Easy and can be implemented with minimal disruption.	Costs depending on number of meters, and on average would be around £100-£200 per meter or supply (on going annual fee) depending on which platform is used.	Energy Management Systems are relatively cheap and can often be integrated into the property management agreement or service charge.

**All costs and rating have been evaluated based on return on investment and are based on an example asset of 25,000 m2 GLA. The costs presented do not include any tendering processes, design or consultancy fees

Light touch intervention	Typology	Impact	Ease of application	Cost	Rating
Heating & cooling					
Operational optimisation Optimising the BMS strategy to enhance the performance to HVAC systems, such as: Heating & Cooling Control Demand based Ventilation Control	Commercial	Up to 25-30% reduction in HVAC energy load.	Easy and can be implemented with minimal disruption.	Assuming BMS system is in place, cost is minimal given most adjustments can be implemented by M&E maintenance teams. However, software upgrade costs for Demand based ventilation and BMS strategies would be around £18,000 and £15,000, respectively.	Cost efficient and high level of energy saving potential.
Deeper retrofit interventions Can be considered if major refurbishment is some way off, or cannot be justified, as energy reduction can be significant, though costs tend to be higher.					
Air source heat pump Requires HVAC to be installed. Is the leading technology to replace gas fired systems.	Commercial – residential unlikely to be able to efficiently utilise within the report typology due to higher heating loads required.	Significant reduction in gas consumption, although this is replaced by an increase in electricity consumption.	Moderate to hard, dependent on existing infrastructure and pipework on site. This level of work strays into deeper retrofit/refurbishment territory, but may be applicable, depending upon asset strategy.	In comparison to other light touch interventions, the cost associated with installing a heat recovery unit and converting a chiller to act as a heat pump is high at around £6/m2.	High expense, likely not to be service charge recoverable. However, supports the move to asset electrification and energy reduction can be significant and tariffs may be reduced in the future. Can eliminate dependency on the use of natural gas and prepares the building to maximise the benefits of a de-carbonised power grid.
Upgrade sources of heating and cooling generation (non-ASHP)	Commercial & Residential	Modern day boilers & chillers are c. 20% more efficient than most older boilers.	Moderate, dependent on existing infrastructure on site.	The costs of replacing major plant can be expensive. If done on a like-for-like basis it can be service chargeable, though this may limit choice to less efficient heating and cooling systems, or prolong the use of fossil fuels.	The cost is moderate, but the energy saving benefits and energy bill savings can be significant. The payback period should be considered as it may be entirely justifiable to replace the heating system if costs are recouped within an acceptable time period. However, it is good practice to move away from fossil fuel reliant heating and cooling systems, in line with the government's Heat and Building Strategy 2021.
On-site renewable energy PV solar panels	Commercial	Typically can generate between 1-3% of total energy consumed on-site.	High – dependent on available roof space, much of which is typically taken up with HVAC plant.	Costs are relatively low in commercial office buildings due to limited availability of roof space and lower number of PV panels that can be installed. 1-2% of energy demand equates to a cost of circa £75,000.	Energy return relative to cost and difficulty in retrofitting to existing systems is prohibitive, however this is a requirement to achieve a Net Zero Carbon Building. Payback period is relatively long.
	Residential	Significant increase over commercial buildings – there is typically less roof space taken up by plant on residential buildings, allowing more PV panels to be fitted.	Moderate – dependent upon structural integrity of roof structure.	Costs relative to commercial will be significantly higher due to more space and number of PV panels that can be installed.	Quantum of energy produced is greater and therefore more viable. Payback period is more reasonable.
Fabric interventions – The energy saved by all the above interventions can be improved by undertaking fabric improvement works, though these may be restricted by planning regulations.					
Secondary glazing and fabric sealing	Commercial & Residential	High-performance secondary glazing systems, combined with fabric sealing, can reduce external noise levels by up to 80% and reduce heat loss by up to 65%. Energy savings of 5-20% can be made.	Moderate, as can be quite intrusive.	On average secondary window glazing could cost between £500 - £1,000 per window.	Moderately cost effective relative to energy savings and increase in insulation levels.

The ideal retrofit project would see the most of these interventions implemented. Many are complimentary and, utilised together, would maximise energy efficiency. However, as this may not be possible, the traffic light system identifies those that produce the highest energy and carbon savings compared to cost and ease of implementation (green), followed by those that are harder to justify individually, but play an important part in carbon reduction (amber and red).

For further reading, see the Better Building Partnership Responsible Property Management Toolkit.[10]

Lessons learned from deep retrofit

Comprehensive or deep retrofit often involves high up-front costs, detailed planning and attention to detail from the project team. However, the long-term benefits in terms of sustainability improvements, operational cost savings and creating a higher value asset suitable for a new generation of use, are indisputable.

In Appendix D, we have set out detailed case studies on six deep retrofit projects: two offices, two residential properties, one hotel and one mixed-use. As identified in an analysis of Westminster's typologies (see Appendix A), the most common heritage buildings are 18th and 19th Century townhouses, so four of the case studies are of this type.

We hope these case studies will provide useful examples for property owners, while acknowledging that each building should be considered on a case-by-case basis taking into account a building's unique needs and retrofitting opportunities.

Most of the measures in the case studies were voluntarily implemented by the owner and go well beyond minimum standards. This reflects the relatively low sustainability requirements of current national and local policies for these building categories, and the potential for much better performance if owners and policymakers work closer together.

Image: Regent Street

Case studies summary

2 Gloucester Place Mews
The Portman Estate

Use
Residential

Typology
19th Century mewshouse

Heritage status
Grade II listed, Portman Estate conservation area

Key measures
Various Passivhaus measure and a 'fabric first' approach. High level of thermal insulation with an intelligent airtight membrane and breathable plaster and paint; mechanical ventilation; triple glazing

Internal insulation, blinds, Air Source Heat Pumps, openable windows and whole-house ventilation have been installed to prevent overheating.

Carbon savings
76% reduction in operational carbon emissions compared to its pre-retrofit performance

Z Hotels, Gloucester Place
The Portman Estate

Use
Commercia – hotel

Typology
18th Century terrace

Heritage status
Grade II listed, Portman Estate conservation area

Key measures
Series of measures to ensure high levels of airtightness; substituting materials with materials for lower carbon alternatives

Carbon savings
Whole life carbon savings have been estimated at 1,200 TCO2e per property over 60 years

40-44 Pimlico Road
Grosvenor Britain & Ireland

Use
Mixed use – retail and residential

Typology
19th Century townhouse

Heritage status
Belgravia conservation area

Key measures
Various Passivhaus measures, including excellent level of airtightness and ventilation measures

Carbon savings
The apartments within the scheme use just a quarter of the overall heating demand of an average UK home

6/8 Greencoat Place
Derwent London

Use
Commercial – offices

Typology
19th Century Victorian institutional/commercial

Heritage status
Conservation area

Key measures
Decommissioning of old gas boilers and installing all electric services with high efficiency heat recovery air-conditioning, a low energy air source heat pump for water heating and LED lighting

Carbon savings
Significantly better embodied carbon savings than the best practice for new-build developments

34 Weymouth Street
Howard de Walden Estate

Use
Residential

Typology
Early 1900s/ Edwardian

Heritage status
Grade II listed, Harley Street conservation area

Key measures
Upgrading insultation to external walls; air source heat pumps; whole house ventilation

Carbon savings
Seeks to reduce operational carbon emissions by up to 94% through improved fabric performance and low carbon technologies

Holbein Gardens
Grosvenor Britain & Ireland

Use
Commercial – offices

Typology
1980s commercial

Heritage status
n/a

Key measures
Cross Laminated Timber and recycled materials; mixed-mode ventilation strategy; extensive greening and a blue roof

The key learnings from these case studies are:

1. Understand the business case

- When a lease comes to an end or a building is selected for redevelopment, property owners should use the opportunity to investigate what could be achieved through retention and adaptation taking a 'whole life carbon' approach

- This should include a robust assessment of the existing carbon footprint so that any carbon savings can be clearly measured

- Consider the positive steps to protect and enhance your heritage asset through retrofit. Older buildings will be given a new lease of life: re-purposing an inefficient and outdated building for a new generation of occupier; and mitigating the risks of climate change, such as over-heating and flooding

- To understand the business case and the building, compare the project's upfront costs, additional time and resources needed from the project team and budgeting for contingencies – with the longer-term benefits of creating a high quality and future-proofed asset with lower operational costs

- Low carbon buildings will be more aligned with emerging planning and other regulatory requirements from local, London and national government (see section 3c) – 'future proofing' the property and avoiding the physical risk, market risk and financial burden of a 'stranded asset'. Introducing a budget line fully dedicated to sustainability inputs and innovations allows for a clearer assessment of the business case

2. Get the project team right and start early

- Select a project team that has the experience and ambition to deliver the required balance between heritage protection and sustainability improvements, and avoid maladaptation. This can be a challenge, due to a general sustainability skills gap in the industry

- Embed sustainability and operational targets into the project brief from day one. Consider appointing a sustainability champion as advocated by institutions such as RIBA

- Data collection and analysis is required early on to calculate carbon assessments and compare against performance

- Attention to detail will be needed throughout the project: from its early design states through to monitoring and adaptation during construction and operations

3. Engage with WCC and Historic England

- Provide early evidence, demonstrating the specific sustainability challenges and opportunities of that building. This could include showing where building adaptations in recent decades can be upgraded without affecting genuinely historic features
- Demonstrate to the planning authorities how heritage protection is being taken into account
- Ensure all appropriate carbon saving interventions are thoroughly explored and justified. This may require creative solutions and flexibility from both the developer and the local authority
- Understand and use WCC policy guidance
- Understand and use Historic England guidance, such as the 'whole house' approach to traditional homes which considers the house as an energy system with interdependent parts
- In aiming for a NZC building, remove fossil fuel appliances and use carbon offsetting as a last resort

4. Implement both established and new solutions

- As a first step, use well-known and tested high impact 'light touch' interventions (recommended in the section above and Appendix C), such as LED lighting controlled by sensors
- Follow a process of implementing measures that maximise the building's overall efficiency, for example, making improvements to the building fabric first through insulation (where appropriate) before introducing new heating and cooling technologies
- Implement more creative and innovative measures that suit the unique needs and policy restraints of the building
- Wherever possible, introduce smart metering to understand and measure the impact and efficiency of low carbon solutions: helping the project team to close the 'performance gap' between design and operations
- Consider spatial changes to encourage tenant behavioural changes e.g. creating flexible spaces that can be used more efficiently by occupiers
- Specialist materials may need to be ordered early to avoid procurement delays and minimise the carbon footprint of the supply chain. Early engagement with your supply chain is recommended

5. Engage with your tenants and maintenance/facilities team

- Engage early to manage the occupiers' expectations (e.g. the need to open windows for natural ventilation), how to use technologies (e.g. mechanical ventilation, heat pumps), and explain the benefits of a more energy efficient and long-life building. Further idea on tenant engagement is provided below in section 3c

6. Learn and share

- Learn and share from the experiences of retrofit projects, especially when using innovative low carbon technologies. These can then be applied to an owner's wider portfolio and shared with other WPA members to speed up industry knowledge and help achieve the shared ambition of a NZC Westminster. Knowledge should also be sought and shared across boroughs
- Utilise the London Plan Guidance on 'Be Seen' post development monitoring and reporting

Image: One Heddon Place, The Crown Estate (photo credit: Philip Vile)

Behavioural change and occupier engagement

50% of a NZC building is achieved through its 'base building load' (i.e. its basic construction, roof and façade, mechanical and engineering systems and public spaces such as corridors). The remaining 50% relates to the 'tenant load': how lettable spaces are fitted out and used by occupiers.

It is therefore vital that tenants are informed and engaged with, to maximise the benefits of sustainability interventions in heritage buildings; improve their overall operational energy performance; and reduce the 'performance gap' between how a building is designed and actually used. This process takes time and effort from all parties, but is a low cost and extremely effective way to reduce the emissions from Westminster's built environment and ensure older buildings contribute to a NZC city.

There are four key touch points for the property owner, agent and occupier to engage and encourage behavioural changes. This sub-section explores those touch points and provides advice on how to engage with occupiers more effectively at each stage. Some of the key principles for property owners are:

- Engage early
- Communicate clearly
- Provide support
- Recognise and maintain the on-going relationship

Image: Regent Street

Marketing

Image: Carnaby Street

When marketing a space, property owners should set out their sustainability agenda to prospective occupiers. This is an opportunity to highlight the sustainability credentials of the base build and set expectations on retaining high performance within building certification schemes such as EPC and BREEAM. Guidance and requirements should be shared prior to a tenant taking occupancy so they are able to consider the information and ask questions before their focus shifts to other concerns.

Building Better Partnership (BBP) provides a toolkit[11] as a guide to sustainability for agents. It provides useful information on how sales and letting agents can advise occupiers and owners on the sustainability features of a building and how these influence costs and occupier requirements.

Recommendation	Detail
Explain net zero targets	Explain what is meant by NZC and the benefits to both the landlord and occupier
	Explain why tenant behaviour is an important part of achieving net zero (e.g. environmental impact, cost to the occupier, buildings falling short of potential)
	Set out expectations on maintaining sustainable building certifications (e.g. EPC, BREEAM)
Provide key building information	Provide relevant information about the building and equipment to ensure it is operated in a way that will maximise sustainability benefits and reduce emissions
	Provide operational handbooks (hard and digital copies), written in an accessible way and considerate of the reader's level of technical awareness
	Consider providing other information tools, such as videos, alongside handbooks
	Set out any relevant occupier behaviours required in estate regulations and other mandatory documents
	Set out limitations of changes: what occupiers can and cannot change within the space

Leasing

Leases are pivotal in the journey towards NZC, particularly for so-called 'Scope 3 emissions': where property owners can influence the carbon emissions in their supply chains via their tenants.

A standard lease does not always encourage meaningful behavioural change or spell out a pathway to NZC. However, a growing number of 'green leases' have introduced concepts for improved understanding and information exchange between the landlord and tenant – some of which are detailed below. The BBP's green lease toolkit[12] sets out a practical approach for developing sustainable lease clauses.

Where leases are already in place, a Memorandum of Understanding (MoU) can be used to create a shared sustainability roadmap for both parties.

Recommendation	Example	Detail
Incorporate green lease concepts into your lease structure	**Data collection**	Clarify what level of data amenity will be provided and who is responsible for what. For example, a combination of traditional formats (e.g. Excel spreadsheets) and smart building apps and metering allows both parties to interpret data better, faster and with more independence.
	Data sharing between landlord and tenant	Include data sharing clauses that cover several key metrics, such as: • Any energy sourced by tenants outside the service charge to ensure landlords account for this in their Scope 3 emissions • Collection of waste data • Any embodied carbon associated with tenant fit-out works (this could form part of the Licence to Alter agreement or included in an MoU to ensure low emissions)
		Establish and maintain a consistent, agreed upon format and collection frequency in relation to data sharing
	Building performance ratings	Introduce requirements to ensure efficient tenant fit-out and operation in order to achieve a strong rating in building performance schemes such as NABERS UK

Recommendation	Example	Detail
	Carbon offsets	Where carbon offsetting is required to achieve NZC (after operational and embodied carbon reductions), ensure that leases set out both parties' responsibilities. For example, there could be a clause regarding costs if offsets are associated with tenant emissions. Likewise, a tenant may wish to secure carbon offsets for their own corporate agenda, and it might be convenient to purchase these through the service charge.
Ensure changes are adopted consistently and communicated clearly	**Start early**	Communicate your lease structure's new sustainability measures at the earliest opportunity, starting with your agency and legal representation. As key stakeholders in the process, they should understand your ambition so they can support it throughout the process (i.e. starting from the presentation of Heads of Terms all the way through to execution of the lease). This will ensure transparency from the outset and reduce the risk of clauses being struck out due to a lack of understanding or clarity.
	Be clear	Take time to ensure the clarity of any new provisions, outputs and responsibilities. Both parties should understand exactly what is required, who is responsible for what and any likely financial implications and how they can be dealt with.
	Be consistent	To make the most of any improved measures, apply these consistently across leases and tenants.
	Support occupiers	Ensure the occupier has any necessary information and details about responsibilities – via a handbook or user guide – ahead of occupation to allow them to review and put into place appropriate management measures. This could also include in-person handover and demonstrations from the building management team. If internal resource/capability is available, include guidance on how a space can be operated efficiently (e.g. best practice energy and waste management techniques).

Fit-out

Buildings can have as many as 30-40 different fit-outs over their lifecycle, where the interior designs and furnishings are changed for the occupier. Each of these fit outs introduces a range of sustainability risks – such as increased embodied carbon by introducing new materials – and opportunities – such as improved lay out which supports lower energy use.

Responsibility for fit-outs (and, therefore, for ensuring the most sustainable outcomes in the fit-out process) depends on lease structures, occupier preference and the amount of space being leased. However, regardless of whether the landlord undertakes only a basic Cat A fit-out or provides a fully furnished, 'turnkey' offering, active collaboration between both parties is required to ensure NZC requirements are incorporated in the design.

A good starting point is the BBP's Responsible Fit-out Toolkit[13]. Though this is first and foremost aimed at office occupiers, a number of these principles are transferable to other uses.

Recommendation	Example	Detail
Incorporate green concepts into fit-out agreements with occupiers	**Scope**	Establish what is included in the scope and how this aligns with the definition of a NZC building. Where feasible, this should include and account for both the lifecycle embodied carbon of the fit-out and the building's operational performance.
	License to alter	Use this to review an occupier's fit-out. This should be read in conjunction with the lease to ensure compliance with any sustainability requirements. Also consider site supervision during fit-out to ensure any problems with the quality of the building are addressed and that good performance is not compromised in the process.
	Data	Agree what metering infrastructure is required to enable data sharing between the landlord and occupier.
	Design for efficient management and operation	Ensure plant is sized appropriately to reflect actual operations, agree relevant user controls and ensure that the right set points are identified.
	Set targets and ways to verify them	Agree operational performance targets with the occupier (e.g. energy use), alongside a process to continually verify that performance. This should include the use of relevant building performance ratings such as NABERS (or equivalent) and Post-Occupancy Evaluation (see Operation recommendations).
	End of use	Consider from the outset the end of use of the fit-out and/or tenancy to minimise waste. This could include the incorporation of circular design principles (e.g. disassembly, reconfiguration, reuse and recycling) or circular business approaches (e.g. servitisation and leasing)
Support occupiers in delivering green fit-outs	**Engage early**	Work with occupiers at the earliest opportunity to help shape the brief for the fit-out. Early engagement provides an opportunity to ensure that NZC requirements are integrated from the outset. The scope of the brief should look to cover not only the design, but also the construction, commissioning and handover of the fit-out
	Provide guidance	Give occupiers advice on how to maximise the sustainability performance of their building. This should factor in: • physical attributes of the space (e.g. size, layout, orientation) • occupier needs (e.g. layout, small power equipment, temperature controls) • operational performance (e.g. energy efficient lighting, HVAC) • procurement (e.g. advice on choosing the right contractor) • Guidance documents such as sustainability fit-out guides or certification scheme documents can be a useful way of providing information and frameworks to guide occupiers
	Handover and ongoing monitoring	Inspect any works once they are completed, and ensure that all as-built information is provided for the space

Operation

Landlords should establish an effective and supportive relationship with occupiers even if they have agreed stringent green leases. Failure to do so can result in the building's performance falling short of potential difficulties in collecting necessary information, and the risk of not being able to adapt to future legislative requirements.

Recommendation	Detail
Engage with tenants and set clear responsibilities	Identify key individuals, their roles and responsibilities and the frequency of meetings/reviews. For commercial tenancies, day-to-day contact with occupiers will often be through managing agents and building managers.
	Communicate with occupiers on a regular basis to discuss the operation of the building and conduct annual reviews. These should include a review of building performance (particularly in terms of any requirements set out in the lease) and an agreed action plan for the year ahead.
Carry out a Post-Occupancy Evaluation (POE)	This is the process of obtaining feedback about a building's in-use performance from the people who use and maintain it. POE is an important step in ensuring that a building is set up correctly and that periodic changes and improvements can be made throughout a tenancy.
Collate accurate and timely data	Having accurate data systems and metering will provide invaluable information for decision making on investments, disposals, refurbishments and redevelopments, ensuring both sustainable performance and value for money.
Carry out energy audits and provide technical support	Energy audits help identify potential improvements. Communicate these – and relevant actions – with tenants to encourage behaviour change, emphasising advantages such as potential cost savings. Occupiers may require technical support to implement any changes. The level of technical support will depend on the occupier and should be discussed at the initial meetings.
Consider regulatory changes	Consider any relevant regulatory requirements – such as ESOS or MEES – which may require information or action form the occupiers and plan for any future changes in those regulations.
Provide handbooks and operational guides	Ensure that important building information is easily accessible (in both hard and digital formats) and include contact information for managing agents and landlord. An operational guide should contain information about the building and its systems, but also expectations for reporting operational data. Since key personnel may change during the tenancy, a well written operational guide can support a smooth transfer of responsibility.

Planning policy and regulations: recommendations for policymakers and applicants

Despite the ambitions and actions by property owners to improve the sustainability of their heritage buildings, planning policy and regulation must be carefully considered to maximise the opportunity for historic buildings to help the fight against climate change.

This section of the report sets out a series of suggested changes that would help applicants adapt and upgrade their buildings, while protecting heritage assets from genuine harm. We recommend that:

- Applicants undertake a thorough assessment of their assets in advance of engagement with WCC and/or Historic England, to identify the most suitable retrofit pathways that maximise their sustainability enhancement while considering heritage implications
- Ensure WCC's new Environmental SPD robustly and positively encourages the retrofitting of historic buildings where it improves environmental performance, and that applicants have due regard to this and Historic England guidance at the start of the feasibility process
- Greater emphasis is given to sustainability improvements in planning decisions
- A sustainability champion is appointed within the planning department
- Training and CPD opportunities are provided for staff to raise awareness of the climate agenda and to ensure it is integrated across the organisation
- Applicants should engage early with Westminster City Council, and also Historic England where necessary
- Westminster's carbon offset fund is utilised for retrofitting historic buildings. Relevant information about the fund is made readily accessible to owners and other interested parties

Planning policy

With increasing scientific evidence of the impact of human activity on the climate and the need to urgently reduce carbon emissions[14], tackling climate change is now at the heart of adopted and emerging planning policy in England.

At the national level, paragraph 8 of the **National Planning Policy Framework (NPPF)[15]** states that sustainable development should include moving to a low carbon economy, and paragraph 152 provides that the planning system should support the transition to a low carbon future.

There is **National Planning Practice Guidance**[16] about mitigation and adaptation measures in the planning process to address the impacts of climate change.

The **London Plan[17]** requires major development proposals to be NZC and achieve a minimum on-site carbon reduction of at least 35% beyond 2013 building regulations. Where the zero-carbon target cannot be fully achieved on site, payments to a carbon offset fund or off-site delivery will be sought.

The **Westminster City Plan[18]** (2021) promotes zero carbon development in Policy 36 (Energy). Policy 38 (Design Principles) sets out guidance for sustainable design to enable the extended lifetime of buildings and spaces. Policy 39 (Heritage) seeks to secure the conservation and continued beneficial use of heritage assets through their retention and sensitive adaptation which will avoid harm to their significance, while allowing them to meet changing needs and mitigate and adapt to climate change.

The Knightsbridge Neighbourhood Plan (2018) includes a policy on retrofitting, albeit this is fairly high level, and the recently adopted Soho Neighbourhood Plan[19] includes 'refurbishment and retrofitting of existing buildings' (policy 21) which supports the adaptation of existing building stock to improve its sustainability credentials.*

Planning applications must of course be taken on a case-by-case basis, however clear policy provisions and guidance on the balance between sustainability and heritage impacts would provide more clarity to owners and developers of historic buildings. This guidance should be flexible enough to respond to new innovations, and respond to the unique challenges and opportunities of each building. It would also be helpful to have guidance collated in a centralised and accessible place, written in plain English and with clear summaries.

Westminster's current SPD (Retrofitting Historic Buildings for Sustainability (2013)) is outdated, and, therefore, the WPA welcomes – and has responded to – the City Council's consultation on an updated Environmental SPD[20]. This will be critical in providing guidance to the development industry and to landowners about the potential suitability of various retrofitting measures when working with heritage assets, including:

– Internal and external insulation
– Boiler upgrade
– Heating controls
– Micro Combined Heat and Power
– Ground source heat pumps
– Air source heat pumps
– Draughtproofing
– Glazed windows
– Solar thermal panels

Many of these measures were fundamental components of the case studies set out in this paper.

Historic England has also produced guidance on Energy Efficiency and Historic Buildings[21](2018); and Energy Efficiency and Traditional Homes[22] (2020) which helpfully encourages a 'whole house' approach.

All applicants should thoroughly review WCC's new SPD and Historic England's guidance in advance of entering pre-application discussions with either party.

As well as due consideration to policy guidance and flexible application, the WPA urges WCC to take action in two key areas relating to sustainability: change at the decision-making level to drive the climate agenda and effectively implement political and policy aspirations and undertaking improvements to the Westminster Carbon Offset Fund.

* Policy 21 of the Soho Neighbourhood Plan makes reference to adaptations to heritage assets, stating that adverse impacts must be carefully considered and justified. Whilst the policy indicates a cultural shift towards consideration of sustainability and heritage factors, it does not go as far as to set out the weight attributed to the sustainability benefits in decision-making.

Driving the agenda

Change at the decision-making level is required to drive the climate agenda and effectively implement political and policy aspirations for a net zero carbon Westminster. As case studies in this report demonstrate, a balance between sustainability and heritage is possible, and the City Council should continue to encourage more of this.

At the **2 Gloucester Place Mews** project, referenced in this paper, there was successful collaboration on heritage and sustainability enhancements to the property, with The Portman Estate retaining the original roof truss and suspended floor timbers and successfully integrating high performance 'fabric first' measures around these. The original timber sash windows had to be retained, so triple glazed secondary glazing was installed, which was sympathetic to the original sash windows and almost invisible from the street.

The application of planning policy is continuing to evolve and change, as illustrated by a residential development to a Grade II listed building in **Soho Square** , including significant sustainability enhancements, that was granted planning permission.

Image: Gloucester Place
Credit: Marylebone Journal

If WCC is to implement its sustainability agenda, it is critical that Development Management Decisions strike the right balance between sustainability and heritage impact. The WPA recommends the following measures to speed up this process:

- Utilise a sustainability champion so that the appropriate sustainability measures can be implemented immediately
- Upskill staff and embed sustainability knowledge and advice
- Encourage the applicant to undertake a detailed assessment of the property in advance of early engagement with Westminster City Council (and Historic England where necessary) to understand the most appropriate retrofit measures

Westminster's Carbon Offset Fund

As set out in The London Plan and the Westminster City Plan, major developments will be expected to make payments to a carbon offsetting fund where net zero cannot be delivered on-site. The carbon offset fund provides an opportunity for certain organisations and small and medium-sized businesses to apply for funds to enable local carbon saving activity.

However, the list of eligible applicants – as outlined in WCC's guidance (Westminster Carbon Offset Fund Guidance[23] (2020)) – does not explicitly include landlords, landowners and larger businesses, thus making the fund inaccessible to a large portion of interested parties which could enhance the carbon performance in Westminster's existing building stock and help meet the council's NZC ambitions.

We recommend that the City Council increases the profile and promotion of the carbon offset fund on its website. We would also recommend that it expands the eligibility pool of property owners as suitable candidates to apply for offset funds.

Image: Howard de Walden Estate

Conclusions

Westminster's heritage stock can play a leading role in the local fight against climate change. Property owners can significantly reduce the carbon impact of their stock by implementing a range of measures, from low cost and 'light touch' interventions, through to comprehensive retrofit projects.

Occupier education and engagement is also key to ensuring that older buildings are used efficiently to reduce unnecessary energy leakage, and that tenants effectively use new technologies and sustainable design.

However, the adaptation of listed buildings and older properties within conservation areas can be sensitive in heritage terms.

This paper calls for greater collaboration between Westminster's property sector, policymakers, and decision makers, to achieve a better balance between heritage protection and climate resilience. The WPA stands ready to work with partners across the private and public sectors to enable historic and older buildings to contribute to a Zero Carbon Westminster.

Image: London aerial

Glossary

Term	Meaning
AHU	Air handling units
AMR	Automated meter reading
Airtightness/air permeability	The measure of air leakage through a building's envelope or fabric
Base build	The basic construction elements of a building – also referred to as its 'shell and core.' It typically includes the core structure, roof and faced, mechanical and supply systems, and public circulation and fire egress areas such as lobbies, corridors, lifts and public stairs.
BBP	Better Building Partnership
BeMS	Building Energy Management System: used to monitor utility meters.
BMS	Building Management System: used to control and monitor energy generating and consuming plant
BREEAM	A widely used method of assessing, rating, and certifying the sustainability of buildings. The acronym stands for Building Research Establishment Environmental Assessment Method.
Building fabric	The components and materials that the building itself is made of, such as the walls, floors, roof, windows and doors
Circular economy principles	Keeping resources in use for as long as possible, extracting the maximum value from them while in use, then recovering and regenerating products and materials at the end their productive life. In simple terms, it can be explained as 'make, use, remake' as opposed to 'make, use, dispose'.
Conduction	The transfer of thermal energy through direct contact.
Convection	The transfer of thermal energy through the movement of a liquid or gas.
CW	Chilled water
Design for Performance/ NABERS UK	Design for Performance (DfP) is an initiative by Better Buildings Partnership to ensure new office developments deliver on their design intent. NABERS UK is an energy efficiency rating system for office usage launched by DfP in October 2020.
DHW	Domestic hot water
Embodied carbon	The total greenhouse gas emissions generated to produce a built asset or building. This includes emissions caused by extraction, manufacture/processing, transportation, and assembly of every product and element of that building.
EPC	Energy Performance Certificates: a UK energy efficiency rating system for buildings.
FCU	Fan coil unit

Term	Meaning
Heritage buildings	In this paper, we are defining heritage buildings as listed buildings and older properties within conservation areas
HVAC	Heating, Ventilation, and Air Conditioning: a building's heating and cooling system or systems.
LETI/LETI Pioneer Project	The London Energy Transformation Initiative (LETI) is a network of more than 1000 built environment professionals that are working together to put London on the path to a zero carbon future. A LETI Pioneer Project is any project with a net zero carbon KPI that is offered up to share knowledge between built environment professionals.
LTHW	Low temperature hot water
Maladaptation	Poor quality or ill thought-out retrofitting measures, that cause damage to heritage assets or do not deliver sufficient sustainability improvements
NZC/Net Zero Carbon	Both operational and embodied carbon emission savings (otherwise known as 'whole life' carbon) are maximised and any unavoidable emissions are offset
NPPF	National Planning Policy Framework: sets out Government's planning policies for England and how these are expected to be applied.
Occupancy profile	The way a building is used. Occupancy profiles are drawn up to predict the energy consumption pattern of a particular building. They can include predications about timings, heating, electricity, etc.
Operational carbon emissions	The carbon dioxide emissions produced during the operational or in-use phase of a building.
Operational optimisation	Running a building efficiently without compromising the air quality and occupant comfort, ensuring that most effective control strategies are in place with sufficient tools and resources to maintain its design objectives. Operational optimisation can be implemented through an asset enhancement plan.
Passivhaus/Passivhaus EnerPHit certification	A voluntary standard for energy efficiency in a building, which results in ultra-low energy buildings.
Performance gap	A disconnect between sustainability measures designed for a building and how it is used in practice.
PIR	Passive infra-red: used to detect motion or occupancy.

Term	Meaning
Scope 1,2,3 emissions	Greenhouse gas emissions are categorised into three groups or 'Scopes'. • Scope 1 covers direct emissions from owned or controlled sources • Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company • Scope 3 includes all other indirect emissions that occur in a company's value chain
Stranded asset	Assets at the end of their economic life, no longer able to earn an economic return as a result of changes associated with the transition to a low-carbon economy.
UKGBC	UK Green Building Council. UKGBC is a charity that represents the voice of more than 500 member organisations spanning the UK building sector in regards to sustainability.
UKPN	UK Power Networks: London's distribution network operator for electricity
VAV	Variable air volume
Whole house approach	Guidance from Historic England concerning traditional homes which considers the house as an 'energy system' with interdependent parts, each of which affects the performance of the entire property.
Whole house standards	A set of measures promoted by the British Standards Institution to assess energy efficiency in dwellings.
Whole life carbon	Considering operational ('in-use') as well as embodied carbon emissions together over a development's expected life cycle.
WCC	Westminster City Council: the local authority for the City of Westminster.

Image: Howard de Walden Estate

Building typology analysis

Appendix A

Mid-18th Century townhouse

Example: Chandos House (Grade I listed); Harley Street Conservation Area

Common features

Typical locations in Westminster

West End, St James's and Marylebone High Street wards (see map in Appendix A)

Architectural features

- Typically constructed to modest classical proportions
- Less ornamentation
- Axial symmetry, more simplistic façades.
- Portland stone cut into ashlar
- Sash windows, flat arches
- Rooftop cornice
- Classical porches: Doric, Ionic or Corinthian columns

Heritage protections

- Statutorily listed
- Typically feature within conservation areas

Construction methodologies

- Roof: timber trusses with secondary rafters, no internal roof lining. Dressed in Welsh slate, laid to either boarding or battens.
- Floors: constructed of timber above basement level, supported structurally by the external walls and timber stud partitions
- Some with vaulted basements, partially supported by piers
- 18-inch recessed roofs

How these buildings are used today

- Institutional
- Residential

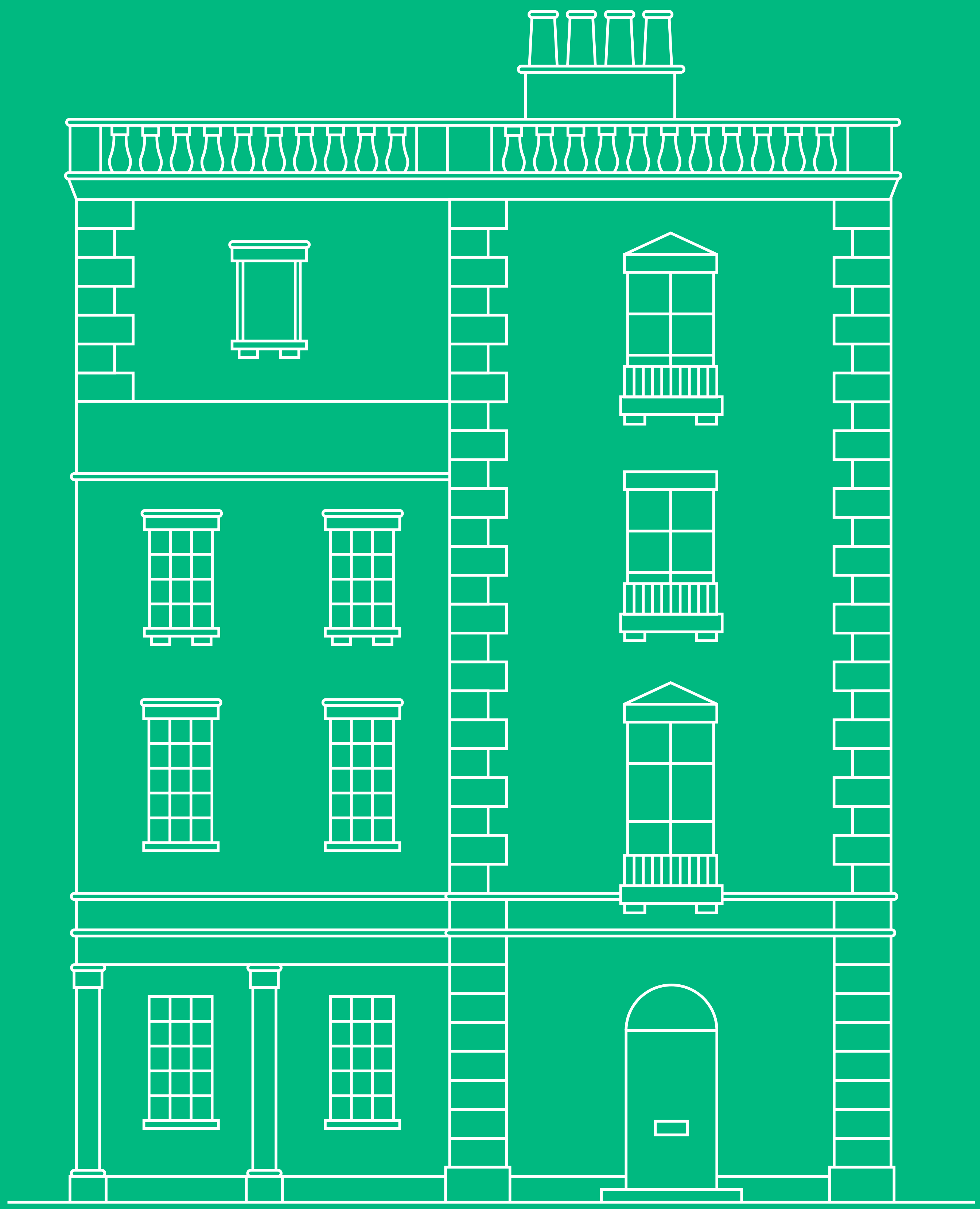
Opportunities and challenges for retrofitting

Challenges

- Retaining as much of the historic building fabric as possible
- Historic England considers a loss of traditional windows to be a major threat to heritage building, so building owners are likely to need to improve the thermal performance of existing windows
- Ensuring adequate ventilation

Opportunities

- Typical sensitive interventions can include:
  - Reinstating shutters, adding secondary glazing and thermal roller blinds on windows to improve energy performance and air permeability
  - Installing low use water fittings and low energy lighting
  - Insulating dormer windows
  - Installing Air Source Heat Pump or Ground Source Air Pumps for heating as part of a 'whole house' approach



Early to mid-19th Century townhouse

Example: 83-102 Eaton Square (Grade II* listed); Belgravia and Portman Estate Conservation Areas

Common features

Typical locations in Westminster

This is the most common type of heritage across the City, however large clusters can be found in Knightsbridge & Belgravia, Abbey Road, Regent's Park and Little Venice wards

Architectural features

- More overt adherence to classical architecture
- Often terraced
- Utilisation of brick or stucco
- Classical motifs on façades
- Façades features: sash windows, pediments, incised stucco, pilasters (Doric, Ionic, Corinthian)
- Quoins and rooftop balustrades

Heritage protections

- Statutorily listed
- Typically feature within conservation areas

Construction methodologies

- Roof: timber trusses with secondary rafters, no internal roof lining.
- Typically 18-inch solid wall, and recessed sash windows
- Dressed in Welsh slate, laid to either boarding or battens
- Floors: constructed of timber above basement level, supported structurally by the external walls and timber stud partitions
- Stairs: Originally constructed to hang from internal wall rafters

How these buildings are used today

- Institutional
- Residential

Opportunities and challenges for retrofitting

Challenges

- Improving the thermal performance of windows, walls and roof
- Identifying methods to outfit the buildings with sustainable power sources, examples may include solar panels and heat pumps
- Ensuring adequate ventilation

Opportunities

- Providing additional insulation over existing roof joists
- Following internal and external piping routes; may include re-lining of chimneys
- Considering Air Source Heat Pump for heating, although this system may be potentially visually intrusive within a conservation area and can cause noise issues and poorer performance during winter if fabric is not upgraded. The pump should be implemented along with measures to improve the building's fabric performance
- Considering Ground Source Heat Pump for heating: less visually intrusive, but may be harmful to material of archaeological value
- Addition of photo-voltaic (solar) panels
- Installing low use water fittings and low energy lighting
- Draught proofing of doors and windows
- Internal solid wall insulation in appropriate locations

Edwardian institutional and commercial

Example: 106-130 Regent Street (Grade II listed);
Regent Street Conservation Area

Common features

Typical locations in Westminster

West End and St James's wards, and to a lesser extent Marylebone High Street

Architectural features:

- Beaux-Arts style
- French neo-classical/Gothic/Renaissance
- Large ground floor shop frontages
- Pilasters, scrolled console brackets
- Mansard roofs
- Sculptural iconography
- Used principally for grand civic buildings

Heritage protections:

- Statutorily listed
- Typically feature within conservation areas

Construction methodologies:

- Typically steel framed
- Portland stone and brick closely packed around steel supports
- Mansard roof clad in slate with interlocking rafters
- Built to commercial scale with larger open plan ground floors, often with mezzanine
- Ground floor pilasters, arches and pilasters tailored to structural support as well as to subdivide shop windows

How these buildings are used today:

- Commercial
- Office
- Residential

Opportunities and challenges for retrofitting

Challenges

- Retention of historic fabric and layout through retrofitting process
- Retaining a suitable balance between air flow and insulation
- Identifying methods to outfit the buildings with sustainable power sources, examples may include solar panels
- Improving the thermal performance of windows
- Ensuring adequate ventilation

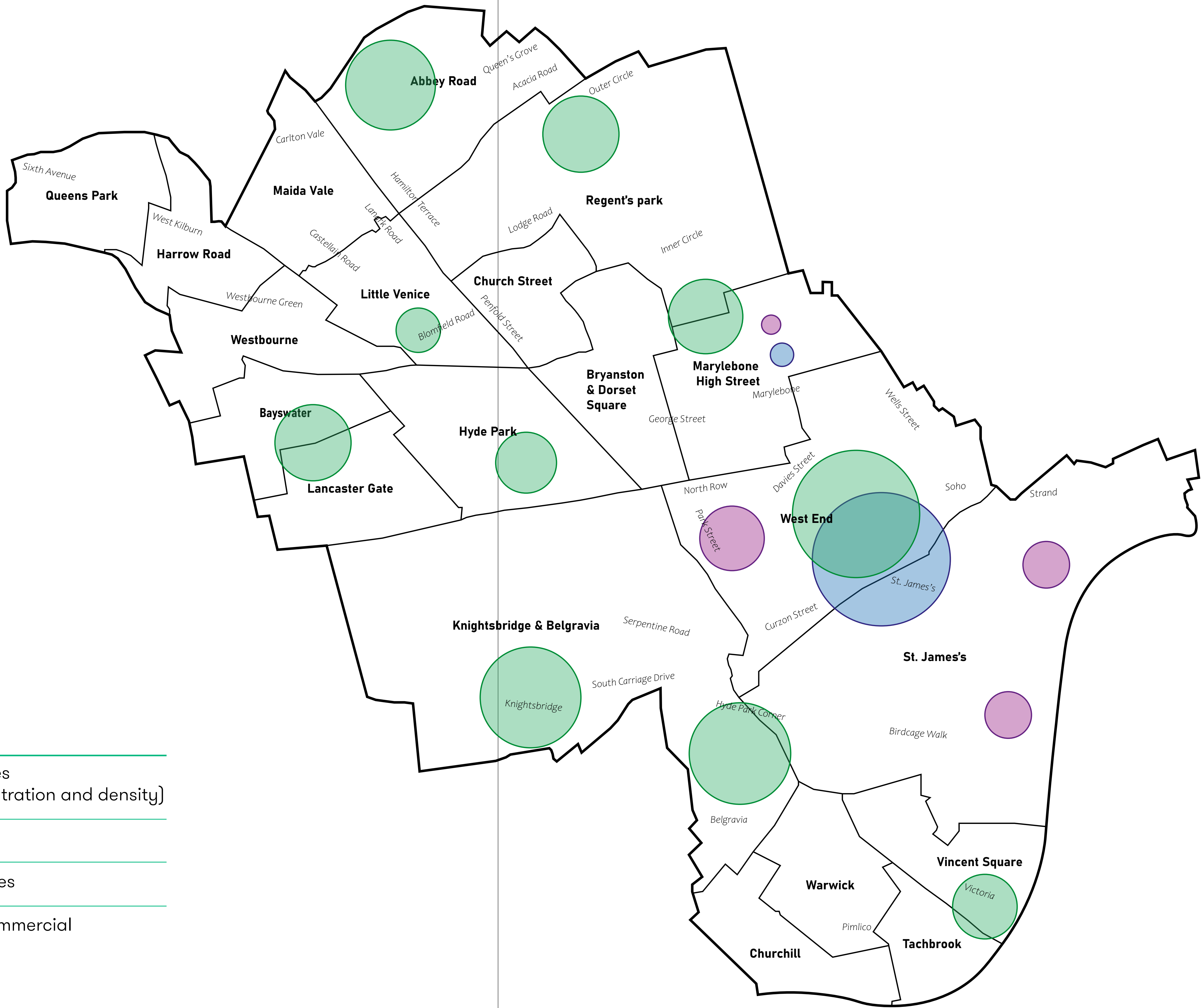
Opportunities

- Insulating walls
- Considering Air Source Heat Pump for heating, although this system may be potentially visually intrusive within a conservation area
- Considering Ground Source Heat Pump for heating: less visually intrusive, but may be harmful to material of archaeological value
- Addition of photo-voltaic sources (solar panels)

Appendix B

Mapping of heritage building typologies across the City of Westminster (created by Savills)

Mapping of heritage building typologies across the City of Westminster (created by Savills)



Selected examples of building typologies (Size of circle relates to building concentration and density)

Eighteenth century townhouses

Early-mid nineteenth century townhouses

Early Twentieth century institutional/commercial

Appendix C

Overview of light touch interventions - table of interventions and glossary of terms

Overview of light touch interventions - table of interventions and glossary of terms

Measure	Intervention name	What is the benefit of this measure/how to implement?	Impact	Cost	Ease of implementation	Service charge alignment (Y/N)
Lighting						
ECM1	Upgrade lighting to LED	LED lights are 75% more efficient than traditional lighting. Given that in a traditional office building, 20-25% of the energy use is associated with lighting this is a crucial upgrade if not implemented already.	LED lighting is 75% more efficient than traditional lighting	Cost will vary depending on the scope of work (i.e. L/L demise only or whole building approach)	Intrusive – depends on scope	Y
ECM2	Installation of PIR sensors to control the lighting	PIR sensors control lighting ensuring that lights are only in operation when there is a requirement (occupancy) and are switched off when not required. Given that in a traditional office building, 20-25% of the energy use is associated with lighting this is a crucial upgrade if not implemented already.	Between 5-30% depending on occupant behaviour.	Cost will vary depending on the scope of work (i.e. L/L demise only or whole building approach)	Intrusive – depends on scope	Y
Monitoring						
ECM3	Installation of AMRs to ensure that data is collected correctly	Where AMRs (HH meters) are not installed, it is highly recommended to do so as it supports the on-going monitoring of the building's performance against targets	The impact of installing AMRs may not be a direct ROI, rather improved visibility of data	The costs will vary depending on number of meters in the building	Intrusive – depends on scope	Y
ECM4	Install AMR sub-metres where possible	Installing sub-metering allows for more detailed analysis of energy use. As detailed in the approach tab, the vast majority of energy use in a building is not thermal related, therefore understanding the profiles and base-load of electricity use and consumption of any associated retail units is essential for a building truly to achieve Net Zero Carbon.	The impact of installing AMRs may not be a direct ROI, rather improved visibility of data breakdown and a platform to engage with key stakeholders/ occupants	The costs will vary depending on the size of asset and HVAC design	Intrusive – depends on scope	Y

Overview of light touch interventions - table of interventions and glossary of terms (continued)

Measure	Intervention name	What is the benefit of this measure/how to implement?	Impact	Cost	Ease of implementation	Service charge alignment (Y/N)
Plant						
ECM5	Operational Optimisation including: Heating & Cooling Control, Demand-based Ventilation Control and Building Management System (BMS) Optimisation	The benefits of this measure are broad and will differ asset by asset, however, generally the ratification required is: • Reducing operating time schedules of any Terminal unit installed in the asset (FCUs, VAVs, Chilled beams etc) to avoid operation during unoccupied periods; Avoiding excessive temperature set points through the application of limiters to the control strategy. Increasing the dead-band on any Terminal unit control strategy to increase the time period between heating and cooling modes of operation; and use of SMART platform to analyse data on an on-going basis to ensure the above interventions are maintained as detailed in the behaviour change tab. • Modification to AHU operation schedules, including optimum start/stop. • Night-time 'purging' to reduce internal temperatures during periods of high ambient temperature. • 'Hold-off' controls to prevent operation of the chillers when ambient temperatures fall below about 10°C. • Proportional control strategies to module plant output before the set-point is attained. • Demand control for dedicated ventilation systems such as toilets and kitchens. • Floating head-pressure control on the chillers. • Temperature compensation in the LTHW and CW circuits. • Setting of minimum ventilation requirements for weekends.	Approximately 25-30% reduction in HVAC load (not to double count with smart building solutions, as this only makes the process simpler).	Most of these interventions in theory can be carried out by the M&E teams, depending on their scope of work. There may be additional costs associated, but these will be minimal compared to the ROI.	Non-Intrusive	Y
ECM6	Install CO2 sensors to the air handling units so that they can run on demand when required	Where possible, installing CO2 sensors on the air handling units is recommended as it allows for more informed operation of the fans based on actual ventilation needs. (Room mounted sensors are often recommended over duct mounted sensors).	Contributes to savings above	The costs associated will vary depending on the size of asset and HVAC design (i.e. number of Air Handling Units)	Intrusive – depends on scope	N
ECM7	Air Handling Unit Heating	Depending on the number of chillers in an asset, there is, in some cases the opportunity to generate heat both from the condenser or compressor of one of the chillers or by operating a chiller as a heat pump. Although a detailed examination of the chillers is required, it is likely that they can be retrofitted such that at least one chiller can provide heat from the compressor and another can be made reversible. The latter would require the creation of a LTWH circuit by isolating the pipework from the modified chiller such that it could operate either as a chiller or heat pump.	Significant reduction in gas consumption (depending on age of plant), difficult to quantify without asset level information.	The costs associated will vary depending on the size of asset and HVAC design	Intrusive – depends on scope	N

Overview of light touch interventions - table of interventions and glossary of terms (continued)

Measure	Intervention name	What is the benefit of this measure/how to implement?	Impact	Cost	Ease of implementation	Service charge alignment (Y/N)
ECM8	Upgrade sources of heating and cooling generation	Depending on the age of the boilers and chillers, and their end-of life tag, replacement should be considered. This can be done on a like-for-like basis and go through the service charge. However for NZC a like-for-like replacement is not recommended, ensuring that the most efficient technology on the market is used and that alternatives are considered where appropriate such as GSHPs and/or complete electrification of assets.	Like-for-like scenario: Modern boilers have a co-efficient of efficiency of around 95% while older boilers have between 70-80% depending on age. Similar logic applies for chillers.	High cost. However, if done on a like-for-like basis it can go through service charge, for the purpose of this exercise this is not recommended	Intrusive – depends on scope	N/Y
ECM9	On-site renewable energy	On-site renewable energy is a crucial part of NZC, however in most office typology there is limited scope for on-site renewable energy generation due to space constraints	Typically, between 1-3% of total energy consumed on-site	The costs will vary, depending on the technology used, space available and size of asset	Intrusive – depends on scope	N
Behaviour change						
ECM10	Smart building platforms (BMS analytics)	BMS data analytics system allows the end user to see in real time the impact of their desired comfort conditions on the HVAC plant and subsequently the energy consumed by the plant. These systems can be used to identify operational anomalies and HVAC plant (mechanical, control and sensors) failure, changes to the design spec and unexpected operation. By having this kind of insight, the building management team can communicate with the occupants to educate and promote behavioural change.	In the region of 5-20%	Cost for a 25,000 m2 building varies from 20-40k depending on which platform is used	Non-Intrusive	Y
ECM11	Energy Management Systems (BeMS analytics)	BeMS systems allow the user to monitor the energy consumed on site through live monitoring on-site meters. The feasibility of these system are directly proportionate to the metering infrastructure on-site. However having insight and trends as to actual energy consumption and continuously looking at daily and monthly profiles to ensure anomalies are picked up and the source of high energy consumption is identified is crucial. By having this kind of insight, the building management team can communicate with the occupant to educate and promote behavioural change.	In the region of 5-20%	Costs depend on number of meters available and size of building	Non-Intrusive	Y

Overview of light touch interventions - table of interventions and glossary of terms (continued)

Measure	Intervention name	What is the benefit of this measure/how to implement?	Impact	Cost	Ease of implementation	Service charge alignment (Y/N)
Building fabric						
ECM12	Fabric interventions: secondary glazing and fabric sealing	**Secondary glazing intervention:** Secondary glazing is a fully independent window system installed to the room side of existing windows. The original windows remain in position in their original unaltered form. Secondary glazing is available as openable, removable or fixed units. The openable panels can be either side hung casements or horizontal or vertical sliding sashes. These allow access to the external window for cleaning and the opening of both the secondary glazing and external windows for ventilation. Fixed forms of secondary glazing are designed to be removed in warmer months when the thermal benefits are not required. Some of the benefits of secondary glazing are: Heat loss from a room through a window during the heating season is complex as three main mechanisms are in play: **Thermal benefits** • By convection and conduction, from the warm room air to the colder surfaces of the glass and the frame • By the colder surface of the window absorbing infra-red radiation from the room • By uncontrolled air leakage, which can either bring in cold air from the exterior or take warm air out from the interior; often called air infiltration, this can occur even when the window is closed **Heat loss through the glass and frames (cause of draught)** • Heat losses from a typical traditional window are predominantly through gaps around the window. With larger windows the proportion of heat lost by conduction through the glass tends to be greater. Since draughts, caused by convection and air infiltration make people feel colder, the occupants may turn up the heating and run it for longer. Purpose-made secondary windows with efficient perimeter sealing (to prevent condensation on the primary window) and brush or compression seals on the opening panels, form an effective seal over the whole of the frame of the original window and can significantly	High-performance frames can reduce external noise levels by up to 80% and reduce heat loss by up to 65% (this does not mean energy savings of 65%, a detailed analysis would be required to determine heat losses through windows to determine the impact, i.e. the 65% of hear loss reduction will apply to perhaps 5-20% of the cost and energy for space hearing)	On average secondary window glazing could cost between £100-£200. However this will vary depending on the size and complexity of the window, which could increase the given cost significantly. Total costs will therefore also depend on the total number of windows requiring upgrades	Intrusive – depends on scope and physical constraints (see measure description)	Y/N

Overview of light touch interventions - table of interventions and glossary of terms (continued)

Measure	Intervention name	What is the benefit of this measure/how to implement?	Impact	Cost	Ease of implementation	Service charge alignment (Y/N)
ECM12 (continued)		reduce excessive draughts. Before embarking on a programme of draughtproofing, think about a fan pressurisation test to find out the sources of air infiltration and determine which windows need attention as they can vary considerably in the amount of draughts, they let in. **Sealing interventions** As mentioned above, before the window intervention can be carried out, a survey must be conducted to determine the sources of air infiltration which will also provide the opportunity to identify any air leaking pockets in the building fabric which may require low cost sealing However, there are some physical constraints to consider in terms of applicability as secondary windows are usually located immediately inside the existing sashes or at a suitable position within the depth of the window reveal. A survey of the existing window opening by the specialist company will identify the limitations, for example whether there is sufficient depth in the reveal to locate the secondary glazing.				

Appendix D

Deep retrofit case studies

i. 2 Gloucester Place Mews, W1 by The Portman Estate

This 19th Century Grade II listed mews house sits in the Marylebone conservation area. An opportunity presented itself for The Portman Estate to fully refurbish, retrofit and adapt the property: testing what could be achieved with delivering Passivhaus standards in a heritage asset.

Completed in 2018, the project respected the historical fabric of 2 Gloucester Mews while creating an ultra-low energy home that minimised the use of fossil fuels and improved its residents' comfort.

Passivhaus principles are now being routinely deployed on other projects by The Portman Estate, ensuring an enduring and positive legacy.

Measures deployed

The measures deployed were 'whole-house'[24] and designed to achieve Passivhaus EnerPHit certification and BREEAM Excellent, including:

- A very high level of thermal insulation with an intelligent airtight membrane and breathable plaster and paint: ensuring that the historic fabric can manage moisture content as originally intended
- Mechanical ventilation with heat recovery
- LED lighting
- Triple glazed secondary glazing that remains fully openable, allowing the house to be naturally ventilated and preserving the aesthetic character of the original sash windows while providing excellent sound insulation adjacent to a busy road
- The retained single car garage was fitted with an electric vehicle charger

Performance

The property has achieved a 76% reduction in operational carbon emissions compared to its pre-retrofit performance, along with its predicted energy savings and reduction in gas consumption, resulting in no performance gap between designed and actual performance.

Image (opposite): Outside 2 Gloucester Place Mews, The Portman Estate

Cost savings

Capital value was improved due to the high-quality design and performance. The property surpassed its forecast estimated rental value.

The home achieved a 75% reduction in gas consumption compared to the original property, resulting in reduced energy bills for the occupant.

Lessons learned

- Early engagement with WCC via a pre-application was useful to understand the council's views and priorities for the property.
- Passivhaus may not be suitable for properties that have an irregular form and shape, where there would be a high volume of bespoke and complex details to insulate and make airtight.
- The project team was selected based on its previous experience of other Passivhaus projects and enthusiasm to learn. This mitigated issues that could have arisen with an inexperienced team.
- Educating the team on the aspiration was important. The site manager doubled-up as the airtightness champion which was a positive benefit and ensured quality was maintained.
- Additional contingencies are recommended in order to deliver the high airtightness standards to budget, and allow for testing and tracing of air leakage during the construction stage.
- Specialist materials should be ordered as early as possible to avoid any procurement delays and the embodied carbon footprint of materials e.g. triple glazing should be measured to ensure that overall whole life carbon savings are maximised.
- It is recommended that occupants' expectations are managed and it is explained that the house will still require windows to be opened to allow for natural ventilation, particularly in summer. Traditional measures to limit solar gain, such as blinds and curtains, should be deployed to avoid overheating during hotter weather.
- Mechanical Ventilation and Heat Recovery systems (MVHR) should also not be confused with mechanical cooling and set to constant or left in boost modes. Occupier training is required.
- Maintenance and repairs need to be planned and carried out thoughtfully to avoid compromises to performance and Passivhaus certification. It is also beneficial for facilities managers to be briefed and to remain in contact with the design team to answer any questions from occupants that may arise from time to time.

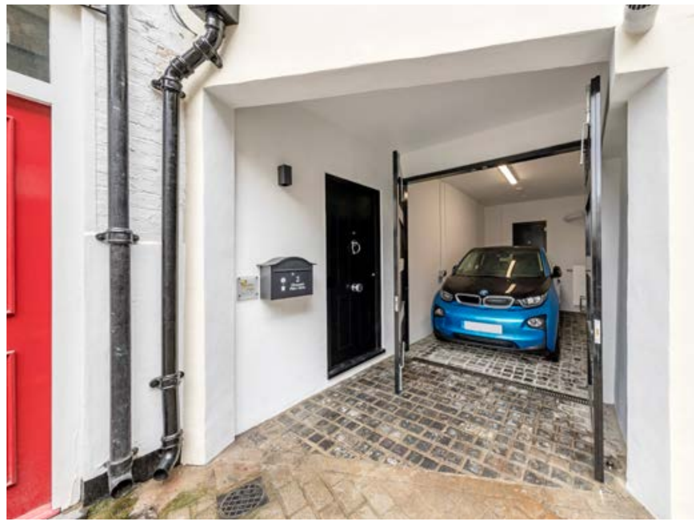
- Though the property utilised a traditional high efficiency gas condensing boiler to provide heating and hot water, the high level of thermal insulation and controlled air permeability should improve the efficacy of an all-electric system which the estate will consider installing the next time the property is fully refurbished and technologies have improved.

Project data

Year of Building Construction	1800	**Structure Retained (%)**	Circa 75%
Year of Retrofit/ Refurbishment	2018	**Building Use**	Residential
Listed Status	II	**Conservation Area?**	Yes
Renewables Incorporated	No (not possible)	**Primary Heating/DHW Fuel**	Gas boiler and radiators

Image (below right): Electric car charging point in the garage

Image (below left): Home interior.



ii. 23, 33, 51-55 and 87 Gloucester Place, W1 by The Portman Estate

The Z Hotels scheme on Gloucester Place is made up of a number of Grade II listed traditional Georgian townhouses. The renovation project started with an extensive whole life carbon impact study by architects Feilden+Mawson in collaboration with a specialist carbon consultant. Airtightness targets were set to minimise energy use, embodied and operational carbon emissions.

As well as the planning constraints from the building's listed status, in the form of original lime and fibrous plaster internal finishes, the nature of its occupier (a hotel scheme) carried additional challenges – such as the need for very high-quality finishes and increased hot water demand.

Completed in 2015, the project by The Portman Estate has successfully delivered a high-quality hotel with a comfortable guest experience while minimising the environmental impact of this historic asset.

Measures deployed

Achieving high levels of airtightness was a key feature of the scheme and was achieved by:

- Ensuring a continuous airtightness layer to the building's envelope by using airtightness tapes to seal joints and gaps between floor, wall and window junctions
- Well-fitted secondary glazing
- A vapour permeable membrane behind insulation, floors and ceilings
- Traditional draught-proofing measures on doors and loft hatches

Other measures included

- Substituting common materials for lower carbon alternatives with recycled content
- Maximising the use of timber materials where possible e.g. partition walls and floor build-ups
- Using wood fibre insulation to insulate external walls where possible
- High efficiency condensing boilers designed to meet the inevitably high hot water demand of a modern hotel
- Using LED and low energy lighting throughout the building

Performance

The results of the airtightness and draught proofing measures improved the air permeability to between 5 and 8 m3/h.m2 @ 50Pa. which is an approximate five-to-tenfold improvement over the building's pre-refurbishment condition.

The whole life carbon savings have been estimated at 1,200 TCO2e per property over 60 years, equivalent to a circa 25% reduction over the baseline model.

Cost savings

Through the improved performance of the building fabric, energy bills have been significantly reduced compared to a traditional Georgian townhouse property.

The durability of the finishes reduces the frequency of replacement which reduces operational costs and room void periods.

Lessons learned

Being one of the estate's first major projects to address building fabric performance in a listed building, the team have taken a number of recommendations forward for future projects:

- From the design stage all elements of the project required an attention to detail from the project team above normal levels e.g. investigating the maintenance life-cycles and product durability of building materials.
- Using the existing wall plaster as an airtightness layer negated the need for a membrane. Some air leakage were detected where it was difficult to obtain full coverage in small, hard to reach areas e.g. behind existing panelling or within floor voids. Very good results were obtained despite this, demonstrating that the measures were worthwhile.
- An airtightness strategy should be introduced as early as possible into the client brief so that the additional requirements can be factored into the cost plan and programme.
- Due to the high hot water demand at peak times, a fossil fuel-free domestic hot water solution was not viable. As low carbon technologies improve, the estate will explore alternative options to provide reliable domestic hot water at the end of the existing plant's lifecycle.

Project data

Year of Building Construction	1800	**Structure Retained (%)**	Circa 75%
Year of Retrofit/ Refurbishment	2015	**Building Use**	Hotel
Listed Status	II	**Conservation Area?**	Yes
Renewables Incorporated	No (not possible)	**Primary Heating/DHW Fuel**	Electric/ Gas boiler for DHW

iii. 40-44 Pimlico Road, SW1W by Grosvenor Britain & Ireland

40-44 Pimlico Road is a mixed-use residential and retail development, which retained the façades of the original 1860s building with new construction behind.

The completed scheme includes two retail units with six Passivhaus homes

Due to the high specification of the building's envelope and low air changes per hour, the air quality inside the property is significantly better than externally. This has a second added benefit of improving sound-proofing on the busy road, increasing occupier wellbeing.

Lessons learned from achieving such high standards have been used to inform Grosvenor's wider retrofit programme.

Measures deployed

- Good levels of insulation with minimal thermal bridges
- Passive solar gains and internal heat sources
- Excellent level of airtightness
- Good indoor air quality, provided by a whole house mechanical ventilation system with highly efficient heat recovery
- High performing Passivhaus sliding sash windows

Performance

- The design achieved Passivhaus (Low Energy) Certification
- PHI Low Energy Building

Cost savings

The apartments within the scheme use just a quarter of the overall heating demand of an average UK home.

Lessons learned

Achieving the required level of airtightness was challenging and as a result, future projects will allow time for additional testing and accountability for airtightness will be set out clearly in contracts.

Project data

EPC Rating	B	**Heating Demand kWh/m²**	24
		Primary Energy Demand kWh/m²	120
		Embodied Carbon (kgCO2/m²)	Not measured
Passivhaus Certified	Yes	**Embodied Carbon (% saving)**	Not measured
Year of Building Construction	2017	**Structure Retained (%)**	Circa 30%
Year of Retrofit/ Refurbishment	n/a	**Building Use**	Resi/retail
Listed Status	None	**Conservation Area?**	Yes
Renewables Incorporated	PV panels	**Primary Heating/DHW Fuel**	Gas

iv. 6/8 Greencoat Place, SW1 by Derwent London

This Derwent London project involved a comprehensive refurbishment of a six-storey former Victorian warehouse in Victoria, creating 32,000 sq ft of high-quality workspace. Designed with Squire & Partners, the renovated building celebrates its original character while repurposing it for the next generation of use.

Many of the original features of the building have been retained and preserved, while delivering new office and reception areas. 6/8 Greencoat Place was completed in June 2021 and has been fully let to the flexible workspace provider Fora.

Measures deployed

- Focusing on retention and refurbishment of the original building features throughout, including the decorative fish and meat hall glazed timber lantern roof lights, vaulted ceilings, cast iron columns, basement vaults and internal Victorian brickwork.
- Installing air handling plant with improved specific fan power to reduce the energy losses through the ventilation systems.
- Enhancing building's energy performance through the installation of new black-framed double-glazed windows, while maintaining the good levels of natural daylight of the original building.
- Further enhancing the building's energy performance through the installation of new black framed double-glazed windows.
- Installing new cycle facilities to encourage sustainable forms of transport.

Performance

Using an internal embodied carbon calculator tool Derwent London's sustainability team could assess and manage embodied carbon in the design, with the project resulting in total upfront carbon of 800TCO2 and Carbon Intensity of 200kgCO2/m2: significantly better than the best practice for new build developments.

The service upgrades outlined above have improved the building's EPC rating from E to B. Operational energy reductions will be measured year-on-year.

Cost savings

The upgrade in building services and more energy efficient plant will reduce power consumption and operating costs. With the transition to a refrigerant based heating and cooling solution, the building no longer incurs the water treatment costs associated with the previous water-based heating and cooling systems.

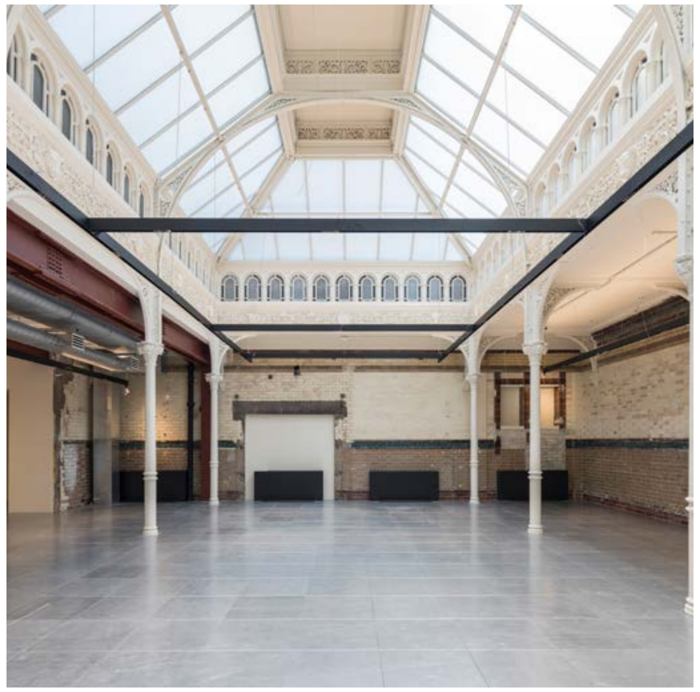
Lessons learned

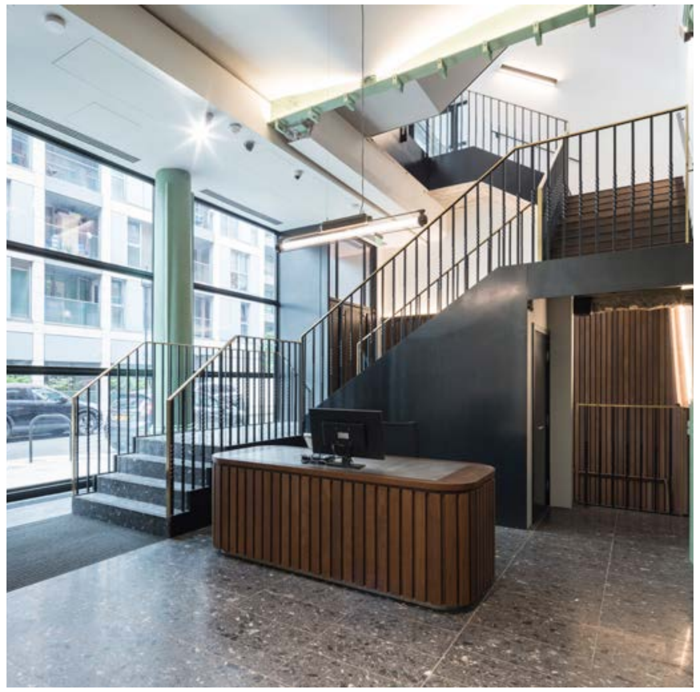
- Working with historic buildings will always have challenges. Undertaking early investigations and surveys was important to understand any possible surprises that could affect the scheme.
- Being one of Derwent London's first retrofit to go through an all electrification process, it was necessary to have early engagement with UKPN to ensure programme targets could be met.
- Enhanced information from the project team was required at an earlier stage in calculating the embodied carbon assessments.
- The all-electrification strategy was well suited to this building, and the removal of boilers created additional plant space.
- Planning permission was required for replacing the old single glazed windows with openable doubled glazed windows throughout. A balance was required in terms of the level of tinting (g Values) on these windows, while ensuring good natural light, user experience, and aesthetics.

Project data

EPC Rating	B	**Energy In-Use (kWh/m².a)**	104*
		Operational Carbon (kgCO2/m².a)	29.461*
		Operational Carbon (% saving)	64%*
		Embodied Carbon (kgCO2/m²)	200
		Embodied Carbon (% saving)	Not measured
Year of Building Construction	c.1900/1950s	**Structure Retained (%)**	100%
Year of Retrofit/ Refurbishment	2021	**Building Use**	Office
Listed Status	No	**Conservation Area?**	Yes
Renewables Incorporated	No	**Primary Heating/DHW Fuel**	Electric

* Predicted data





v. 34 Weymouth Street, W1 by Howard de Walden Estate

The Howard de Walden Estate has undertaken an extensive refurbishment of this Grade II house from the early 20th Century, which sits within the Harley Street Conservation Area. The project has preserved the building's historic features, while delivering a step-change in its carbon emissions and indoor air quality by using the latest available mechanical and electrical plant and technologies.

The single-family property had not been updated for some time and due to the opportunity of a lease expiry, the estate was able to take back the building and investigate ways to update and modernise it, while seeking to create a more sustainable and future-proofed building.

As well as preserving the building's heritage by maintaining features such as historic fireplaces and joinery, the refurbishment has sought to reduce operational carbon emissions by up to 94% through improved fabric performance and low carbon technologies.

Measures deployed

While seeking to reduce carbon emissions, the estate has achieved a delicate balance of maintaining the historic integrity of the building while working with WCC to create a policy-compliant scheme.

Approved measures included

- Upgrading insulation to external walls, between floors and introducing a new insulated floor slab
- Fitting new single glazed windows throughout the building along with new secondary glazing
- Replacing a gas fired boiler system with a new air source heat pump: providing comfort cooling, heating and domestic hot water. The heating and cooling systems are fully programmable alongside smart metering
- Introducing whole house ventilation with high efficiency filters and heat recovery
- Insulating pipework and ductwork
- Using new LED lighting and energy efficient appliances
- Creating a green roof

Lessons learned

It was a challenge to agree planning consent for incorporating the larger piping, ductwork and servicing associated with installing the air source heat pump, ventilation and heat recovery systems. New building services were therefore selectively installed to bathrooms and central areas of the house to feed adjoining rooms – preserving the original ceiling heights across the building and maintaining its historic character and proportions.

Project data

EPC Rating	C	**Energy In-Use (kWh/m².a)**	n/a
		Operational Carbon (kgCO2/m².a)	n/a
		Operational Carbon (% saving)	94% predicted saving
		Embodied Carbon (% saving)	Unquantified
Year of Building Construction	1908	**Structure Retained (%)**	75% (approx.)
Year of Retrofit/ Refurbishment	2021	**Building Use**	Residential
Listed Status	Grade II	**Conservation Area?**	Yes
Renewables Incorporated	ASHP	**Primary Heating/DHW Fuel**	Electricity

vi. Holbein Gardens, SW1W by Grosvenor Britain & Ireland

Grosvenor's vision for Holbein Gardens is to create one of London's most sustainable office buildings. The project is committed to achieving a Net Zero Carbon construction status, and will be one of the first commercial refurbishments in the UK that aligns with the Better Building Partnership's Design for Performance Initiative[25].

Planning permission has been granted by the Royal Borough of Kensington & Chelsea for the partial redevelopment and one-storey extension of this 1980s office building off Sloane Square, while retaining the original building's façade and four-storey structure. Designed by Barr Gazetas, the refurbishment project has an emphasis on integrating new into old and circular economy principles, while creating a 25,000 sq ft of modern and highly sustainable workplace.

Measures deployed

All contractors and advisors on the project have been challenged to help Grosvenor deliver against its goals of achieving Net Zero Carbon, zero waste and a significant biodiversity gain.

As well as minimising embodied carbon through the retention of much of the original building, the project uses some of the industry's most innovative sustainable products, including:

- Cross Laminated Timber for extended floors and walls
- Reclaimed steelwork reused from other Grosvenor projects
- Reclaimed brickwork
- Mixed-mode ventilation strategy: using a combination of natural ventilation from windows and mechanical systems for air distribution equipment and cooling
- A blue roof to mitigate localised flood risk
- Titanium dioxide roof tiles that absorb pollution from the air
- Cork wall finishes
- Air purifying paint
- All-electric heating and cooling systems
- Extensive greening across the external façade and within the building's reception

Performance

- An early whole life carbon assessment minimised upfront embodied carbon, meaning the development will exceed the LETI Pioneer Project embodied carbon target of 500kgCO2/m2 and contribute to Grosvenor's goal for Net Zero operational carbon by 2030
- The design has a 74% operational carbon saving against a typical office building
- Façade retention will save 39% embodied carbon compared to a new façade solution, equivalent to 59 tonnes of concrete
- An all-electric clean energy supply enables the scheme to be Net Zero operational carbon by 2030, and 99.95% of strip-out waste has been diverted from landfill, surpassing best practice

Cost savings

Through the retention of the existing structure, the construction costs have been significantly reduced. The careful selection of sustainable materials such as Terrazzo and Cork are often more cost effective than the more commonly adopted material finishes.

Lessons learned

Over the course of the design process, the project team have made a number of key observations which should be adopted for projects going forward, namely:

- Embedding sustainability and operational targets into the project brief from day one
- Seeking to implement peer reviews at each design using third parties which specialise in sustainability
- Engaging with sub-contractors and the supply chain from an early stage to gain an understanding of any new pioneering projects
- Ensuring the consultant team is aligned with the sustainability aspirations for the project
- Introducing a budget line fully dedicated to sustainability inputs and innovations

Project data

EPC Rating	B*	**Energy In-Use (kWh/m².a)**	89-94*
BREEAM Rating	Outstanding*	**Operational Carbon (kgCO2/m².a)**	21-22*
WELL Certification	Gold V2*	**Operational Carbon (% saving)**	74%*
		Embodied Carbon (kgCO2/m²)	350*
		Embodied Carbon (% saving)	39*
Year of Building Construction	1981	**Structure Retained (%)**	TBC
Year of Retrofit/ Refurbishment	2021	**Building Use**	Office
Listed Status	Not listed	**Conservation Area?**	No
Renewables Incorporated	PVs /ASHP	**Primary Heating/DHW Fuel**	Electric

*Predicted data

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