



Architecture | Interiors | Consultancy

Retrofitting 19th Century Homes

A Practical Guide to Low-Energy Retrofit

How these Victorian townhouse retrofit projects balanced heritage, breathability and high-performance living.

Featuring:

- RetroPHit House
- The Old Timberyard

Real projects, measured outcomes, practical lessons.

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Modernist EnerPHit

RetroPHit House



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1 What is the Purpose of This Guide?

This white paper brings together technical detail and architectural insight. It examines the challenges of retrofitting Victorian buildings, the building physics that inform retrofit decisions, and the measured performance outcomes. It provides a practical model for professionals working under the combined pressures of conservation and decarbonisation, demonstrating how careful, evidence-based retrofit can significantly improve the performance of even the most challenging homes.

The UK's route to net zero depends heavily on improving Victorian housing. Homes built in the 19th century are among the most difficult to upgrade. Whilst their

structures are often robust, they typically perform poorly in thermal terms, have often been altered over time, and are frequently located within conservation areas where changes to their external appearance are restricted.

Our featured projects, RetroPHit House and The Old Timberyard, show how these challenges can be addressed. Both projects achieved high levels of energy performance despite restrictions on external insulation, visible renewable technologies, and changes to the façade. By following a carefully planned and sequenced retrofit strategy, each project achieved Passivhaus Low Energy Building performance while preserving the building's original character.

This guide is for:

+ **Homeowners** upgrading Victorian homes, navigating planning and energy requirements, even in protected estates, such as the Dulwich Estate.

+ **Built environment professionals** including architects, surveyors and energy consultants working on retrofit projects in conservation settings.

+ **Contractors and suppliers**

involved in delivering retrofit works and advising on materials and systems.

+ **Planning, conservation and building control** officers responsible for assessing and approving retrofit proposals.



2 Why Victorian Homes Need Retrofitting



RetroPHit House,
Before: draughty single
glazed windows + Uninsulated solid
brick walls

Built long before modern energy standards, Victorian townhouses lose heat quickly, suffer from draughts and often rely on inefficient heating systems. Their solid brick walls were designed to manage moisture naturally rather than provide insulation, making retrofit more complex than in modern homes.

Today, these homes face several retrofit challenges, including uninsulated solid walls, hidden air leakage, thermal bridging, poorly performing sash windows and heritage constraints that limit external alterations. Any upgrade must improve performance while protecting the building's historic fabric and breathability.

Despite these challenges, Victorian homes are durable, adaptable and built to last. Retrofitting them reduces operational carbon, preserves embodied carbon and helps safeguard the character of historic neighbourhoods.

Most of the UK's historic housing stock will still be standing in 2050. Improving these buildings is essential to meeting climate targets while creating healthier, more comfortable homes.

BEFORE RETROFIT	AFTER RETROFIT
Uninsulated solid brick walls	Lower energy bills
Air leakage through floors	Improved comfort
Thermal bridging at junctions	Better air quality
Single-glazed sash windows	Reduced carbon emissions
High heating demand and energy bills	Increased resilience to rising energy costs
Cold surfaces and draughts	
Poor indoor air quality	Preservation of architectural character

What is PHPP modelling?

PHPP (Passive House Planning Package) is a detailed energy modelling tool that helps designers make informed decisions by identifying priorities, evaluating trade-offs and verifying building performance. It provides a clear picture of a building's energy performance.

These challenges shaped every aspect of the Victorian townhouse retrofit. PHPP modelling showed that without carefully designed internal insulation, improved airtightness, thermal bridge mitigation and a coordinated ventilation and heating strategy, the home would remain energy-intensive, uncomfortable and at risk of moisture problems.

3 Case Study: RetroPHit House



RetroPHit House
Before



RetroPHit House,
before: poor indoor
air quality

RetroPHit House is a deep retrofit of an 1840s Georgian terrace, demonstrating how a protected historic building can achieve EnerPHit-level performance through a conservation-led approach. The project retained the building's historic character while significantly improving comfort, energy efficiency and indoor air quality. Breathable materials, high-performance sash windows, comprehensive MVHR and rigorous PHPP modelling created a resilient, low-energy home without altering the street-facing façade.

Large reduction in energy use

Heavy reduction in carbon emissions

Air source heat pump

MVHR ventilation system

Double glazing and airtight construction



RetroPHit House
After

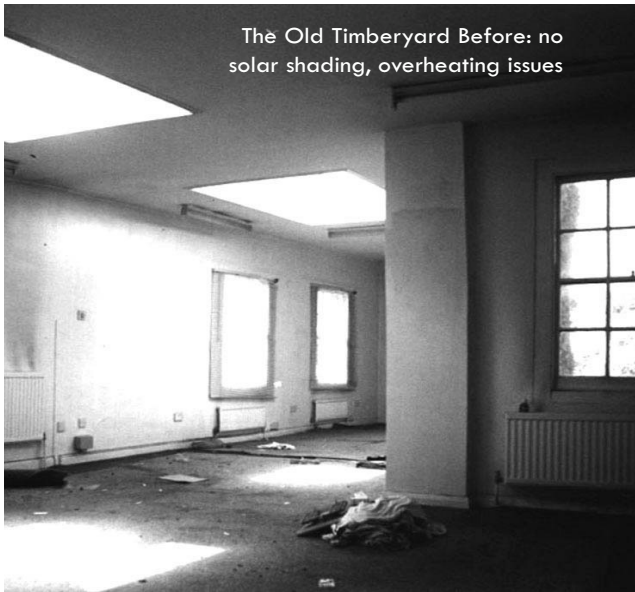
4 Case Study: The Old Timberyard

A sensitive retrofit of a former 1890s workshop that demonstrates how heritage conservation and low-energy performance can successfully coexist, offering a thoughtful example of how existing buildings can be adapted for contemporary living without compromising their historic character. Retaining the original brick façade, the project transforms a redundant industrial building into a comfortable, breathable home through a “building-within-a-building” approach, carefully balancing the needs of modern occupation with the qualities of the existing structure.

A new internal steel structure, high-performance insulation, improved airtightness, mechanical ventilation with heat recovery, and an air-source heat pump deliver exceptional energy efficiency and thermal comfort while preserving the historic character and industrial identity of the building. The result is a carefully considered retrofit that demonstrates the potential of sensitive adaptation, combining improved environmental performance with a strong connection to the building’s original architectural and industrial character.



The Old Timberyard
After



The Old Timberyard Before: no solar shading, overheating issues

- Less energy than the standard UK home
- Deep fabric-first retrofit
- Significant heating demand reduction
- Improved airtightness
- Air source heat pump
- Improved air quality



The Old Timberyard
After

5 Before and After Performance

There are multiple ways to measure performance post-retrofit. The figures below show how efficiently RetroPHit House and The Old Timberyard use energy, how comfortable they are to live in, and their environmental impact. The benefits of a high-quality retrofit include lower energy bills, reduced carbon emissions and improved comfort.

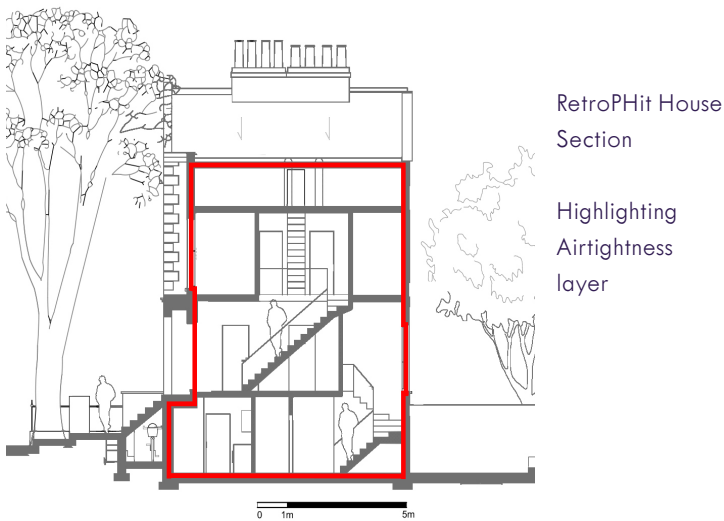
Energy Use measures the amount of energy a building requires each year, with lower figures indicating greater efficiency. Renewable technologies such as solar panels, battery storage and heat pumps reduce reliance on fossil fuels and lower energy costs. Carbon Emissions measure the annual CO2 produced through energy use, with lower emissions indicating reduced fossil fuel dependence.

Ventilation Performance measures how effectively

fresh air is supplied while removing stale air and moisture. MVHR systems recover heat from outgoing air, improving indoor air quality while reducing energy loss. Airtightness measures unwanted air leakage; while the average UK home achieves 10–15 m³/m²h, high-performance retrofits can reduce this to below 1 m³/m²h,

significantly improving comfort and reducing heat loss.

Glazing Performance measures window efficiency using U-values, where lower values indicate better insulation and improved comfort. Fabric Performance describes how well the building envelope, including the walls, floors, roof and windows, retains heat. Effective insulation and careful detailing reduce heat loss, helping the building use less energy overall. Because heat naturally rises, reducing the roof U-value can significantly reduce heat loss and improve the building's overall energy efficiency.



	RETROPHIT HOUSE	THE OLD TIMBERYARD
Energy Use	Reduced heating demand to 16 kWh/m ² /year	Reduced heating demand to 24 kWh/m ² /year
Renewable Energy	Solar generation + battery storage	Mitsubishi Ecodan ASHP + smart hot water storage
Carbon Efficiency	70 % lower due to parred down gas boiler	No Gas, solar ready / mixergy tank, reliant on the grid
Ventilation Performance	82.7% heat recovery efficiency through MVHR	80.3% heat recovery efficiency through MVHR
Airtightness	≤ 1.0 ACH@50Pa	0.8 ACH@50Pa
Glazing Performance	Double-glazed sash windows (1.0 W/m ² K)	Solar-controlled glazing strategy + external shutters (0.79 W/m ² K)
Fabric Performance	Vapour-permeable insulation + thermal bridge improvements	Wood-fibre insulation + breathable lime finishes
Roof U-value	Roof insulation improved to 0.119 W/m ² K	Roof insulation improved to 0.120 W/m ² K

6 What Makes Victorian Retrofit Challenging?

What is Retrofit?

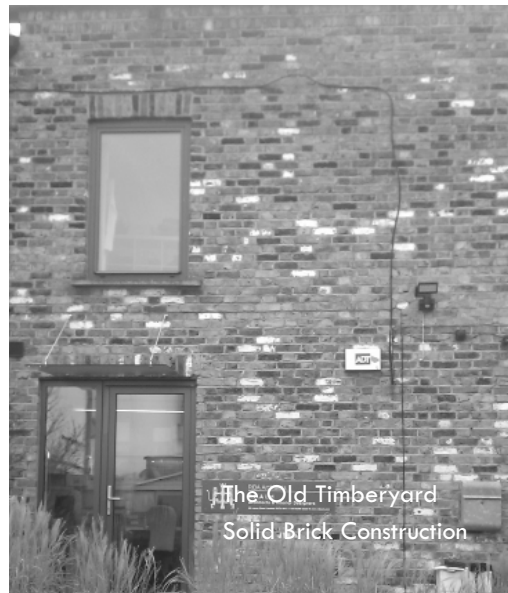
Retrofit is the process of upgrading an existing building to improve its energy performance, comfort and sustainability while retaining as much of the original structure as possible, without the need for full reconstruction.

Victorian buildings present a different set of retrofit challenges to modern homes. Their solid masonry construction, traditional materials and conservation requirements mean improving performance requires a careful balance between energy efficiency, moisture management and heritage protection.

Although often robust and adaptable, Victorian buildings were never designed to meet modern comfort or energy standards. Successful retrofit depends on understanding how the original building fabric works as a complete system, ensuring new interventions improve performance without compromising durability or historic character.

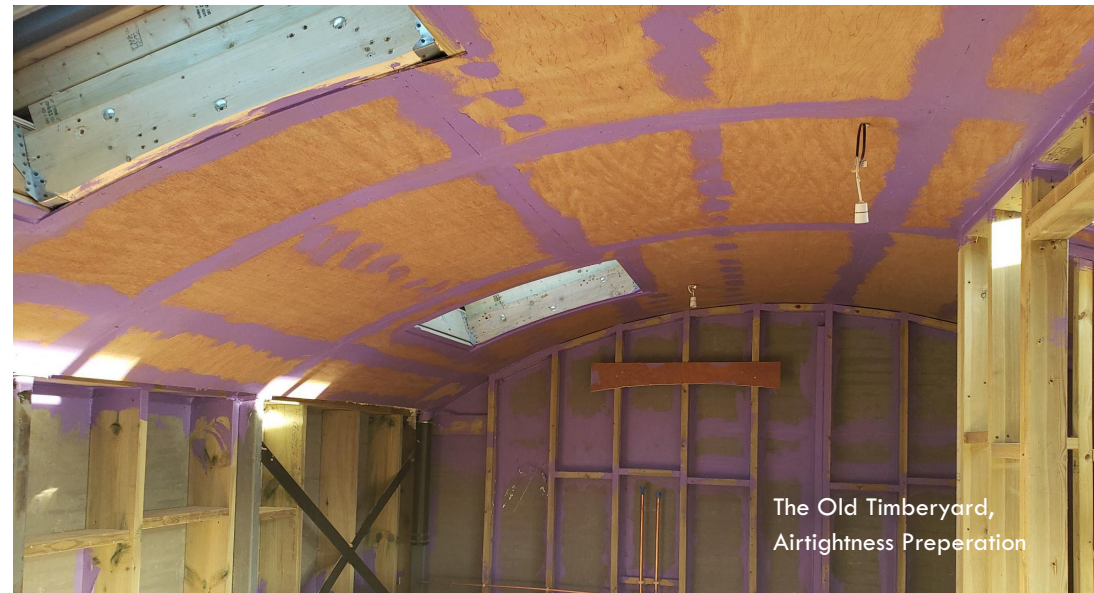
Solid Brick Construction

One of the defining characteristics of Victorian buildings is their solid brick walls, constructed without insulated cavities. These walls naturally absorb and release moisture, allowing the building to breathe, but they provide very little thermal resistance. Introducing insulation without considering this moisture movement can trap condensation within the wall, leading to dampness and long-term deterioration. Both RetroPHit House and The Old Timberyard demonstrates how breathable internal insulation can significantly improve thermal performance



Air Leakage

Victorian buildings contain numerous hidden air leakage paths through timber floors, chimney breasts, suspended ceilings, service penetrations and ageing joinery. These uncontrolled gaps increase heat loss, create draughts and make indoor temperatures difficult to regulate. High levels of airtightness can be achieved, but only through meticulous detailing, continuous airtight layers and careful sequencing of construction, as demonstrated in both case studies.



Thermal Bridging

Even when walls are insulated, heat can continue to escape through junctions such as floor connections, roof intersections, window reveals, chimney penetrations and structural elements. These thermal bridges reduce insulation performance and create cold internal surfaces where condensation may occur. Successful Victorian retrofits carefully resolve these junctions to create continuous thermal envelopes while respecting the existing building fabric.

Windows and Heritage Constraints

Traditional sash windows contribute significantly to heat loss through single glazing, air leakage and low internal surface temperatures. However, conservation requirements often restrict replacement with larger or triple-glazed units. Retrofit strategies therefore rely on carefully upgrading existing windows where possible while improving the surrounding building fabric to reduce overall heat demand without altering the building's historic appearance.

Daylight, Ventilation and Overheating

Deep floor plans and large areas located away from external walls often result in poor natural ventilation and limited daylight. At the same time, large west-facing openings can create significant overheating during summer months. Mechanical ventilation with heat recovery, improved daylight strategies and carefully considered solar shading help maintain comfortable indoor conditions throughout the year while minimising energy demand.



The Old Timberyards,
MVHR

The Lessons

The most successful Victorian retrofits begin by understanding the behaviour of traditional building fabric rather than simply adding insulation or new technology. Both RetroPHit House and The Old Timberyards demonstrate that breathable construction, careful airtightness, continuous insulation and conservation-sensitive detailing can dramatically improve comfort and energy performance while preserving the character and longevity of historic buildings.

Assess Your Home:

Factors to consider when assessing a Victorian home for retrofit.

Building Fabric and Heat Loss

- Solid brick walls without cavities
- Existing insulation levels
- Thermal bridging at junctions
- Condition of roofs and masonry
- Previous alterations and repairs

Airtightness and Detailing

- Air leakage around floors, chimneys and services
- Window and door sealing
- Continuity of airtight layers
- Quality of previous repair work

Windows and Doors

- Existing sash window condition
- Draughts and glazing performance
- Heritage restrictions on replacement
- Solar gain and shading

Moisture and Ventilation

- Risk of condensation and damp
- Breathability of existing construction
- Ventilation strategy
- Indoor air quality

Heating and Building Services

- Existing heating system efficiency
- Suitability for low-temperature heating
- Mechanical ventilation requirements
- Renewable energy opportunities

Comfort and Wellbeing

- Cold internal surfaces
- Uneven temperatures
- Overheating risk

Acoustic performance and internal comfort

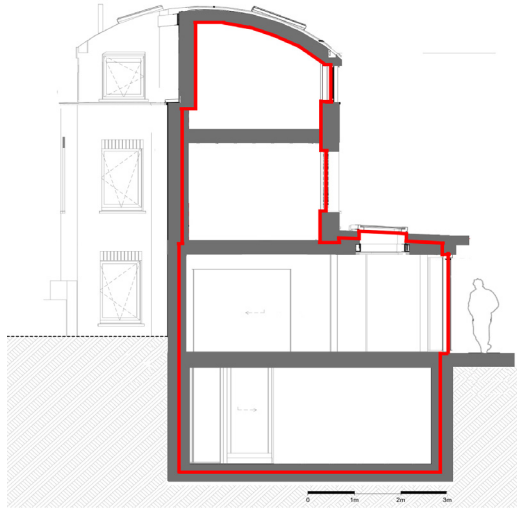
Planning, Conservation, Compliance

- Conservation area or listed status
- Building Regulations
- Restrictions on façade alterations
- Limitations on renewable technologies

Construction and delivery

- Buildability of retrofit solutions
- Sequencing of works
- Occupation during construction
- Long-term durability and maintenance

7 The Four-Step Retrofit Strategy



Fabric First Approach: a successful retrofit reduces energy demand by first improving building fabric before introducing renewable technologies.

FABRIC FIRST APPROACH

Step 1 VAPOUR PERMEABLE INSULATION

Use breathable insulation systems that improve thermal performance while protecting historic building fabric.

Step 2 AIRTIGHTNESS

Improve airtightness through internal detailing to reduce heat loss, draughts, and energy demand while preserving the external appearance.

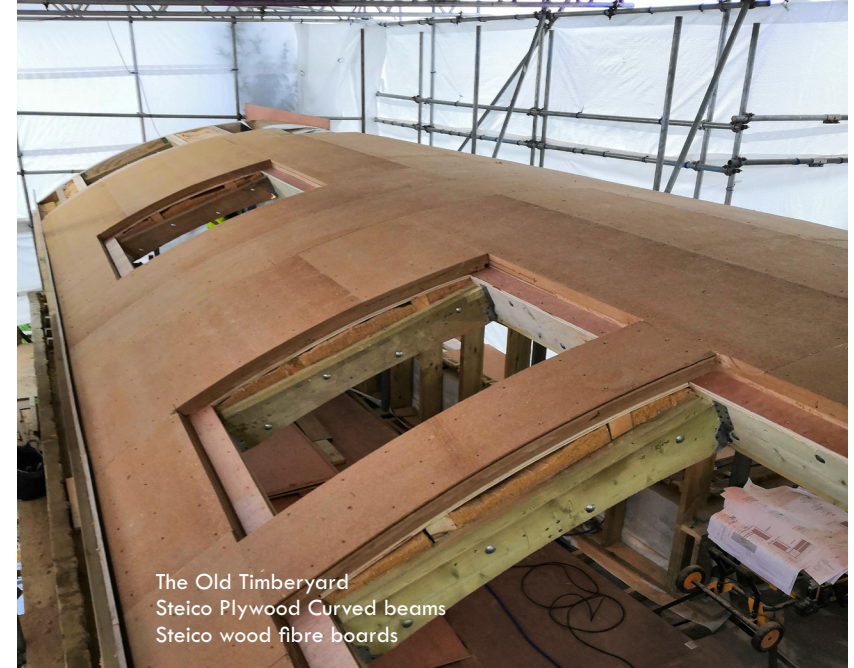
1 Improve Vapour permeable Internal wall Insulation

Vapour-permeable insulation protected the historic brickwork while improving thermal performance. Benefits: reduced heat loss, healthier moisture balance, and lower condensation risk.

To maintain the building's ability to manage moisture naturally, the project used wood fibre insulation boards, lime plaster, and breathable thermal renders instead of impermeable foam-based systems.

- Steico wood fibre boards
- EcoCork lime plaster
- Breathable thermal lime renders
- Post-retrofit U-values: 0.25–0.30 W/m²K, depending on build-up depth

These materials allow moisture to diffuse through the wall, buffer internal humidity, and significantly reduce the risk of interstitial condensation, providing safer long-term hygrothermal performance for the historic fabric.



The Old Timberyard
Steico Plywood Curved beams
Steico wood fibre boards

2 Increase Airtightness, Reduce Air Leakage

Careful airtightness detailing reduced uncontrolled draughts and energy waste while creating more stable indoor temperatures. Benefits: improved comfort, lower heating demand, and EnerPHit-level performance.

Airtightness measures were installed entirely from the inside, preserving the building's historic façade while sealing common air leakage paths throughout the building.

- SIGA Sicrall airtight tape
- Intello membranes
- Sealing around joist ends
- Airtight linings
- Integrated MVHR duct penetrations

Airtightness testing was carried out before insulation, after window installation, and on completion to verify performance. The final result achieved $\leq 1.0 \text{ ACH}@50\text{Pa}$, meeting the EnerPHit airtightness criterion.



The Old Timberyard
Airtightness testing



The Old Timberyard
Airtightness Proofing,
Using Passive Purple

Step 3 FLOOR & ROOF INSULATION

Upgrade key heat-loss areas with compatible insulation measures to improve comfort and overall building efficiency.

Step 4 THERMAL BRIDGE MODELLING

Identify and improve vulnerable junctions to reduce heat loss, condensation risk, and cold spots within the building envelope.

3 Floor & Roof interventions

Upgrading the floor and roof insulation reduced heat loss through two of the building's largest thermal pathways. Benefits: improved comfort, lower energy demand, and more consistent internal temperatures.

Existing timber floors were upgraded using breathable insulation systems that complemented the overall retrofit strategy while maintaining moisture performance.

- Mineral wool insulation
- Vapour-permeable membranes
- Airtightness linings
- Roof insulation installed wherever practical

Together, these interventions significantly reduced heat loss through the building envelope, improving thermal performance while supporting the overall airtightness and energy-efficiency strategy.

4 Thermal Bridge modelling

Thermal bridge modelling identified and reduced heat loss at critical junctions throughout the building. Benefits: warmer internal surfaces, reduced condensation risk, and improved occupant comfort.

Complex construction details were analysed using THERM software and Ψ -value calculations to optimise junction performance before construction.

- Joist ends
- Window surrounds
- Party wall connections
- Basement transitions
- Roof eaves

Addressing these thermal bridges reduced cold spots and raised internal surface temperatures, helping to prevent condensation and mould growth while improving the overall performance of the building envelope.

8 Retrofitting Without Losing Character

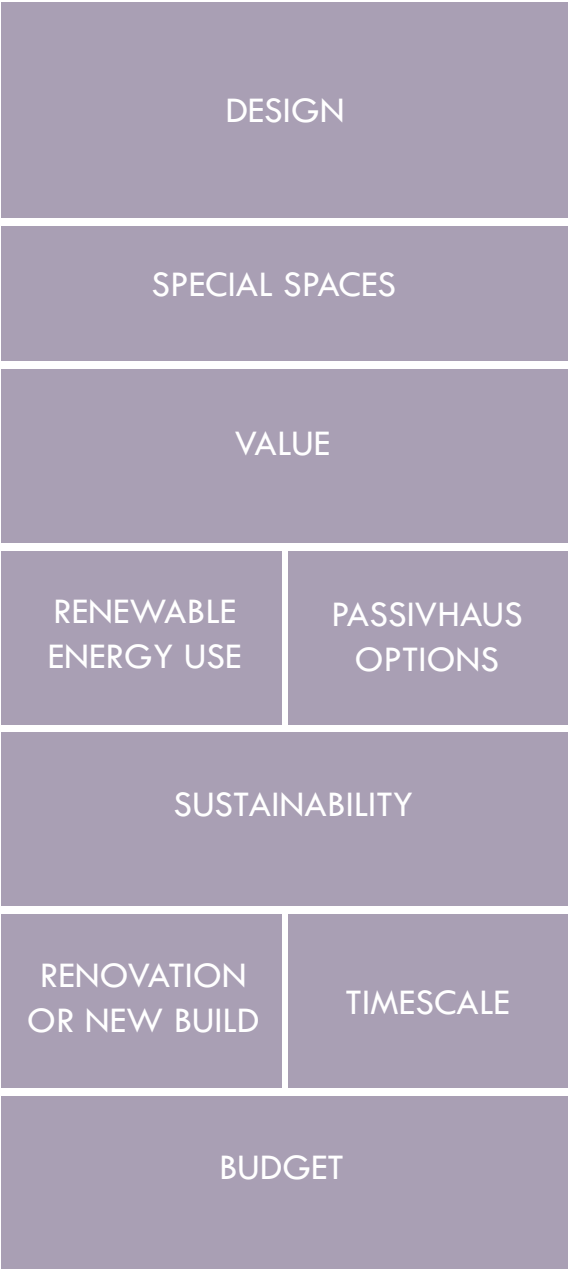
One of the biggest concerns for homeowners undertaking retrofit is preserving the architectural identity of their home. Both projects show how significant energy improvements can be achieved while respecting Victorian character and responding sensitively to planning and conservation requirements.

At RetroPHit House, the original appearance of the Victorian home was retained while introducing high levels of insulation, improved airtightness and high performance glazing. Original brickwork and architectural details were preserved wherever possible, while renewable technologies were discreetly integrated to minimise their visual impact.

Similarly, The Old Timbervard transformed a historic

Victorian industrial building into a highly energy efficient home through a fabric first approach. The existing structure and character were retained while incorporating insulation, airtightness, mechanical ventilation with heat recovery and renewable energy systems. This preserved both the building's embodied carbon and its heritage value.

Together, the projects demonstrate that heritage and sustainability can work successfully together. Careful retrofit strategies can improve energy performance without compromising a building's appearance, character or architectural significance. Planning constraints can also encourage more thoughtful solutions, allowing historic buildings to meet modern standards while retaining their original identity.



9 What Should Homeowners Prioritise?

1. Start With the Building Fabric

Before adding new technologies, improve how the house retains heat. Remember, **FABRIC FIRST**.

Highest Impact Improvements:

- Roof insulation
- Airtightness and draught reduction
- Wall and floor insulation
- Ventilation and air quality strategy
- High-performance windows and glazing

Why This Matters:

A well-insulated and airtight home stays warmer in winter, cooler in summer and requires far less energy to run.

2. Plan Technical Systems Early

Renewable systems and ventilation equipment need careful coordination from the start of the project.

Plan Early For:

- Plant room and storage space
- Ventilation duct routes
- Battery storage location
- Access for maintenance
- Roof orientation for solar panels or slates

Why This Matters:

Many retrofit challenges happen because systems are introduced too late in the design process.

Important Reminder

Successful retrofit projects rely on early planning, realistic budgeting and experienced architects, consultants and installers who understand both retrofit and low-energy design.

- ✓ Fabric First
- ✓ Ventilation
- ✓ Heating
- ✓ Renewables
- ✓ Comfort

Common Mistakes to Avoid

- Installing a heat pump before improving insulation
- Focusing on technology before reducing heat loss
- Poor airtightness detailing around windows and junctions
- Ignoring ventilation requirements
- Underestimating how different systems need to work together



10 Lessons Learned

Retrofitting a Victorian home is not simply about adding new technology or improving individual building elements. The most successful projects adopt a holistic approach, carefully integrating insulation, ventilation, renewable energy systems, and sensitive architectural design from the earliest stages. This ensures that each intervention contributes to improving overall building performance while respecting the character and construction of historic properties. At RetroPHit House, achieving high levels

of airtightness and energy efficiency required careful detailing around existing walls, floors, windows, and roof junctions to minimise heat loss and reduce thermal bridging. Close collaboration between designers, contractors, and specialist consultants was essential to deliver modern performance standards without compromising the original structure. Planning and conservation requirements also influenced key design decisions, encouraging the discreet integration of renewable technologies while preserving the building's historic appearance.



The Old Timbervard



The Old Timbervard

The Both projects successfully achieved all of their primary objectives:

- High levels of comfort with low energy use
- Discreet integration of renewable energy systems
- Efficient low-temperature heating
- Compliance with planning and conservation requirements
- Improved airtightness while preserving the original façade
- Resolution of thermal discontinuities

The greatest lesson from both RetroPHit House and The Old Timbervard is that retaining and upgrading existing buildings can deliver excellent environmental performance while conserving architectural character and reducing embodied carbon. These projects demonstrate that Victorian homes can achieve modern standards of comfort and efficiency without compromising their heritage value.

11 Retrofit, Health and Wellbeing

A successful retrofit is not only about reducing energy use. It is also about creating healthier, more comfortable homes that support everyday wellbeing.

Both RetroPHit House and The Old Timberyard were designed to improve:

- indoor air quality
- thermal comfort
- daylight access
- acoustic performance
- connection to outdoor spaces



MVHR systems continuously supply filtered fresh air while reducing heat loss, helping create healthier indoor environments with fewer pollutants and allergens. Improved insulation and airtightness eliminate draughts, cold surfaces and temperature fluctuations, making homes feel consistently comfortable throughout the year. Triple glazing also helps reduce external noise, creating calmer interior spaces. Natural materials and low-VOC finishes were carefully selected to support healthier living environments and improve air quality.

The result: homes that are warmer in winter, cooler in summer, quieter, healthier and more resilient to future climate conditions.

12 Why Retrofit Matters for the Future

As energy costs continue to rise and climate targets become increasingly ambitious, fabric-first retrofit approaches will play an essential role in improving the performance of existing buildings while reducing carbon emissions.

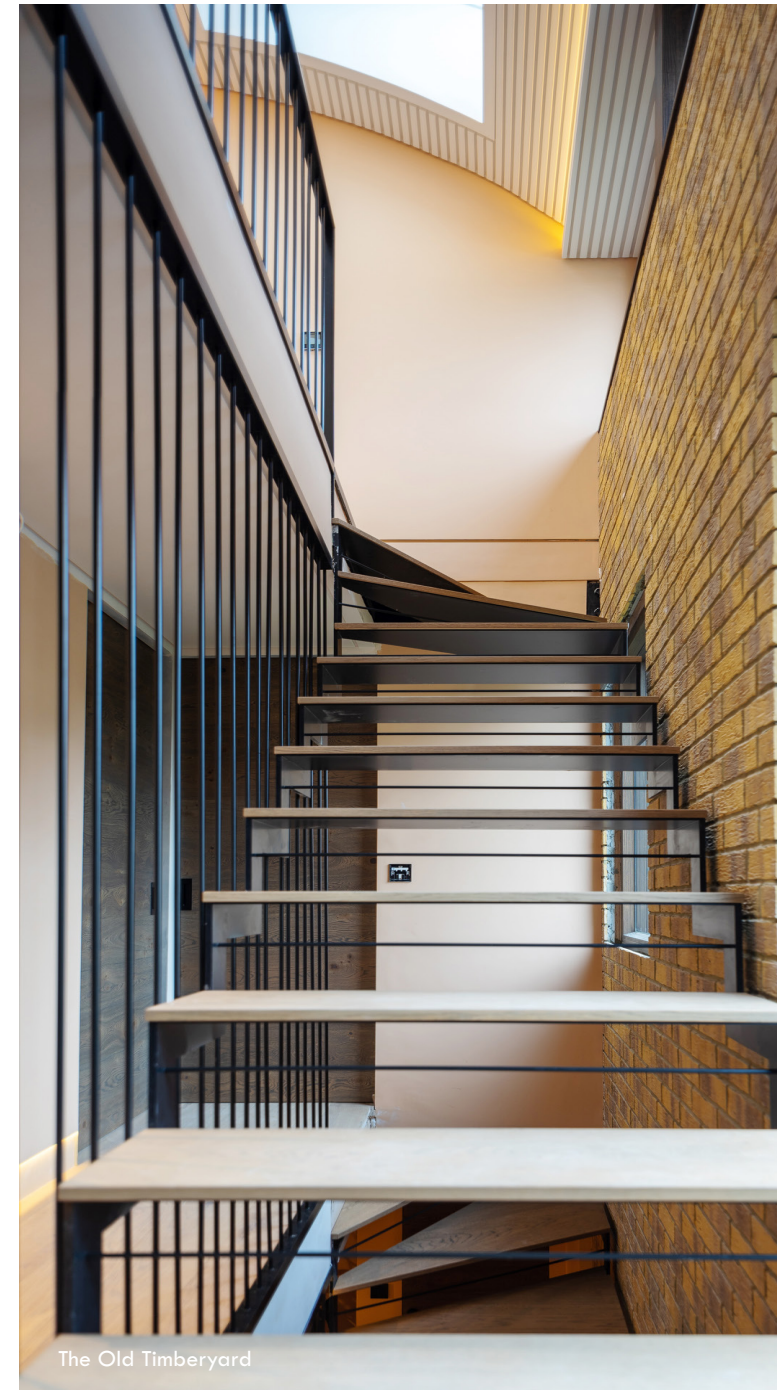
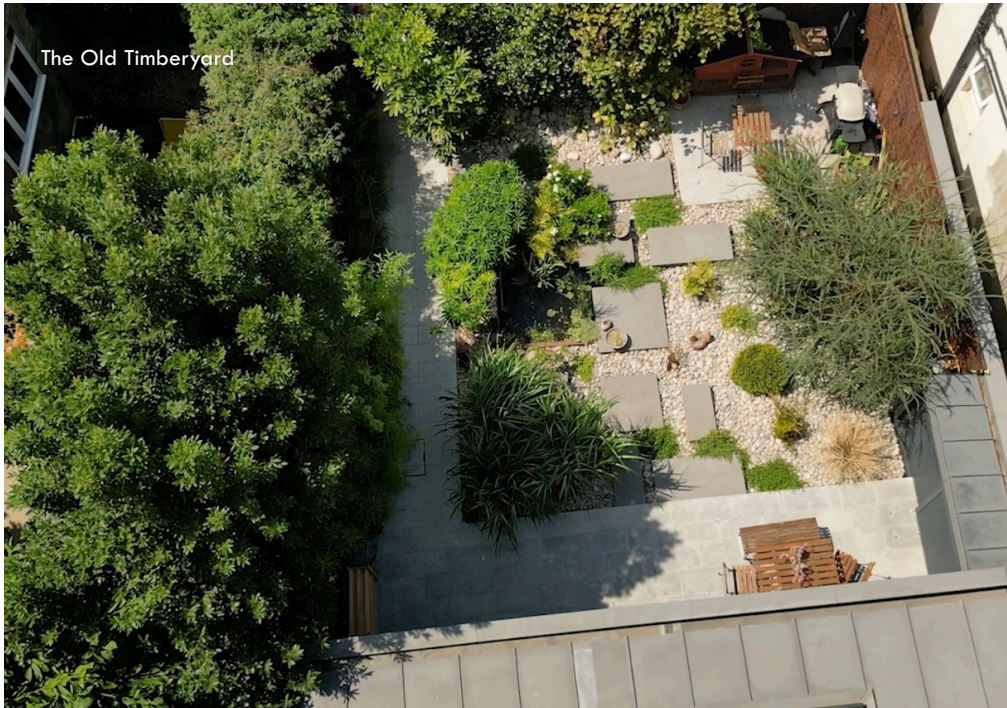
The UK's extensive Victorian housing stock represents one of the greatest opportunities for low-carbon transformation. By combining sensitive conservation with modern building science, these homes can achieve significantly higher levels of comfort, energy efficiency, and sustainability without losing their historic character.

Remember: the greenest building is often the one that already exists.

Projects such as RetroPHit House and The Old Timberyard demonstrate that:

- demolition is not always necessary
- existing homes can achieve exceptional performance
- retrofit can preserve architectural heritage
- renewable systems can integrate successfully within existing buildings.

Retrofitting existing homes will play a critical role in reducing carbon emissions and preparing UK housing stock for future climate conditions.



13 Further Guidance

Every building is different, so taking the time to research its condition, constraints and opportunities is essential to delivering a successful retrofit project.

TOP TIPS

- Retrofit before extending where possible
- Improve insulation before installing renewable systems
- Prioritise airtightness and ventilation together
- Retain and adapt existing structures
- Plan plant room space early
- Use experienced retrofit professionals
- Consider long-term maintenance and access
- Balance energy performance with heritage considerations

FURTHER GUIDANCE

- Passivhaus Trust
- LETI Retrofit Guide
- RIBA Sustainable Outcomes Guide
- Local planning and conservation guidance





The Old Timbertyard
Garden



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Get in touch:

We invite you to get in touch. We would be delighted to discuss your project and how we can work together to design your new home.

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