Shire Hall Museum: Decarbonisation Plan

Cultural & Heritage Sector Decarbonisation Pilot Study

January 2026

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SKELLY & COUCH

ARTS COUNCIL ENGLAND

Working together with

Historic England

Contents

Executive Summary

The following report presents a Decarbonisation Plan for the Grade I listed Shire Hall Museum in Dorchester. Originally designed as a Courthouse, the 18th-century building was refurbished and adapted in 2018 into an immersive museum of social justice, with two separate residential apartments on the upper floor.

The Shire Hall building is owned by Dorset Council and is leased by the Shire Hall (Dorchester) Trust.

The Decarbonisation Plan has been commissioned by Historic England and Arts Council England, as part of a pilot study focussing on the decarbonisation of listed and existing buildings within the cultural & heritage sector.

The report has been prepared collaboratively by architects Haworth Tompkins and MEP engineers Skelly & Couch, with input from cost consultants Gardiner & Theobald and historic building surveyors Conisbee.

The study has been developed in consultation with senior staff at Shire Hall, based on information collected through:

- Initial briefing workshops carried out with staff at Shire Hall.
- A building visit attended by Haworth Tompkins and Skelly & Couch.
- A visual services inspection and thermal imaging survey carried out during the site visit.
- Online information records including the planning portal, and Historic England Listing register.

Building information was also provided directly by Shire Hall including:

- Architectural plans developed by Philip Hughes Associates and electrical, alarm & small power services record information from the 2017 refurbishment works.
- A Conservation Statement produced by Keystone Historic Buildings Consultants in 2012 and a Heritage Statement and Impact Assessment produced by Philip Hughes Associates in 2018.
- A building condition survey/planned preventative maintenance report from Hartnell Taylor Cook carried out in May 2024.
- Metered data on gas and electricity usage obtained from the energy supplier.

An airtightness test , commissioned by Historic England and undertaken by BSRIA, was also carried out on 1st September 2025.

The Decarbonisation Plan is underpinned by Historic England's 'Whole Building Approach', and includes recommendations for targeted improvements to building fabric, services, and operations, as well as the development of a costed and prioritised roadmap to decarbonisation.

The development of the Plan has followed a six-step process, which corresponds to Stages 1 and 2 of the Historic England Whole Building Approach.

1 **DEFINE** the goals of the project

2 **GATHER** existing data and documentation

3 **SURVEY & ASSESS** the building and services systems

4 **APPRAISE** options for potential improvement strategies

5 **DEVELOP** a prioritised list of improvements

6 **FORWARD PLAN** the implementation of the decarbonisation pathway

Decarbonisation Plan

Define → Gather → Survey & Assess → Options Appraisal → Develop → Forward Plan

Historic England – Whole Building Approach

WBA Stage 1: Gather Data & Surveys	WBA Stage 2: Assess & Plan	WBA Stage 3: Design & Specify	WBA Stage 4: Procure & Install	WBA Stage 5: Use, Evaluate & Maintain
• Define brief and objectives • Collect information and data • Establish performance baseline • Identify inefficiencies	• Appraise opportunities for improvements • Shortlist preferred options • Create implementation plan • Set pathway to Net Zero			

Decarbonisation Plan (WBA Stages 1–2)

RIBA Plan of Work 2020

0	1	2	3	4	5	6	7
Strategic Definition	Preparation and Briefing	Concept Design	Spatial Coordination	Technical Design	Manufacturing and Construction	Handover	Use

PROJECT DEFINITION

1.1 Introduction

Decarbonisation Context

UK Government carbon targets
The built environment accounts for around 25% of the UK's total carbon footprint. [1]

Decarbonisation of the built environment is therefore a key factor in achieving overall UK carbon reduction targets, such as the UK Government's target to achieve net zero carbon emissions in the UK by 2050.

New buildings and planned refurbishments
Statutory measures exist that require new buildings to achieve high levels of energy efficiency and carbon performance, and energy efficiency to be introduced when work is carried out on existing buildings. This includes Part L of the Building Regulations, which was updated in 2021 with higher efficiency standards. There are also measures set through the planning system.

These statutory measures are relatively demanding and mean that many new and refurbished buildings should meet high levels of energy and carbon performance. Furthermore, industry guidance such as that developed by the UK Green Building Council (UK-GBC), the London Energy Transformation Initiative (LETI), and the UK Net Zero Carbon Building Standard (UK NZCBS) recommends that all new buildings (domestic and non-domestic) should be planned to be Net Zero by 2030 to meet broader climate change targets. Such targets, along with similar targets set by the Royal Institute for British Architects (RIBA) in their 2030 Climate Challenge, are being voluntarily adopted by clients as an enhancement to statutory requirements.

1 Source: UK Green Building Council (UKGBC), Net Zero Whole Life Carbon Roadmap Technical Report (November 2021) p 10. Note: This figure includes buildings and infrastructure and relates to consumption emissions (i.e. the figure includes emissions from imported materials)

Existing buildings
It is projected that 80% of existing buildings are expected to remain in use until at least 2050,[2] meaning that statutory or voluntary measures for new buildings alone will not sufficiently reduce carbon emissions from the built environment in line with overall targets. There are however currently no direct statutory requirements to make energy and carbon performance improvements to existing buildings where no work is planned, or indeed where only minor works are carried out (e.g. decorative) or where such improvements would affect the nature of historic and listed buildings.

There are some indirect statutory measures that would promote higher carbon efficiency, and grant schemes to promote new systems such as heat pumps.

To meet national carbon reduction targets, voluntary measures to decarbonise existing buildings will therefore be required. It is hoped that the findings and proposals in this report will allow the Lit & Phil Library to set objectives for a decarbonisation pathway accordingly.

By upgrading energy and carbon performance, other benefits for the library could include:

- Reduced energy costs
- Enhanced occupant comfort
- Higher resilience in services where loads are reduced
- Potential promotional benefits

2 Source: https://post.parliament.uk/net-zero-and-the-uk-historic-building-stock/

Net Zero Carbon

The concept of net zero carbon, where buildings are fully decarbonised in terms of Scope 1 and 2 carbon emissions[3], is gaining increasing attention as a means to bring buildings in line with the wider UK and international targets for decarbonisation.

Interim targets for lower degrees of carbon reductions may also be appropriate, particularly for existing buildings where steep reductions in carbon emissions are technically and economically challenging. Regardless of the target set, it is important that key principles of net zero are applied to ensure consistency.

The UK Net Zero Carbon Building Standard Pilot Version was published in 2024 and creates a unified definition for 'Net Zero Carbon Aligned Buildings' in the UK, underpinned by an evidence-based reporting methodology. The guidance provides set energy use intensity targets, which are compatible with the availability of renewable energy sources expected to be available in 2040, the deadline which the standard sets.

As part of the development of the UKNZCB Standard, a working group was convened to look at the specific challenge of applying a Net Zero Carbon Building Standard to historic buildings or those with heritage significance. After extensive consultation and analysis, heritage buildings do not currently form part of the Standard.

3 Scope 1 emissions are those from on-site fuel use; Scope 2 emissions are indirect emissions from purchased electricity use. Refer to Appendix "Net Zero Carbon Glossary"

There is consequently a need for specific guidance to support the progressive decarbonisation of listed and historic buildings, which offers a more practical and proportionate pathway than achieving absolute net zero carbon. These buildings face unique constraints including heritage significance, structural limitations, and construction typologies that make full decarbonisation technically challenging or inappropriate.

A progressive approach prioritises measurable, incremental emissions reductions through targeted efficiency improvements, system upgrades, and low/zero carbon technology integration, while respecting conservation requirements. This enables steady performance gains aligned with technological progress, funding cycles, and grid decarbonisation.

Crucially, it supports a balance between climate action and heritage preservation, recognising that historic buildings can lead by example in sustainable management and adaptive reuse.

1.1 Introduction

The term "net zero" is often used incorrectly. To better define the concept and parameters, a group of construction organisations including LETI and CIBSE produced the following definitions.

	A 'Net Zero (whole life) Carbon' Asset is one where the sum total of all asset related GHG emissions, both operational and embodied, over an asset's life cycle (Modules A0-A5, B1-B8, C1-C4) are minimised, which meets local carbon, energy and water targets or limits, and with residual 'offsets', equals zero[1].
NET ZERO EMBODIED CARBON OR NET ZERO LIFE CYCLE EMBODIED CARBON	A 'Net Zero Embodied Carbon' asset is one where the sum total of GHG emissions and removals over an asset's life cycle (Modules A0-A5, B1-B5 and C1-C4) are minimized, which meets local carbon targets or limits (e.g. kgCO2e/m2), and with additional 'offsets', equals zero.
NET ZERO UPFRONT CARBON	A 'Net Zero Upfront Carbon' asset is one where the sum total of GHG emissions, excluding 'biogenic carbon', from Modules A0-A5 is minimized, which meets local carbon targets or limits (e.g. kgCO2e/m2), and with additional 'offsets', equals zero.
NET ZERO CAPITAL CARBON INFRASTRUCTURE	A 'Net Zero Capital Carbon' infrastructure asset is one where the sum total of GHG emissions, as aligned with the scope of Capital Expenditure (or Capex) as determined by the asset owner's preference but always including Module A and C, is minimized, meets local carbon targets or limits (e.g. kgCO2e/m2), and with additional 'offsets', equals zero.
NET ZERO OPERATIONAL CARBON ENERGY	A 'Net Zero Operational Carbon – Energy' asset is one where no fossil fuels are used, all energy use (Module B6) has been minimized, meets the local energy use target or limit (e.g. kWh/m2/a) and all energy use is generated on- or off- site using renewables that demonstrate additionality. Direct emissions from renewables and any upstream emissions are 'offset'[2].
NET ZERO OPERATIONAL CARBON INFRASTRUCTURE	A 'Net Zero Operational Carbon' infrastructure asset is one where the sum total of GHG emissions, as aligned with the scope of Operational Expenditure (or Opex) as determined by the asset owner's preference, has been minimised and meets local carbon, energy and water targets or limits, and where no fossil fuels have been used for operational energy use (Module B6), and which, with additional 'offsets', equals zero.

1 To meet the requirements of 'Net Zero (whole life) Carbon' the definitions for 'Net Zero Upfront Carbon', Net Zero Embodied Carbon', 'Net Zero Capital Carbon', Net Zero Operational Carbon – Energy', 'Net Zero Operational Carbon – Infrastructure', 'Net Zero In-Use Carbon Asset' and 'Net Zero Operational Carbon – Water' must also be individually met as applicable.

2 Note: Direct emissions must include CH4 and N2O emissions from the combustion of biomass and biodiesel fuels. Upstream emissions include: direct and indirect emissions from energy generation and distribution, WTT emissions for energy consumed in the building and from energy generation and distribution.

1.2 Project Context

1.2.1 Previous Capital Project

In 2018 Shire Hall underwent a major capital refurbishment project to transform the former Courthouse into a Exhibition and Visitor Centre. The project was delivered with support from the Heritage Lottery Fund and match funded by West Dorset District Council.

The primary purpose of the project was to bring a disused listed building back into sustainable economic use, and for Shire Hall to be the centrepiece of a new cultural quarter for Dorchester incorporating visitor attraction, education, lifelong learning and training. The Shire Hall project improved the accessibility of the whole building through spatial alterations alongside new interpretation, education and training facilities, enabling a wide range of new activities to take place.

The key deliverables of the project included:

- Creation of a working museum, with specialist exhibition spaces
- Learning space
- Shop
- Café
- Two new residential apartments for private rent.
- New services including:
    - New gas boilers for space heating.
    - New domestic hot water systems.
    - New Ventilation systems
    - New fire & security alarms
    - New lighting and small power
    - Street façade floodlighting

1.2.2 Challenges and opportunities

The Shire Hall Museum is currently not operating to the full extent originally envisaged in 2018.

While it remains a valuable community asset and event venue, the building is underutilised, with significant spare capacity. Increasing activity within the space is a priority to raise the Museum's profile and strengthen its financial sustainability.

Several building services installed in 2018 are no longer functioning as intended, and limited documentation on the existing systems makes operation, maintenance, and adaptation difficult.

Frequent changes in management and staff have also created a gap in operational knowledge, particularly regarding the building's systems and controls.

As a result, inconsistent management of the heating system has caused thermal comfort issues, while ventilation faults have contributed to condensation and damp problems, most notably in the upper-floor residential flats.

The Shire Hall intend to open the building up to more commercial activities and event hire to increase revenue generation and make the building more of a community hub. They are therefore looking to maximise occupancy in the lettable spaces.

Shire Hall before the 2018 refurbishment works
Image source: Philip Hughes Associates

Cafe and shop during the 2018 refurbishment works
Image source: Philip Hughes Associates

1.2 Project Context

1.2.3 Decarbonisation Aims and Objectives

As a centre for social justice, Shire Hall Trust feels a responsibility to promote awareness of climate change issues and act as an exemplar for sustainable energy consumption.

The key aims of this Decarbonisation study are as follows:

1. Gain a better understanding of the performance of the existing building and its service systems.
2. Address defects and deficiencies in the existing systems and fabric.
3. Identify opportunities to reduce energy demand; improve energy efficiency and transition towards low or net zero carbon services.
4. Improve thermal comfort and indoor environmental quality, including increased control of environmental conditions for occupants.
5. Reduce energy bills wherever possible, to help with ongoing financial constraints
6. Increase the intensity of use of the building in order to generate further revenue to secure the long-term resilience of the organisation.

Entrance Hall

Exhibition space

Venue Hire at Shire Hall

Cafe

All images courtesy of Shire Hall Museum

BACKGROUND INFORMATION

2.1 The Existing Site

2.1.1 The Building

Shire Hall served as Dorset's courthouse from 1797 until 1955, playing a pivotal role in the region's legal and social history. Over the years, it witnessed many significant events, including the 1834 trial of the Tolpuddle Martyrs—six agricultural labourers who were convicted for forming a trade union to fight for better wages. It also saw the 1856 domestic abuse case that would go on to inspire Thomas Hardy's famous novel Tess of the D'Urbervilles, which highlighted the harsh realities faced by women in Victorian England. In addition, the courthouse became a place of trials involving mesmerism, child perpetrators, and some of Dorset's most infamous smugglers, each leaving their mark on the local and national consciousness.

Alongside its rich social history, Shire Hall is recognised for its exceptional architectural value. As one of the best-preserved buildings of its kind in the country, it holds a Grade I listed status, which was granted in 1950. Designed by the renowned architect Thomas Hardwick, the building is a striking example of Georgian architecture. Hardwick was not only a skilled architect but also the tutor of the celebrated artist J.M.W. Turner. Though Hardwick recognized Turner's talent, he advised the young artist to focus on painting rather than architecture, a decision that would ultimately shape the future of British art.

After ceasing its function as a courthouse in 1955, Shire Hall was re-purposed as office space for West Dorset District Council (previously known as the Rural District Council). This transition helped ensure the preservation of its Georgian features for future generations, preventing the erosion of its architectural integrity.

In recognition of the historical importance of the Tolpuddle Martyrs' trial, the Trades Union Congress (TUC) took ownership of part of the building in the mid-20th century. The TUC established a charitable trust and purchased the courtroom and cells from the Rural District Council for £4,000. In 1968, the TUC decided to return their portion of the building to the Council, including a covenant that stipulated the courtroom must remain open for public inspection during reasonable hours on weekdays.

In 2018, Shire Hall underwent a major restoration project, funded by a Heritage Lottery Grant and match funding from West Dorset District Council. Today, it functions as an interactive museum, attracting a diverse range of visitors, including tourists, local passers-by, and school and community groups. The museum offers a variety of exhibits and educational experiences, engaging visitors in the complex history of the building and its role in Dorset's legal and social landscape.

Image source: Shire Hall Museum

Year of construction	1797
Architect	Thomas Hardwick
Listing status	I
Year of Listing	1950
Primary function	Courthouse Museum
Other uses	Self-directed visits and guided tours Gift shop & cafe Spaces for private and corporate hire Easter/Summer/Christmas markets Regular evening events desired - e.g.. music concerts 2x 2b3p residential flats on top floor
Location	Dorchester, Dorset
GIA	1,240m2
Significant later construction works / alterations	2018 - Comprehensive restoration led by Philip Hughes Associates
Neighbouring buildings	Grade II listed buildings adjacent to the east – Stratton House & Agriculture House Shared car park to the rear – well used

2.2 Heritage Significance

2.2.1 Heritage Designations

Shire hall is a Grade I listed building, situated within the Dorchester Conservation Area.

Official list entry:

- Heritage Category: Listed Building
- Grade: I
- List Entry Number: 1119069
- Date first listed: 08-May-1950
- List Entry Name: The Shire Hall
- Statutory Address 1: The Shire Hall, High West Street, Dorchester, DT1 1UY

Location

- Statutory Address: The Shire Hall, High West Street, Dorchester, DT1 1UY

- District: Dorset (Unitary Authority)
- Parish: Dorchester
- National Grid Reference: SY 69101 90736
- Details SY 6990 7/79

HIGH WEST STREET (North Side) The Shire Hall

8.5.50.

GV I

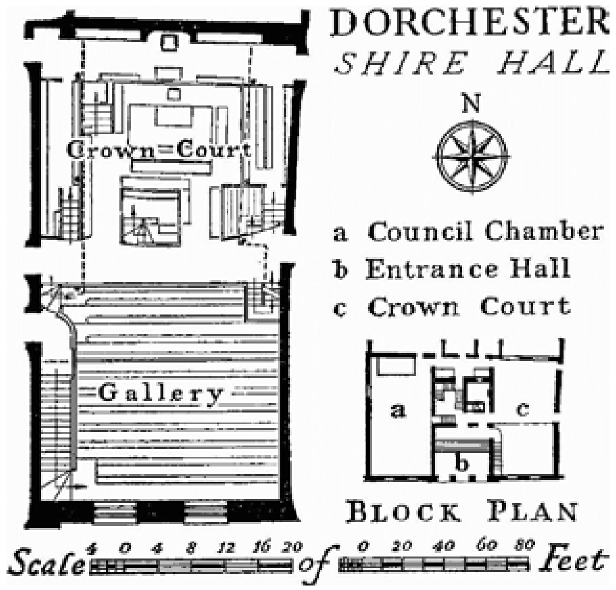
List description:

1797 (rainwater head). Architect Thomas Hardwick. Portland ashlar. Two storeys, seven windows. Divided into three bays, the centre (three windows) breaking forward and having rusticated ground floor with three round-arched openings with imposts and keystones. Each opening has rusticated reveals, double doors, transome and fanlight. Sash windows above, cornice and pediment. Side bays are two windows with round-headed windows to ground floor. Parapets. Cornice and string course continuous across facade. At east end of front is the mileage to Hyde Park Corner, Blandford and Bridport inscribed in contemporary incised lettering. A tablet states that the Tolpuddle Martyrs were sentenced here in 1834. Side elevation is red brick. Moulded modillion eaves cornice. Six sashes with glazing bars. Rainwater head with “1797”.

Interior retains the court-room virtually as it was when the Tolpuddle Martyrs were tried here. Contemporary wooden dock, bench, jury and witness boxes, and public galleries.

Nos 48 to 65A (consec) including the Shire Hall, Holy Trinity Church, the Museum, St. Peter’s Church and monument to William Barnes in churchyard immediately south of West Tower form a group.

Shire Hall, taken in 1859
Image source: Shire Hall Museum



Shire Hall Plan
Image source: British History Online:
'Dorchester', in An Inventory of the Historical Monuments in Dorset, Volume 2, South east (London, 1970), British History Online https://www.british-history.ac.uk/rchme/dorset/vol2/pp104-132 [accessed 24 February 2026].


Dorset election c.1910
Image source: Shire Hall Museum


The Courtroom shortly before refurbishment in 2018
Image Source: Martin Thomas Associates

2.2 Heritage Significance

2.2.2 Building Significance

As a collective term for the sum of all the heritage values attached to a place, Significance can be understood through a series of inter-related themes. For further information on the assessment of heritage values, please refer to the following Historic England document 'Conservation Principles, Policies and Guidance', 2008.

The following section provides a summary of the overall significance of the Shire Hall Museum, based on the Conservation Statement produced by Keystone Historic Buildings Consultants in 2012 and Heritage Statement and Impact Assessment produced by Philip Hughes Associates in 2018. These documents have also informed the hierarchy of significance diagrams on the following page.

Evidential Value

The potential of a place to yield evidence about past human activity, or the potential for new knowledge about the fabric or history of the asset.

The Shire Hall, Dorchester is a highly significant example of late Georgian neo-classical public architecture, designed for legal proceedings. Its imposing front elevation, clad in local Portland stone, remains largely unaltered and provides insight into the building's original design, particularly the mirror-plan courts, of which only one survives.

The Glyde Path Road and rear elevations are significant for retaining elements of the 1790s structure. The Glyde Path Road elevation is notable for Oswald Brakspear's historicist alterations, while the north elevation is partly obscured by later additions.
The building's incorporation of the Crown Court and associated fittings is highly significant, as are key Hardwick-era spaces such as the entrance hall, room beneath the public gallery, main stair, original cell rooms, and Grand Jury room. These spaces demonstrate the architectural provisions for separating different groups attending the Assizes.

The rear west Council Chamber, adapted in the 1960s, and remnants of a co-eval nuclear bunker have material significance as part of the site's local government history. In contrast, the western office spaces from the 1960s are of neutral significance.

There is potential for significant buried archaeology, particularly at the rear of the building and beneath its interior. Discoveries could further illuminate Dorchester's early history, as evidenced by previous Roman finds.

Historical Value

The ways in which past people, events and aspects of life can be connected through a place to the present; or the way in which a place supports a narrative of the past. This tends to be illustrative or associative.

The Shire Hall holds national and local historical significance. Most notably, it is associated with the trial of the Tolpuddle Martyrs, a key event in the history of labour relations. The Conservation Area Appraisal (2003) emphasizes the trial's 'great historical and cultural importance,' linking the site to the Tolpuddle Martyrs' Museum and Dorset's 19th-century agricultural history. Cultural ties extend to figures like poet William Barnes and novelist Thomas Hardy, who served as a Justice of the Peace and grand juror at the Assizes.

The building's ownership by the TUC from 1956 to 1968 underscores its role as a monument to labour history with ongoing international relevance. Its historical function as a site of public justice from 1797 to 1955 connects it to changes in the judicial system and reflects a deep slice of social history involving judges, defendants, and marginalized individuals.
The survival of original documentation relating to its construction, alterations, and judicial functions enhances its historical value. The Quarter Sessions records at the Dorset History Centre are particularly valuable.

As part of Dorchester's history, the Shire Hall contributed significantly to the town's economic and cultural life. In addition to judicial functions, it hosted Petty and Quarter Sessions and various social events, including concerts and dances.

Architecturally, the building is significant as part of the opus of Thomas Hardwick. Hardwick, known for his conservative neo-classical style, also worked on Dorchester prison.

Aesthetic Value

The ways in which people draw sensory and intellectual stimulation from a place, and how they engage with it emotionally.

The Shire Hall is a prominent example of the most striking neo-classical architecture in Dorchester's historic centre. Its front elevation, characterised by plainness and symmetry, contrasts with neighbouring buildings, including the modest No. 58 and the elaborate Stratton House.

The interior's surviving first-phase elements extend the imposing aesthetic of the exterior. In contrast, the 20th-century offices and rear additions are of neutral aesthetic significance. There is a striking contrast between the grim, poorly lit atmosphere of the basement cell rooms and the generous, well-lit spaces of the entrance hall, court, and Grand Jury Room.

Communal Value

The meanings of a place for the people who relate to it, or for whom it figures in their collective experience or memory, as well as how the place brings people together as a community.

The Shire Hall has served the community for over 200 years, symbolising public justice and local government. It has played a role in the lives of court and local government workers as well as visitors. The building is well-known locally for its association with the Tolpuddle Martyrs and attracts significant interest during the annual Tolpuddle festival. Since 1956, it has been presented as a monument to labour history, with international resonance within the Trades Union movement.

The Shire Hall's prominent front elevation contributes to Dorchester's public realm. There is strong local support for its continued future as a heritage attraction and learning space. Historical associations, particularly with the Tolpuddle Martyrs and the history of justice, are highly valued. Many visitors also express an interest in themes such as the Hardy connection, Dorchester's history, and the stories of trials and ordinary defendants.

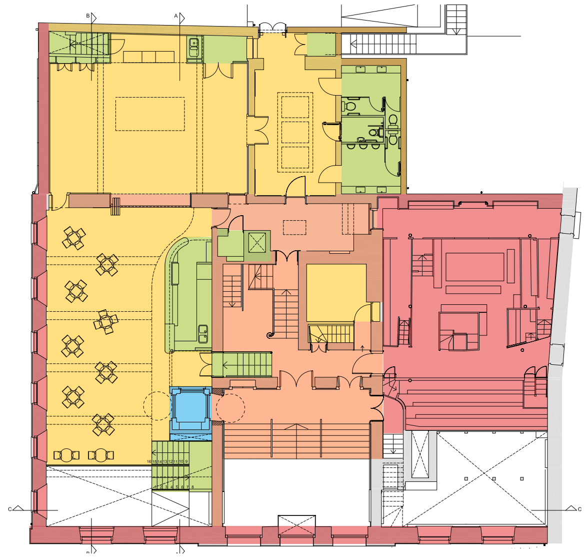
The Courthouse and Grand Jury Room and learning space have hosted a wide variety of community events since the refurbishment in 2018, including concerts, performances, exhibitions and festive markets.

2.2 Heritage Significance

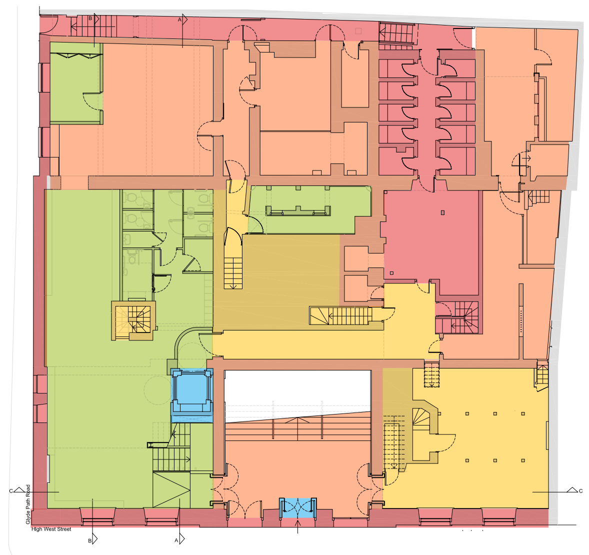
Summary

The Grade I listing underscores the Shire Hall's national importance for its architectural and historical significance. It remains a crucial element of Dorchester's townscape and is historically significant as the site of the Tolpuddle Martyrs' trial. Its preserved Crown Court and cell rooms are particularly valuable. The building's evidential significance extends beyond the courtroom to include its broader architectural context, reflecting the design of 19th-century justice.

Upper First & Second Floor Plan



First Floor Plan



Ground & Lower Ground Floor Plan

Key

- Exceptionally Significant
- Highly Significant
- Significant
- Neutral
- Detrimental

2.3 Site Constraints

2.3.1 Site Location

Location, exposure & vulnerability

The Shire Hall Museum is located along the main High Street in Dorchester, just north of the town centre.

Dorchester is the county town of Dorset, with a population of 19,060. The town lies on the banks of the River Frome, at the junction of the A35 South Coast East to West trunk road and the A37 to the North. It also has direct rail links to London and Bristol.

The front facade of the building faces south onto the high street. The West facades addresses a tight passageway between the adjacent building, which is used as a pedestrian route.

To the rear, there is a lower storey extension which faces onto a small rear car park, shared by the surrounding buildings. These range in uses from residential to commercial activities.

The east side of the building is a party wall with the neighbouring building.

Image source: Google Earth

2.3 Site Constraints

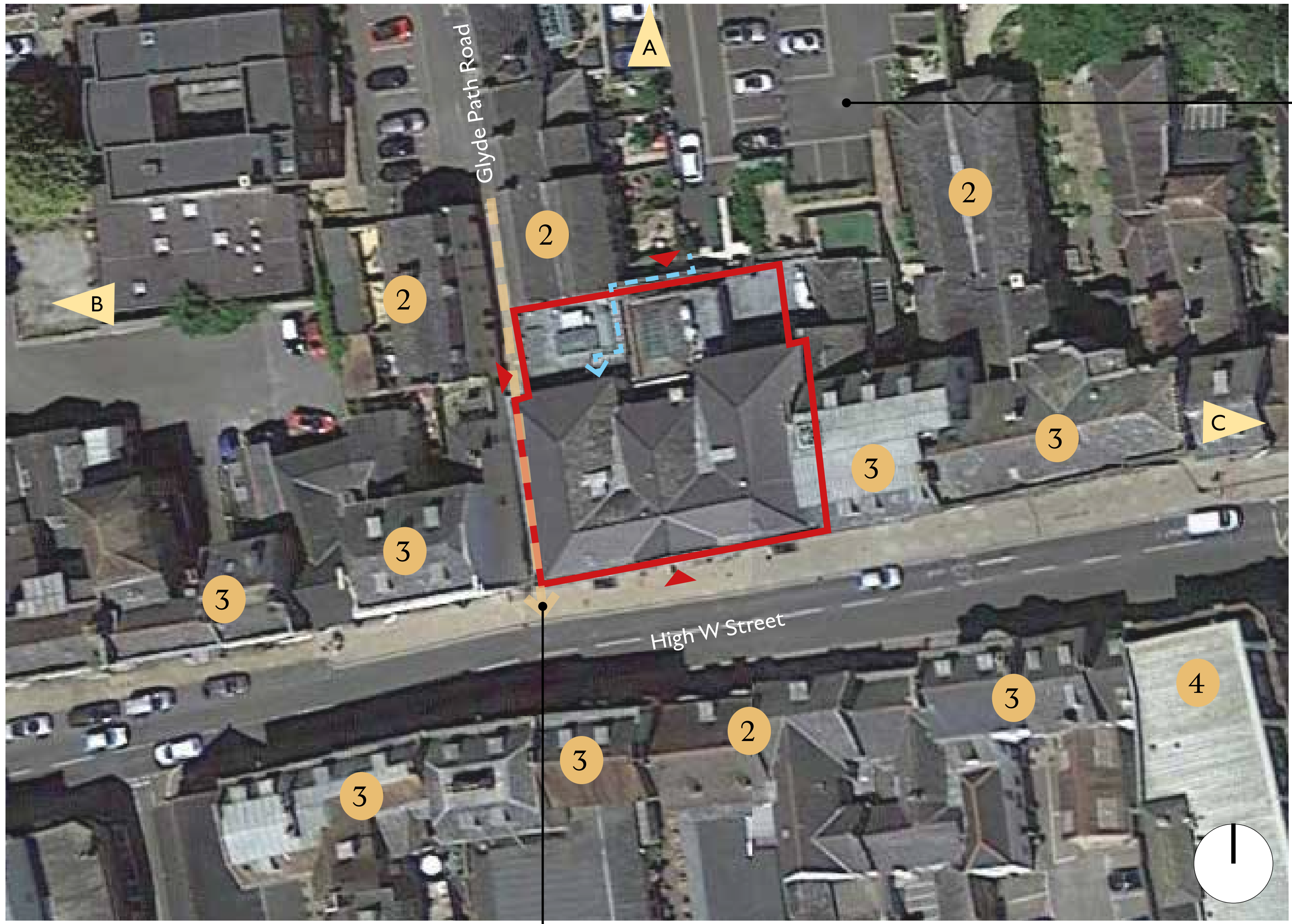


Image source: Google Earth

A

B

C

KEY

- Site boundary
- Entrances
- 3d View
- Number of storeys
- Access to flats

2.4 Occupancy & Management

2.4.1 Use, Occupancy & Management

Shire Hall Museum is run by a small team, most of whom work part time, supported by a number of volunteers and guided by a Board of Trustees.

Key personnel include:

- Museum Director
- Museum Developer

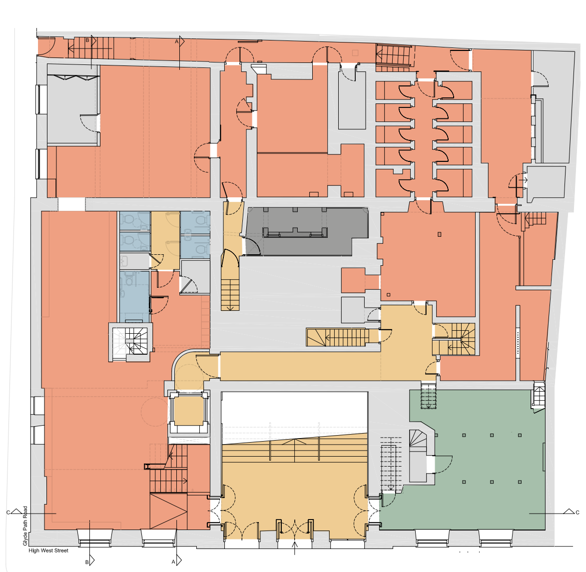
The building does not have a facilities manager. The trustees directly oversee operations following restructuring.

Shire Hall operates as an interactive museum, within the building under lease from Dorset Council, managed by the Shire Hall Trust.

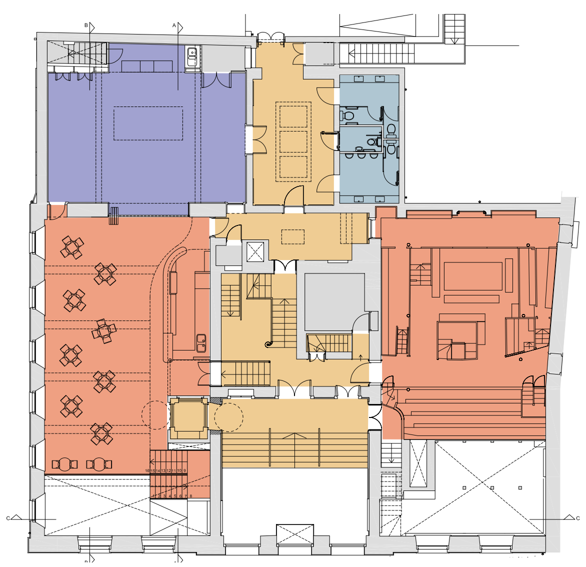
The museum offers self directed visits, tours, audio guides, a gift shop, café, and spaces for private and corporate hire, including the 120-person council chamber. Building users tend to be both general visitors, passers-by, school and community groups.

The Shire Hall includes two residential flats located on the second floor. The flats are rented out, and the revenue generated is received directly by the trust. The flats are managed by a property management company on behalf of the museum trust.

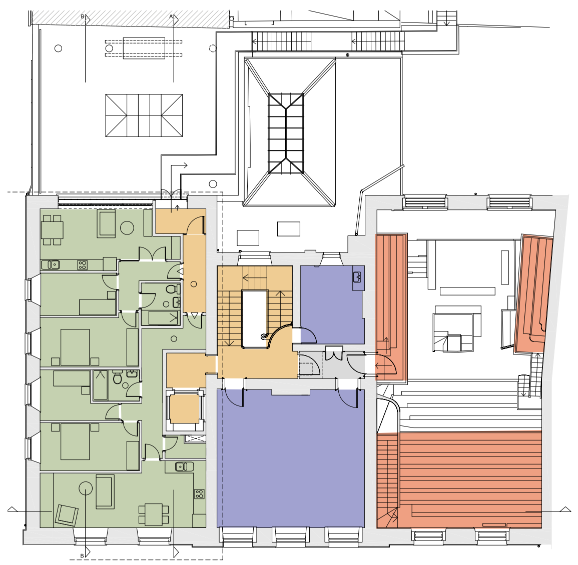
Building Ownership	Leased by the Shire Hall Trust from Dorset Council (full repairing lease, excluding external fabric and structure – including the flats)
Management	Shire Hall Trust - Incorporated Charity Overseen by Board of Trustees Key staff: Director, Operations Officer, Museums assistant, finance officer, and cafe manager.
Days of opening	Monday - Saturday
Typical hours of operation	Visitor hours: 10am-4pm Staff hours: 9am-5pm
Out of hours use	Paranormal events 7pm-2:30am Twice monthly evening events 7pm-10:30pm
Occupancy	Learning room – 70 Council Chamber - 120 Grand Jury Room (exhibition space) - 40 Cafe - 90 (estimated) Small meeting room - 6
Users	General visitors, locals, passers-by, school and community groups
Uses	Community groups, e.g.. Memory cafe (Age UK) Events - Concerts/performances, markets Exhibitions Training days e.g.. council training Paranormal events in the cells.



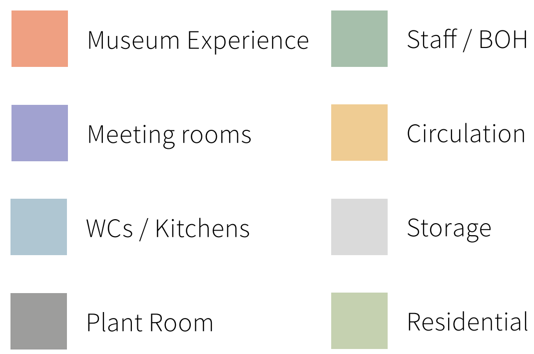
Ground & Lower Ground Floor Plan



First Floor Plan



Upper First & Second Floor Plan

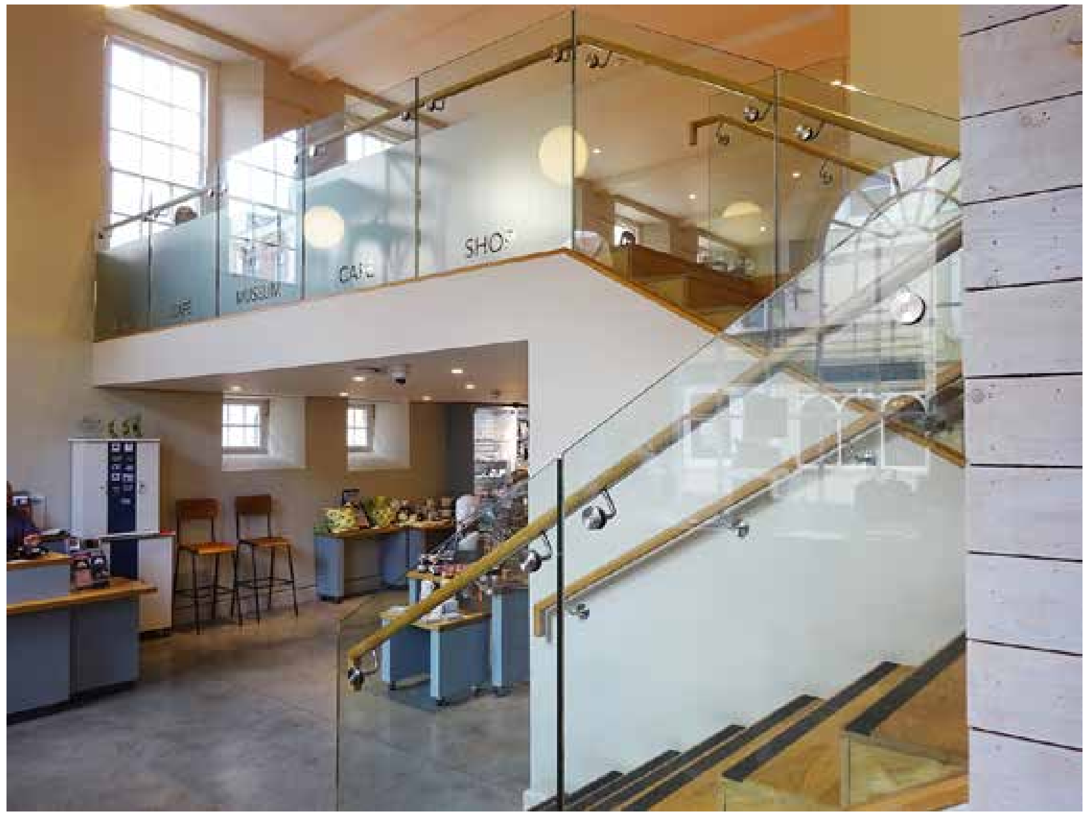


2.4 Occupancy & Management

Entrance Foyer

Staff Office

Shop



Reception, shop and cafe

All images courtesy of Shire Hall Museum

2.4 Occupancy & Management

Learning Room

Cafe

Cells

Cells

All images courtesy of Shire Hall Museum

2.4 Occupancy & Management

Crown Court

Grand Jury Room

All images courtesy of Shire Hall Museum

2.5 Building & Services

2.5.1 Building Construction

The front elevation is Portland Ashlar, with side and rear elevations of red brick, while the lower extensions are rendered. The building incorporates typical period stone detailing including cornicing, quoins, window surrounds, banding and plinths.

The original building is surmounted by a pitched roof with slate finish, lead valleys, and flashings. The extensions to the rear are surmounted by a combination of flat roofs with a GRP covering assumed overlaid over the original asphalt and a pitched roof with slate finish.

The main roof is insulated at ceiling joist level. The insulation is believed to have been installed as part of the 2017 works.

Several sun tubes penetrate the roof to provide daylight to the internal bathrooms and hallways in the flats.

The rainwater goods for the most part are cast iron, with the exception of some uPVC rainwater goods to the rear and an assumed lead parapet gutter to the front elevation.

Fenestrations are predominantly single glazed timber sash, with some metal Crittal style windows to the flats. Secondary glazing has been installed in isolated locations.

The lower storey extensions to the rear date from the 19th century, but were partially reconstructed in 2005 in brick and blockwork construction. The flat roofs to these extensions may also have been replaced or insulated during the 2017 works, however this is uncertain.
There is a small carpark to the rear with tarmacadam finish and footpath with flagstone finish.

The flats are accessed via a galvanised steel staircase and walkway to the rear.

Internal finishes are typical and include painted plaster board ceilings, painted plaster walls, a mixture of floor finishes including stone slab, power floated concrete, timber boards, vinyl and carpet, with painted, stained/varnished joinery.

2.5.2 Building Condition

A building condition survey was commissioned by Dorset Council in May 2024, and carried out by Hartnell Taylor Cook.
The report highlighted issues with the building and services, however, these are yet to be addressed.

Damp & mould

The Shire Hall report that there are some damp issues to some of the space, particularly highlighting one of the store rooms in the basement.

Mould has been reported in the flats. One of the flats has been treated for mould. Both flats have had new extract fans installed recently to try to overcome the damp/mould issues.

Windows

All windows are openable to provide natural ventilation, particularly for the summertime. However, staff find it difficult to open windows as they are large and heavy. Opening these windows is a two-person job. Some windows are secondary glazed, but not all.

Flat 1 window is in disrepair, this is to be repaired by the council imminently.

Access

There is generally poor access to services, particularly to roof mounted equipment to lower roofs to the rear. No gates are provided in handrails along walkway and no safe routes across the roof to equipment. There is poor access to rainwater goods on rear façade.

Mould around flat window

Damp in basement

2.5.3 Building Services

The services were installed as part of the major refurbishment, completed in 2018.

Heating

Heating is provided by 2 Gas Boilers, which were installed during the 2018 refurbishment.

The boilers do not have functioning automatic/ programmable controls. The boilers were set up with a programmable timer when installed, however this is currently disabled. Staff manually enable the heating using the boost function on the boiler when heating is required.

The heating system only has two zones, which is not practical. More individual room controls are desired.

No heating is provided to the entrance hall or to the museum spaces on the lower ground floor and basement level. Museum visitors generally keep their coats on.

Shire Hall staff are unsure if the underfloor heating (UFH) to the museum reception/shop is functional. Unsure if there are any UFH controls.

Staff office at lower ground floor level is reported to be very cold.

The building is unheated outside of occupied hours.

Ventilation

There are active ventilation systems installed in the Cafe, Learning room, Grand Jury Room, Council Chamber, WCs and in the two residential flats.

The Shire Hall report that the ventilation systems generally don't work, and have never functioned properly after the installation during the 2017 works.

The Grand Jury Room and Learning space get very stuffy, particularly at higher occupancy levels.

The building generally stays cool in the summer, particularly the museum spaces on the lower ground floor and basement level. However, Spaces on upper floors and south facing spaces overheat in summer, particularly at high occupancies.

Lighting

Typically, lighting is LED throughout the refurbished areas, although some areas are still installed with fluorescent fittings.

Hot Water

Domestic Hot Water is provided via 2 local electric hot water heaters

Services routes through the basement

SURVEYS & ASSESSMENTS

3.1 Building Surveys

3.1.1 Building Fabric Condition Survey

A Building Condition Survey from April 2024 was provided by the client. The results of the survey are summarised as follows:

Structure

The building is constructed with solid masonry walls, solid or suspended timber floors and timber roof structures. Some elements have been subject to alterations, although no defects were noted to suggest these were detrimental to the building's existing structure and its function.

The original timber roof structure is in fair to poor condition, with isolated instances of rotten timber purlins and signs of past beetle infestation.

The basement experiences damp conditions and some basement timber beams were found to be rotten and friable.

External Walls

Defects noted to the external masonry walls include poor, eroded or cement pointing, vegetation growth, delamination of stone and brick faces with some cracking to stone. There is also staining internally that appears to correlate to the defective pointing.

Roofs

The roof finishes all appear generally sound albeit, there are slipped and damaged slates. There was no water ingress noted internally correlating to the damage, however it likely will cause issues if repairs are not undertaken. Pointing to the ridges, hips and chimney stacks, that were visible, are in fair condition.

There are pockets of lichen growth at various locations throughout all roof areas that will require clearing.

The flat roofs to the rear of the property appear to be finished with GRP covering, they are in fair condition however there is staining and algae growth with some evidence of water pooling.

There appears to be blistering to the one flat roof. There is also staining below the flat roof in the rear corridor and store. Isolated perished mortar and damaged brickwork was noted to the parapets and copings to the rear flat roofs.

Rainwater goods

Gutters, hoppers and downpipes are cast iron for the most part with sections of modern uPVC to the rear of the property. The rainwater goods are generally defective and in poor decorative order, there are areas of damp to the external walls as a result of the defective guttering and downpipes.

Windows

Fenestration throughout is predominantly single-glazed painted timber sash windows. The sash windows require realignment and isolated repairs to frames, some also have secondary glazing with slight mould and some cracking to the glazed panes.

The sash windows to the flats are suffering from mould as a result of condensation build up.

External Doors

Timber doors are in poor decorative order and swollen. Internally, the walls are stained adjacent to the fire exit to the left elevation.

The doors should be overhauled, rotten timber replaced and eased and adjusted to ensure they open and close correctly. In addition, the joints between the stone elevation and timber frames to the doors and windows require resealing.

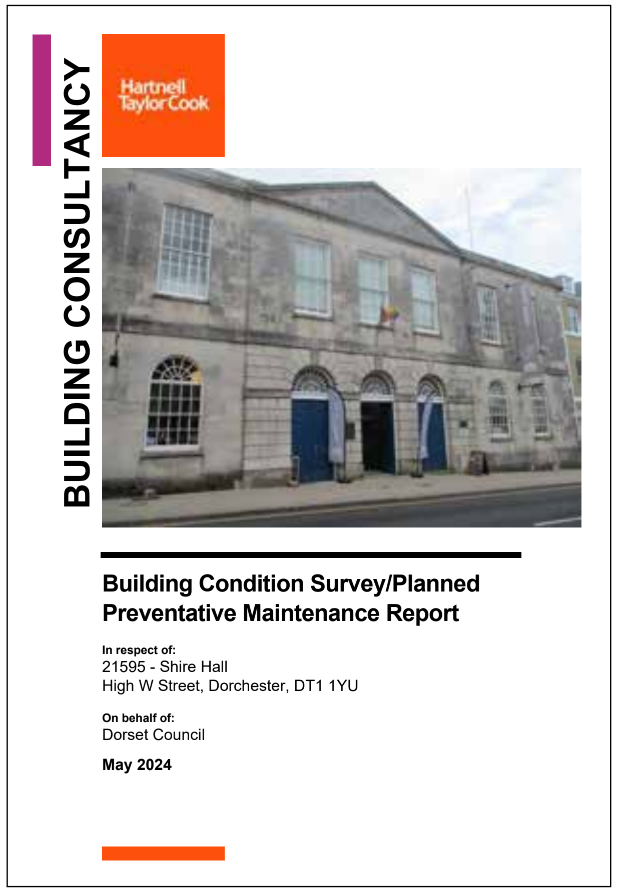
Ceilings

Ceilings comprise of proprietary painted plasterboard, all were noted to be in reasonable repair. Some damage was noted in the form of minor cracking and paint peeling as a result of water ingress.

Internal Walls

Walls are a combination of brick, stone, painted plaster and, some historic timber panelling exists. No significant defects were noted, although the finish in multiple areas of the basement is damaged as a result of damp and water ingress. In addition, the left-hand wall is stained in multiple locations due to defective pointing and rainwater goods.

The Lower Ground floor/basement has been finished with a number of cementitious materials. The removal of non-breathable wall coverings, to the damp affected areas of basement, is recommended to allow the walls to breathe. The mechanical ventilation should also be repaired or replaced.



3.1 Surveys & Assessments

3.1.2 Building Services Condition Survey

Skelly & Couch undertook a site survey on 3rd February 2025.

The report is based on visual inspections made at this time. The building was open and occupied to staff and the public throughout the survey. The purpose of the survey was to identify M&E equipment, their condition and capacity to help inform a replacement strategy and provide a base point for energy and carbon reduction measures.

A number of items of note were identified through the survey and discussion with staff. Generally poor access to services, particularly to roof mounted equipment to lower roofs to rear.

- Generally poor labelling of services throughout, particularly mechanical services.
- Boilers are set up with programmable timer however this is currently disabled. No heating thermostats appear to be present throughout the building.
- Building is heated under a single zone
- Radiators do not have individual TRVs
- Staff believe there is underfloor heating to the museum reception & shop area and basement WCs, which is backed up by information in the O&M file, however the location of the underfloor heating manifold is unknown and the heating is therefore not able to be controlled or adjusted.
- Mechanical ventilation controls are not functioning and/or disassembled in many areas. This is likely contributing to the damp issues identified in the basement and residential flats noted in the condition survey.

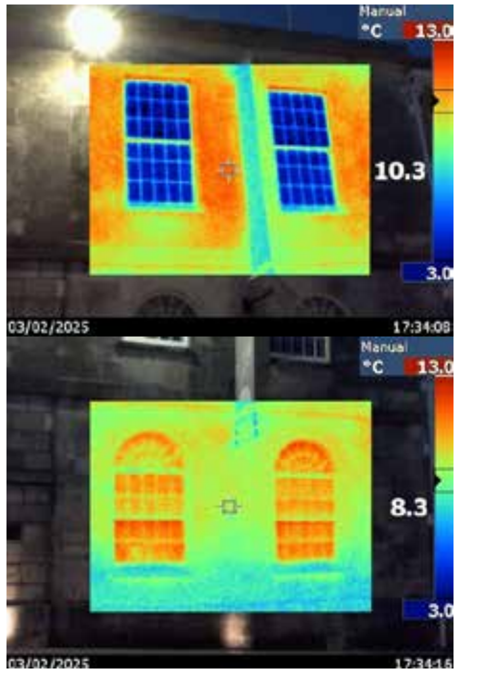
Recommendations for further analysis:

- Detailed survey of existing M&E installation
- Detailed survey to identify outputs of the heat emitters in each space.
- Temperature monitoring in peak season to assess performance of control
- CO_2 monitoring in heavily occupied spaces to assess performance of control

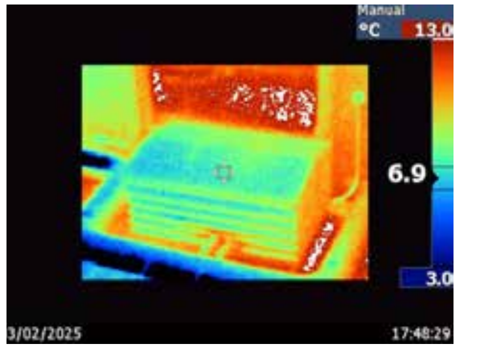
3.1.3 Thermal Imaging Survey

The key findings from the Thermal Imaging Survey were as follows:

- Secondary glazing is present to some of the spaces in the Shire Hall. The age and configuration of the secondary glazing is variable, however, the windows with secondary glazing were found to perform well thermally compared to the areas with single glazing only. This is evident from the thermal imaging.
- The main pitched roof was found to be insulated, performing well thermally. No significant heat loss was evident from the ornate ventilation grilles in the ceilings of the Crown Court or Grand Jury Room.
- The thermal imaging shows thermal bridging around the structural columns in the staff office, which is located above an unheated undercroft.
- Heat loss is evident around services penetrations on the rear flat roof.



Difference in heat loss in windows with and without secondary glazing



Heat loss through roof cowl over ventilation opening into basement plant room

3.2 Fabric Performance

Little information is available on the building's original construction and no intrusive inspection into the building fabric has been carried out. Existing U-values have been based on the details provided by Philip Hughes Associates. Typical building practices of the time have also been considered. Proposed U-values have been either calculated using the wall build ups detailed below or estimated using tabulated CIBSE guidance. Current knowledge or assumptions of the building fabric are set out in the following table.

	Fabric Element	Construction	Condition	U-Value (estimated)	Notes / Assumptions
EXTERNAL WALLS	South façade	880mm Portland ashlar assuming 6% lime mortar 20mm lime plaster internally		1.40 Above ground 1.48 Below ground	Assumed solid Portland ashlar construction only with internal plastering
	West facade	620mm brick assuming 16% lime mortar 20mm lime plaster internally		0.94 Plastered above ground 0.51 Plastered below ground 0.99 Above ground 0.55 Below ground	Assumed solid brick wall with internal plaster Below ground U-Values estimated using CIBSE Guide A table 3.22 detailing basement walls based on depth.
	North façade	620mm brick assuming 16% lime mortar 20mm lime plaster internally		0.94 Plastered above ground 0.51 Plastered below ground 0.99 Above ground 0.55 Below ground	Assumed solid brick wall with internal plastering where applicable Below ground U-Values estimated using CIBSE Guide A table 3.22 detailing basement walls based on depth. Partially rendered externally A combination of exposed and plastered brick internally
ROOFS	Main roof	200mm of insulation between timber joists 26mm layer of lath and plaster ceiling.		0.25	Multiple pitches clad in slate Sun tubes penetrate the roof providing daylight to internal bathrooms and hallways in flats
	Extension roof	50mm insulation 26mm lath and plaster. 200mm concrete slab and 5mm bitumen		0.65	Unknown construction – assumptions of insulation and depth from Phillip Hughes section
GLAZING	Single glazed sash			4.80	U- Value estimated using CIBSE Guide A table 3.29 Found in TIC, Reception, Café, Stairwell & Flats
	Single glazed sash with modern secondary glazing			2.40	U- Value estimated CIBSE Guide A table 3.29 Found in the Grand Jury room
	Historic single glazed sash with historic secondary glazing			3.00	U- Value estimated using CIBSE Guide A table 3.29 Adjusted U-value for historic secondary glazing Found in the Crown Court
	Glazed lanterns			5.3	U-Values estimated using CIBSE Guide A table 3.29 with roof adjustments in table 3.30 and 31 Found in the learning room and rear entrance with glazing at ceiling level
FLOORS	Basement floor	130mm brick		0.57	Construction based on visual inspection
	Museum floor	75mm polished concrete 50mm Insulation 200mm concrete slab		0.49	Unknown construction below concrete museum floor

Summary of assumed building fabric performance by type

3.3 Building Services

3.3.1 Overview

Generally, services are relatively new as the 2017/2018 works included complete replacement of most services. However, a number of problems are evident which have led to the services not being used or not being suitable for use. These include:

- Lack of record information meaning operation of systems is not understood
- Some services broken or not maintained
- Few obvious controls
- Controls are not user-friendly

A number of issues have been raised by the staff and volunteers which are summarised below. A more in-depth review of the systems follows.

Ventilation

- The Shire Hall report that the ventilation systems generally don't work and have never functioned properly after the installation during the 2017 works.
- The Grand Jury Room and Learning space can get very stuffy, particularly at higher occupancy levels.
- Mould has been reported in the flats. Both flats have had new extract fans installed recently to try to overcome the damp/ mould issues.

Heating

- 2No. gas boilers supplying space heating
- Heating system only has two zones, so they must heat more of the building than desirable if i.e. only one room is in use.
- The boilers do not have functioning automatic/programmable controls - Boilers were set up with programmable timber during the works, however, this is currently disabled. Staff generally manually enable the heating using the boost function on the boiler when heating is required.
- Shire Hall staff are unsure if the underfloor heating to the museum reception/shop is functional. It is unclear if there are any controls. It is currently not used.
- Staff office at lower ground floor level is reported to be very cold.

Overheating

- Building generally stays cool in the summer, particularly the museum spaces on the lower ground floor and basement level.
- Spaces on upper floors and south facing spaces overheat in summer, particularly at high occupancies.

Windows

- All windows are openable to provide natural ventilation, particularly for the summertime. However, staff find it difficult to open windows as they are large and heavy and can be a two-person job.
- Some windows are secondary glazed, but not all.
- Flat 1 window is in disrepair; this is to be repaired by the council imminently.

Platform lift

- Not functioning

3.3.2 Thermal comfort

From our observations and staff feedback, it appears that the typical conditions experienced in Shire Hall are not generally considered to provide adequate thermal comfort.

The heating strategy is dependent on the staff opinion and public feedback of a space rather than a systematic, programmed and monitored approach. This can lead to unreactive heating and poor zonal control which may cause overheating in some areas with lack of heat in others.

The current ventilation is limited due to a few factors:

- Many ventilation control panels are non-functioning or damaged
- Staff are unaware on the controls of the ventilation systems in place

There is no current cooling within Shire Hall however management seemed to indicate that this is not a problem currently. The basement and cells do stay cool throughout the year and can often be used as cool areas if the building becomes hot.

It is possible that these issues affect visitor numbers and would be more likely to cause problems with the aspiration of larger occupancies in the future, particularly when renting spaces to external organisations who may be more demanding in their requirements.

The benefit to this strategy is that the building energy use is much lower than expected, and this is discussed more in section 4.

3.3.3 Immediate recommendations

It is clear that the knowledge of the existing systems is not currently held within the museum, and that there may have been issues with the building handover which has led to a lack of maintenance.

We recommend the following are carried out:

- Ventilation systems reviewed, repaired and utilised.
- Flat ventilation systems repaired or replaced, it may be that acoustic issues have led to them being turned off.
- Internal temperature is monitored to ascertain occupant comfort.
- Market research to understand who may want to hire spaces and their expectations.
- Staff members and volunteers to be trained in control of the building systems.

3.3.4 Utilities

The gas supply and utility meter for the museum is in the store off the Induction Area in the North-West corner of the building. The gas meter is U16.

Location of utility mains water meter and stop cock not identified. This is believed to be in a locked cupboard in the South-West corner of the Introduction Area (based on the Philip Hughes Associates drawings). Access into this cupboard was not possible during site visit, the Shire Hall note that the key to this cupboard is missing.

3.3 Building Services

3.3.5 Heating

Heating is served by two wall-mounted 70kW MHG ProCon 77 condensing gas boilers located in the basement plant room.

Control

The heating is separated into two zones, each served by twin-head, variable speed Grundfos Magna3D 32-100 180 pumps.

- Zone 1:
  Café
  Learning room
  Grand Jury Room
  Intro room
  Stairs
- Zone 2
  Staff office
  Courtroom
  Corridor near the staff kitchen.

It is unclear which zone serves the museum reception & shop. The museum areas to the basement and the entrance hall are unheated.

The boilers appear to have been set up with a programmable timer mounted on a pump control panel during the 2018 works, however this is currently not functional. It is unclear if the controller is broken or just disabled. There were no heating thermostats found during our survey, and staff do not know of any.

After discussion with the staff, we understand that heating for the museum is controlled entirely manually. Heating will be turned on If deemed necessary when the staff open the museum and will turn the heating off or boost it depending on the staff and customers feedback during opening hours.

The system includes the following ancillaries:
- Pressurisation set, dosing pot & air/dirt separator.
- Expansion vessel
- Boiler condensate discharging into stub stacks
- Boiler flues entering chimney.

Pipework

Pipework is generally well insulated throughout the building in foil faced insulation but has damage to the insulation in some areas. Pipework runs at high level in museum areas on lower ground floor/ basement and are painted in black. The ancillaries are insulated to a varying degree. Valve bags are generally present, but gaps can be found between rigid insulation and valve bags. The pipework material was not identified due to enclosure in insulation.

First Floor

Second Floor

Ground Floor

igure 3-3: Basement plant room housing 2

2no condensing gas boilers

Zone 1

Zone 2

3.3 Building Services

Heat Emitters

A variety of heat emitters are present across the building including:

- Cast iron column radiators
- Panel radiators
- Underfloor heating (50°C Flow temp)
- Local oil-filled portable electric radiator in gift shop

Some of these emitters have TRVs but not all.

The majority of spaces within the building are heated by large historic cast iron radiators, including:

- Crown Court
- Grand Jury Room
- Classroom
- Circulation Areas

It was stated that these retain heat well for a while after heating is turned off.

The following spaces are heated by panel radiators:

· Introduction area
· Back-of-house circulation lower first floor
· Lower first floor WCs

The Shire Hall staff believe there is underfloor heating to the museum reception & shop area and basement WCs, which has a polished concrete floor. This is backed up by a certificate of commissioning for underfloor heating present in the O&M file.

The certificate suggests this is LTHW with a mixing manifold and associated pump, however,
there was no heating on at the time of the site visit, and the location of the manifold is unknown, therefore it is not clear if the system is working.

An electric radiator is used in the reception due to the space not being well heated by the heating underfloor heating system.




Cast iron radiators to Learning space, Crown court, & circulation space.

Electric oil radiator in the reception

3.3 Building Services

3.3.6 Ventilation

There are no active cooling measures at Shire Hall, the only strategy to reducing room temperatures are through natural and mechanical ventilation.

Mechanical ventilation systems are present in the spaces described below. The remainder of spaces are generally naturally ventilated. Basement plant room has permanently open ventilation ducted to roof cowl (no fan).

Mechanical ventilation fans generally appear to be by Nuaire, however, specs are unknown due to poor labelling, poor access and lack of O&M information. Ventilation controls are in some areas not functioning and/or disassembled.

Ductwork routes were not traced.

Ground floor WCs & volunteer kitchen

- Extract only
- System name: WC extract EF1
- Fan location: Unknown
- Fan controller located in store adjacent to WCs
- Fan status in failure at time of survey

Basement museum areas

- Supply & extract ventilation
- System name: Unknown
- Fan location: Assumed to be located externally on low rear roof (refer to images)
- Fan controller located in store adjacent to cells in basement
- Controller broken/disassembled. Empty back-box on wall and Nuaire cover on floor.

First floor WCs

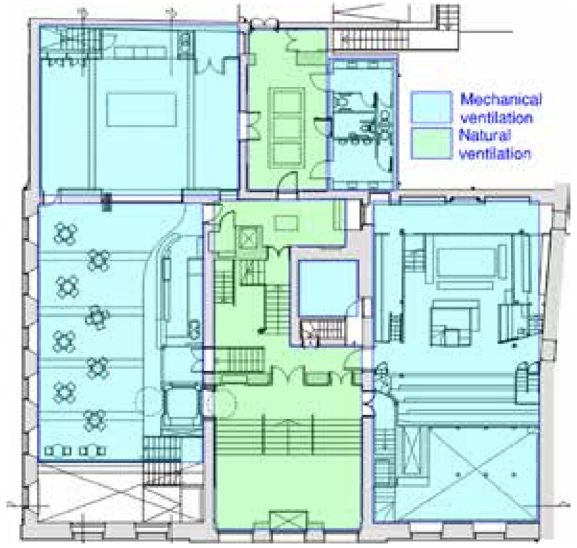
- Extract only ventilation through-the-wall extract fans
- Ventilation controls appear to be via PIR in WCs

Learning space

- Supply ventilation through combination of linear slot diffusers and ceiling diffusers.
- Open ventilation grille in centre of rooflight, unclear what the purpose of this is. Rooflight covered by glazed lantern at roof level.
- System name: Learn Supply SF2 SF3
- Fan location unknown
- Fan controller located in learning space
- Automatic controls do not appear to work
- Manual enabling and override of fan speed possible from controller.

Kitchen

- Kitchen extract ventilation and café supply ventilation provided by separate systems.
- Kitchen extract ventilation through canopy above servery
- System name: Kitchen extract
- Fan controller on wall adjacent to café servery
- System operational during site visit
- System set to manual controls
- Fan location assumed to be located on lower roof to rear of building.
- Kitchen extract running during site visit



First Floor

Second Floor

Ground Floor

Mechanical Ventilation

Natural Ventilation

3.3 Building Services

Café

- Café supply ventilation with heater battery, supply to café through slot diffuser on face of bulkhead above cafe counter.
- Manual enabling and override of fan speed possible from controller.
- System name: Café supply air SF1
- Fan controller on wall adjacent to café servery
- System set to manual controls
- Heater in fault during site visit
- Fan location: assumed to be located on lower roof to rear of building.

Crown court

- Mechanical extract through 1no. historic ornate ceiling grille. Second ceiling grille open to roof void above.
- System name: C Court Extract EF7
- Extract fan EF7 located in roof void
- Fan controller located in the Grand Jury Room
- Extract fan currently disabled.
- Automatic controls do not appear to work.

Grand Jury Room

- Mechanical supply and extract ventilation with heat recovery (MVHR).
- Extract through historic ornate ceiling grille
- Supply location not identified
- System name: unknown
- MVHR unit located in roof void
- Fan controller located in the Grand Jury Room
- Ventilation system disabled and controller disassembled.

Left: MVHR unit located on low rear roof assumed to server basement museum areas. Access up to unit not possible. Right: assumed system controller location in store at basement level.

Open ventilation grille in centre of rooflight to learning space. Glazed lantern at roof level above rooflight.

Cafe supply & extract ventilation

Cafe extract fan on low rear roof

Historic ornate ceiling grilles in Crown Court and Grand Jury Rooms

Grand Jury Room fan controller disassembled

MVHR unit in roof void assumed to serve grand Jury room

Ductwork connection onto ceiling grille in roof void.

3.3 Building Services

3.3.7 Domestic Hot Water

Shire Hall's DHW is entirely supplied via local electric hot water heaters with no central DHW system in place. Most spaces with hot water requirements are located very centrally and so a small DHW distribution is present.

1No. Heatrae Sadia Multipoint 50L is believed to serve:

- Café
- Volunteer kitchen
- Staff kitchen
- WCs

1No. Heatrae Sadia Hotflo 10L serves: Learning space

Pipework was not traced but assumed to be insulated copper.

3.3.8 Cold water

The cold water pipework is generally insulated in foil faced insulation. High level services in museum areas on lower ground floor/basement are painted out in black. Possible water tank located on roof of Learning space indicated on Philip Hughes Associates drawings. It was not clear what, if anything, this serves.

3.3.9 Drainage

The rainwater drainage is generally external. Rainwater goods are generally in poor condition as reported in the 2024 condition survey.

Rainwater goods are cast iron to the front and side of the building, and a mixture of cast iron and PVC to the rear.
Foul drainage SVPs and main pipework internally are generally plastic pipework.

3.3.10 Electrical

The incoming mains enters in the storeroom off the introduction area. The main panel board is located adjacent to the CT cut-out and utility meter. The incoming supply is 200A TPN

The flats on the second floor have separate utility meters which are billed to the tenants directly.

As noted above there are issues with the supply to the café.
The main panel board feeds distribution boards throughout the building. The main panel board and distribution boards were installed during the 2017 works and appear to be in good condition. Cables are generally installed on cable trays.

3.3.11 Telecoms

Incoming telecoms could not be identified
A data rack is located in the store off the Introduction area, into which the telecoms will likely be routed.

Cafe store cupboard housing an electric water heater

Incoming supply and adjacent switch panel

3.3 Building Services

3.3.12 Lighting

New lighting was installed to most areas in the building during the 2017/2018 refurbishment works. These lighting installations are generally LED fittings; however, fluorescent light fittings appear to have been used in some areas. Lighting systems dating to before the 2017/2018 works appear to be fluorescent.

The WCs & storerooms generally have PIR lighting controls, all other internal spaces have manual controls.
The control strategy for external lighting is unknown.

The table below details the types of fittings found through Shire Hall.

SPACE	FITTINGS
TIC (Staff Office)	Suspended LED battens
Entrance	Track mounted spotlights LED Pendants
Reception & Gift shop	LED Pendants Recessed spotlights Recessed downlights Recessed display strip lighting
Introduction area & Store	Track mounted spotlights Suspended battens
AV Experience	LED Strip lighting
Basement/Cells	Surface mounted battens Surface mounted LEDs Surface mounted fluorescent fittings LED strip lighting
Café	Recessed downlights
Learning space	Recessed downlights
Back entrance	Surface mounted LEDs
Crown court	LED Pendants
Stairwell	LED Pendants Surface mounted spotlights
Staff kitchen	Surface mounted battens
Grand Jury room	Track mounted spotlights

There are a mixture of integrated and standalone emergency fittings. A static inverter is located in roof void though it is unclear which areas it serves.

Externally there are wall mounted light fittings outside the rear entrance and on the roof, lighting the access route to the flats.

There are also recessed floor fittings (strip/spots) which uplight the façade and a building mounted streetlight.

Pendant fittings in circulation areas

Fluorescent fittings within basement corridor



Track lighting in left to right: Main Entrance, Grand Jury Room, and Introduction Area




Suspended/surface mounted linear fittings in second floor meeting room, volunteer kitchen, and basement corridor

3.3 Building Services

3.3.13 Other

- No fire-fighting supplies have been identified or are known about.
- No access control is incorporated, manual locks used throughout.
- There are CCTV cameras throughout and externally.
- There is an intruder alarm system with panels at main and rear entrance.
- There is an MXPro fire alarm panel adjacent to the main entrance with a repeater by the car park entrance to the rear of the building.
- There is an aspirating smoke detection system to the Crown Court and Grand Jury rooms, with a standard system elsewhere.
- Disabled WC alarms are located in the accessible WCs.
- Disabled refuge alarms and control panel are located at the refuges and entrance.
- No induction loops were identified.
- A platform lift serves the cells however at the time of visit this was out of order.
- Lightning protection appears to be in place

3.4 Residential Flats

No billing data has been available for the flats as these are metered separately and not under the control of Shire Hall. However, there were problems noted particularly with ventilation and condensation issues which should be addressed separately.

3.4.1 Power

Each flat has a separate incoming utility electrical supply. Size and details of supply unknown. Electricity is billed directly to the tenants by the utility. Utility meter and consumer unit located in each flat.

3.4.2 Water

Location of incoming water unknown.

3.4.3 Gas

None present

3.4.4 Telecoms

Unknown

3.4.5 Rainwater drainage

Refer to the Museum services description section.

3.4.6 Foul drainage

Foul Drainage present in the following locations:
· Flat 1 & Flat 2 bathrooms, kitchens & utility cupboards – assumed present, not seen
SVPs and main pipework generally plastic pipework.

3.4.7 Cold Water

Mains cold water is provided to the following locations:

- Flat 1 & Flat 2 bathrooms, kitchens & utility cupboards

3.4.8 Hot water

Domestic hot water (DHW) is provided to the following locations:

- Flat 1 & Flat 2 kitchens, bathrooms

The DHW is provided by a Heatrae Sadia Electromax Combined electric flow boiler and direct un-vented hot water cylinder.

3.4.9 Space heating

Boiler installation:
a Heatrae Sadia Electromax Combined electric flow boiler and direct unvented hot water cylinder is located in the utility cupboard in each of the two flats.

Emitters including controls:
The flats are heated by LTHW panel radiators with TRVs fed off the flats' respective electric boilers. The communal hallway outside the flats is heated by an electric radiator.

Electric boilers to flats

Left: LTHW panel radiator to flat. Right: Electric radiator to communal hallway

3.4 Residential Flats

3.4.10 Distribution pipework & insulation

Distribution pipework not traced. Pipework is generally insulated throughout in foil faced insulation.
Exposed final tails observed.

3.4.11 Ventilation

Mechanical extract ventilation is present to both flats.

A Nuaire extract fan is located in the roof void above the flats is assumed to serve the flats. However, the ductwork routes were not traced. The fan does not appear to function, and no controls were located during the survey. Ducted kitchen extract hoods and some evidence of ceiling extract valves present in both flats.

Ceiling mounted Vent-Axia extract fans are present in the bathrooms of both flats. The Shire Hall note that these were installed recently to combat moisture/mould issues in both flats.

Insulated pipework to flats

Ceiling mounted Vent-Aixia extract fans in flat bathrooms

Right: Un-labelled extract fan in roof void. Left: Ventilation ductwork from kitchen cooker hood

4.1 Energy & Carbon Assessment

The following section investigates the existing energy and carbon performance of the museum. An estimated heating demand has been calculated in order to set a carbon baseline, based on the available building information and reasonable assumptions.

Industry benchmarks and standards are used for a comparison as well as metered data for the observed use of the building.

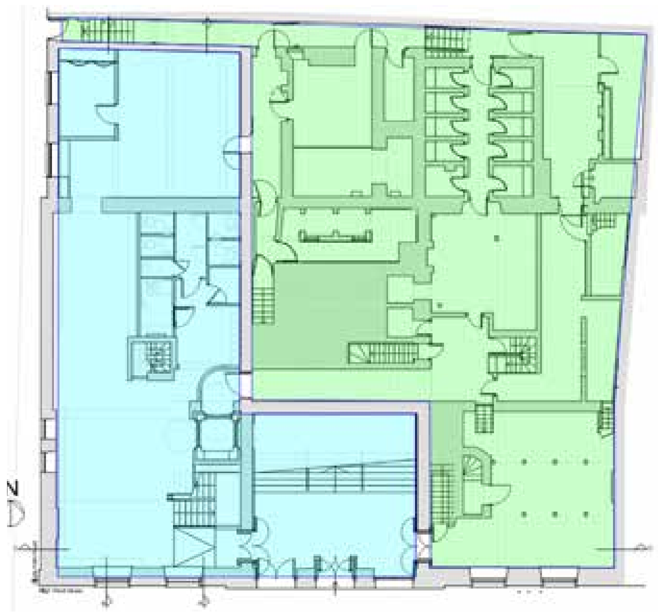
4.1.1 Building Areas Scope

For the purposes of this report, the residential flats have been excluded from all heat loss and emission calculations due to the lack of metered data available. All services and utilities are supplied independently and are not impactful on Shire Hall's energy usage. The adjacent diagrams show the external elements considered to have heat loss from the building.

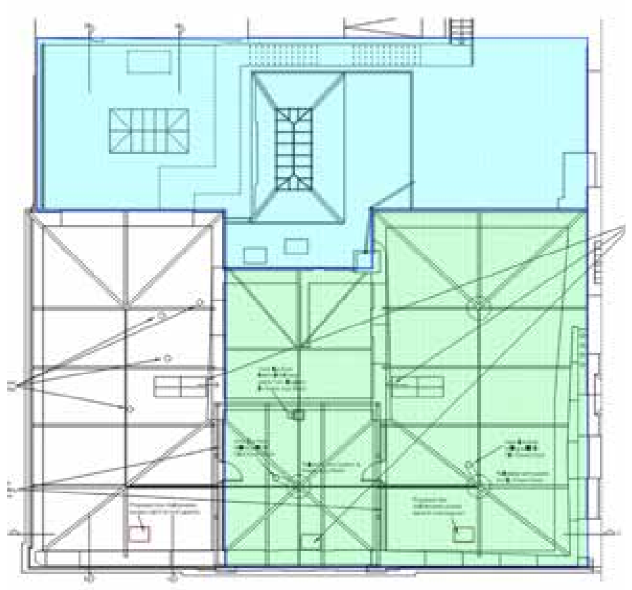
Heat transfer between Shire Hall, the adjacent building and flats has also not been considered on the assumption that these spaces are heated to the same temperatures as Shire Hall. The heat lost through the un-highlighted areas therefore would be captured within the Flats' energy measurements and would not reflect the museums energy use.

The highlighted areas are then the only areas considered for potential fabric improvements.

Difference in highlighted colour indicates a separate wall or roof construction.



Ground floor plan highlighted per floor construction



Roof plan highlighted per roof construction

Later addition

Original construction

South, west and north elevations showing areas considered with heat loss, highlighted per wall construction

4.1 Energy & Carbon Assessment

The following section investigates the existing energy and carbon performance of theShire Hall Museum. An estimated heating demand has been calculated in order to set a carbon baseline, based on the available building information and reasonable assumptions.

Industry benchmarks and standards are used for a comparison as well as metered data for the observed use of the building.

4.1.2 Collection of Data

The Shire Hall Museum was subject to a building services survey and a qualitative thermal imaging survey performed by Skelly & Couch on 2nd Feb 2025. During this, information on the museum was witnessed and discussed with management.

The following were witnessed, inspected or reviewed with building management staff*:

- Locations of heat emitters within the building
- Discussion on the management of the building heating
- Locations of mechanical/natural ventilation supply/extract
- Discussion with staff on the usage of the mechanical ventilation within the building
- Collected data from installation notes of some ventilation ducts
- Metered energy bills - provided by management
- Record information – provided by management
- Visual inspection of building fabric
- Photographs and thermal imagining used to assess building fabric estimations.

*Note: The building was open and occupied to staff and public throughout the survey.

Energy data

Monthly utility electricity and gas meter readings for the museum have been provided by the museum's management for the period Jan 2022 to Dec 2024.

As there is no sub-metering data available, only overall utility use information has been used. It is therefore not possible to obtain detailed energy use data for various end uses, so approximations have to be used.
No meter readings are available for the two flats. These are billed directly to the tenants.

Building information

Building floor, wall, roof and glazing areas have been determined based on the building layouts drawn by Philip Hughes Associates, the surveyors and architects involved in the previous 2017/2018 works.

Carbon conversion factors

The annual carbon emissions have been calculated based on The National Calculation Methodology modelling guide – 2021 Edition.

Values used in carbon conversions for different fuel types are detailed in the adjacent table.

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Electricity emissions (kgCO2/kWh)	0.163	0.160	0.153	0.143	0.132	0.120	0.111	0.112	0.122	0.136	0.151	0.163
Gas emissions (kgCO2/kWh)	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21

Gas and electricity CO2 emission and primary energy factors for buildings other than dwellings.
Extracted from the National Calculation Methodology 2021

FUEL TYPE	UTILITY CHARGE (P/KWH)
Electricity	22.875
Gas	10.524

Shire Hall Museum's utility rate per fuel type excluding standing charges

4.2 Heat Energy Usage Estimate

4.2.1 Design temperature assumptions

The predicted annual heat energy usage of the existing Shire Hall Museum has been calculated to provide a comparison with metered data for the museum's operational energy and carbon performance before interventions are investigated, and to allow apportionment of the heating energy use to different aspects of the building.

A number of methodologies are available to estimate the expected heating energy requirement in a building, as detailed within the accompanying fact sheets.

In this case, due to the limited building information available, a simple heating degree days calculation was carried out. A brief overview of the assumptions made within this methodology are included below:

This degree days method allows a peak load to be converted into a yearly heating consumption rate, accounting for the local climate.

A brief overview of the assumptions made within this methodology are included below:

- Bournemouth heating degree days with a base temperature of 17.5°C.
- An internal design temperature of 21°C throughout the whole building.
- Peak load calculation using external temperature of -4°C based on the CIBSE tabulated extreme temperature for Southampton.
- The adjacent buildings (flats and has been assumed to be heated to the same internal temperature of 21°C
- The building is heated constantly throughout the year. This should result in an over-estimate of the energy use based on the heating being off for a period every day.

4.2.2 Infiltration

An air permeability test was carried out on the building, resulting in an air leakage at 50Pa of 10.71 m3h-1m-2.

This has been converted into an average annual air infiltration rate using two methods for validation

- 0.25 ACH - Conversion via empirical data in CIBSE guide A, figure 4.15, based on the building volume.
- 0.3 ACH - Conversion via tabular data in CIBSE guide A, table 4.16 for partially exposed buildings.
- The value of 0.3 has been used in the calculations.

Where improvements have been made to building openings, an estimated improvement to this infiltration value has been made to account for an improvement in the buildings heat loss via infiltration.

4.2.3 Ventilation assumptions

	Space	Flow rate	Assumptions
NATURAL	TIC (Staff office)	40 L/s	Building infiltration rate would ventilate the space sufficiently so natural ventilation was not considered to be used here – Heat losses in this room would consequently be calculated within the infiltration heat loss
	Staff kitchen	15 L/s	As above
MECHANICAL	Shop WCs	36 L/s	
	Introduction room	50 L/s	
	AV Experience room	30 L/s	
	Back lobby WCs	42 L/s	
	Volunteers' kitchen	8 L/s	
	Café kitchen	585 L/s	Assumed that kitchen extract was operational for ~25% of opening hours – This was factored into the heat loss value calculated
	Learning space	30 L/s	Infiltration is in excess of this therefore further ventilation has not been included.
	Crown Court	200 L/s	Infiltration is in excess of this therefore further ventilation has not been included.
	Grand Jury	200 L/s	

Estimated Shire Hall Museum room flow rates and assumptions used for calculating operational energy baseline

4.2 Heat Energy Usage Estimate

4.2.4 Baseline results

The steady state heat losses were then calculated along with the proportion of heat lost through each element. The pie chart adjacent illustrates these by loss type as a proportion of the total heat lost.

Key observations are as follows:

- Fabric losses account for over half of the buildings heat loss
- Infiltration and ventilation losses are significant, at ~20% of total losses each
- External walls are the element type with the largest heat loss, at 48% of all fabric losses.
- Single glazing accounts for 53% of all external glazing heat loss.
- Both the Grand Jury room and Café Kitchen have significant ventilation heat losses.

The steady state heat loss of Shire Hall was calculated based on the available information of building fabrics and spaces along with observations made while surveying the building.

It should be noted that, due to the thick, heavy stone walls, the steady state calculation for heat loss through walls is unlikely to reflect reality as the building will rarely be in a steady state, with the internal surfaces either heating up or cooling down depending on whether the heating is on or not. This also makes it difficult to heat the space to a comfortable temperature as there will usually be significant radiant losses to the walls.

A dynamic thermal model would provide more accurate results.

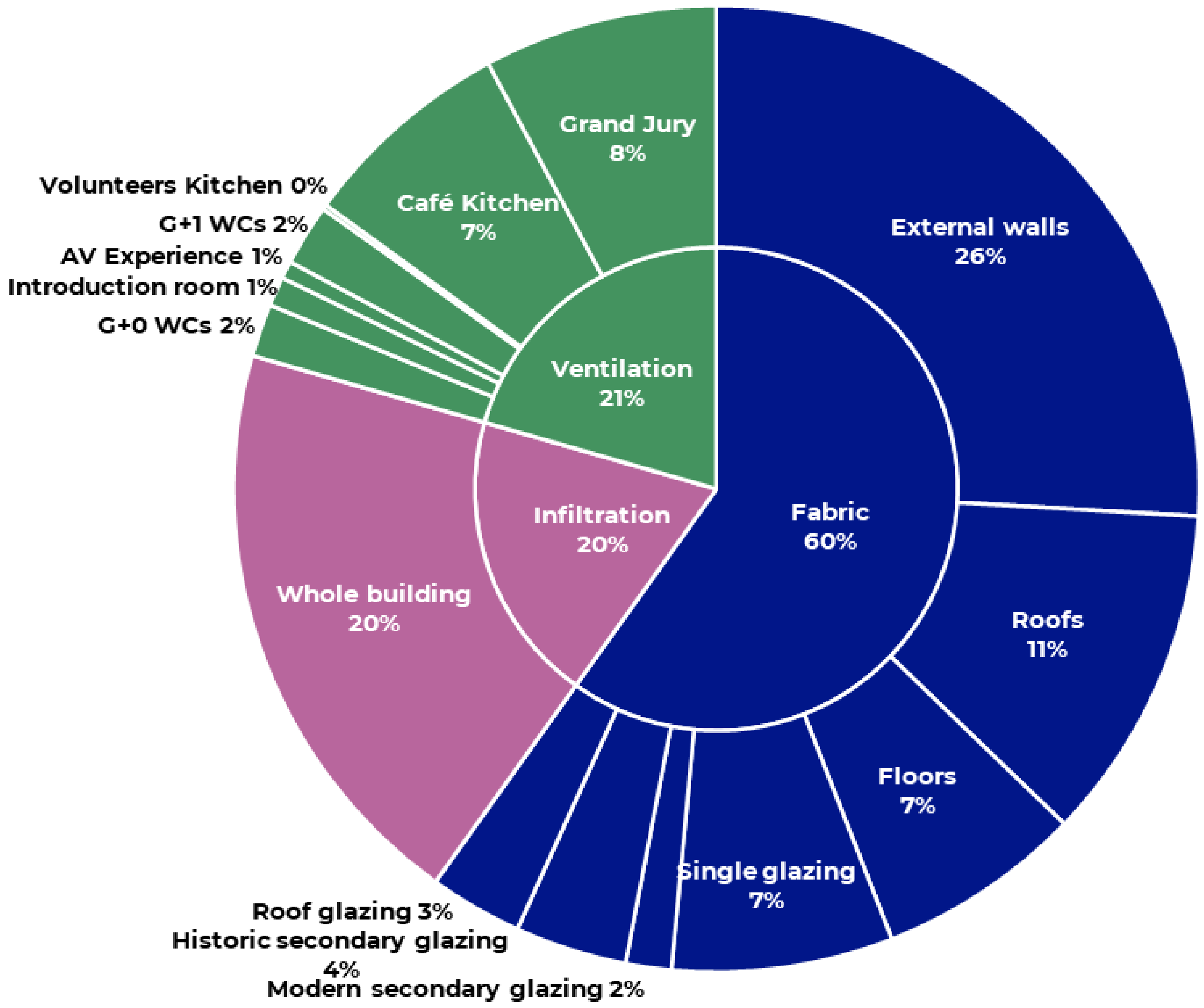
4.2.5 Operational energy baseline

The heating energy estimate from the degree days calculation was used to generate an operational energy baseline which has been to compare the buildings expected energy use, under typical comfort conditions, to industry benchmarks.

Energy savings from improvements are made upon the assumption that the building systems will be managed according to the assumed internal target temperature of 21°C.

It is likely that employing strategies suggested in this report will increase the buildings energy/heating usage because of this as calculations have been based on occupant comfort as opposed to currently achieved conditions.

In reality, improving building fabric will likely increase temperatures and improve comfort in the museum rather than saving any energy as the industry standard temperatures are not currently met.



Estimated steady state heat losses from existing Shire Hall Museum, expressed as a proportion of the total building heat loss based on the type of loss and the individual fabric type

4.3 Metered Data

4.3.1 Metered annual energy use & carbon emissions

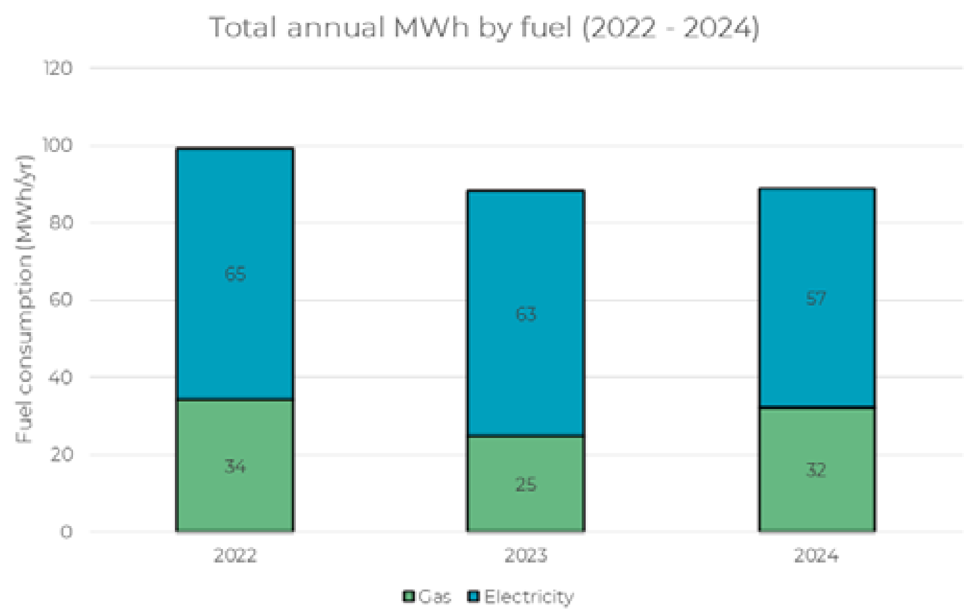
The adjacent graphs show the total energy consumption , cost and carbon emissions respectively for the museum by fuel type in 2022, 2023, 2024.

Note that the meter data does not include the two flats which have independent utility supplies and are billed directly to the tenants. The flats have been excluded from the review of the current energy usage. Key findings were as follows:

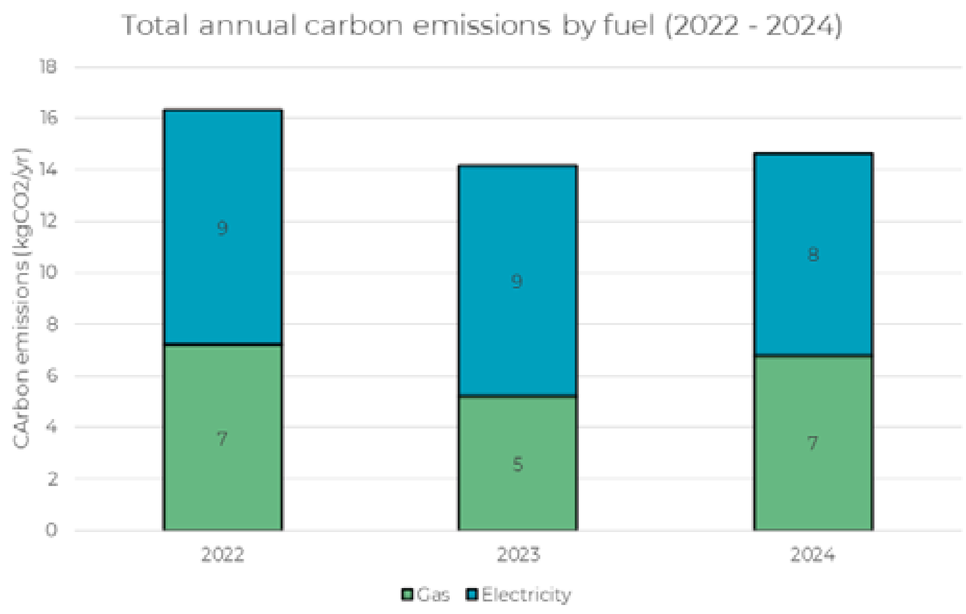
Energy
- Energy usage has remained consistent over the past three years ranging only by around 8 MWh (10%).
- The average annual energy use for the period was 93 MWh.
- Of the average energy use, 67% was electricity use and 33% was gas usage.

Carbon
- Total average carbon emissions relating to building energy use in the period were 16 tCO_2.
- Of the total carbon emissions, 56% related to electricity use and 44% related to gas usage

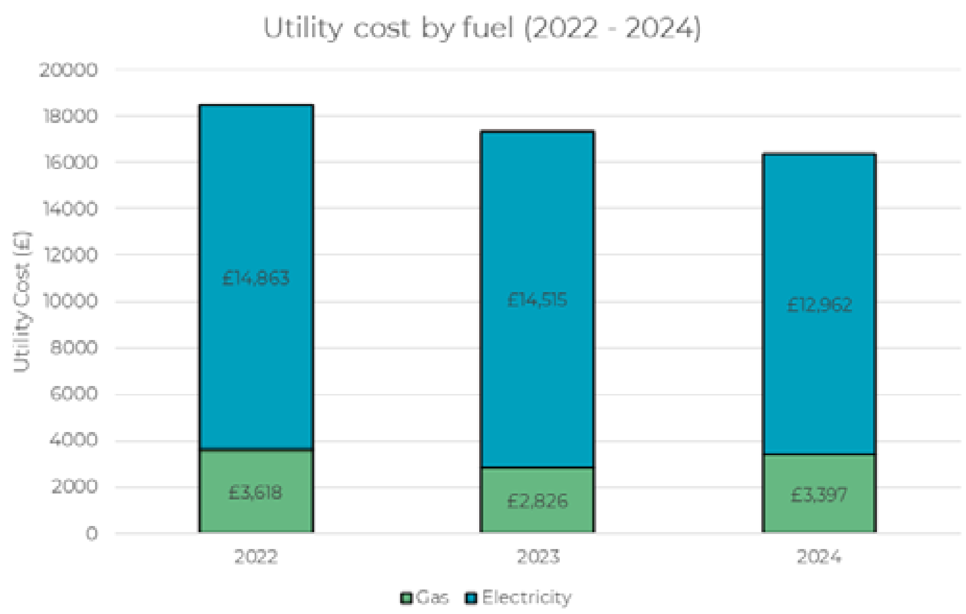
Cost
- Total annual cost has decreased consistently for the past three years
- 2023 had the lowest gas cost out of all the collected data.



Total annual energy consumption by fuel in MWh based on 2022-2024 meter readings



Total annual carbon emissions by fuel in tCO_2 based on meter readings from 2022-2024



Total annual cost by fuel in £ based on current energy rates excluding standing charges

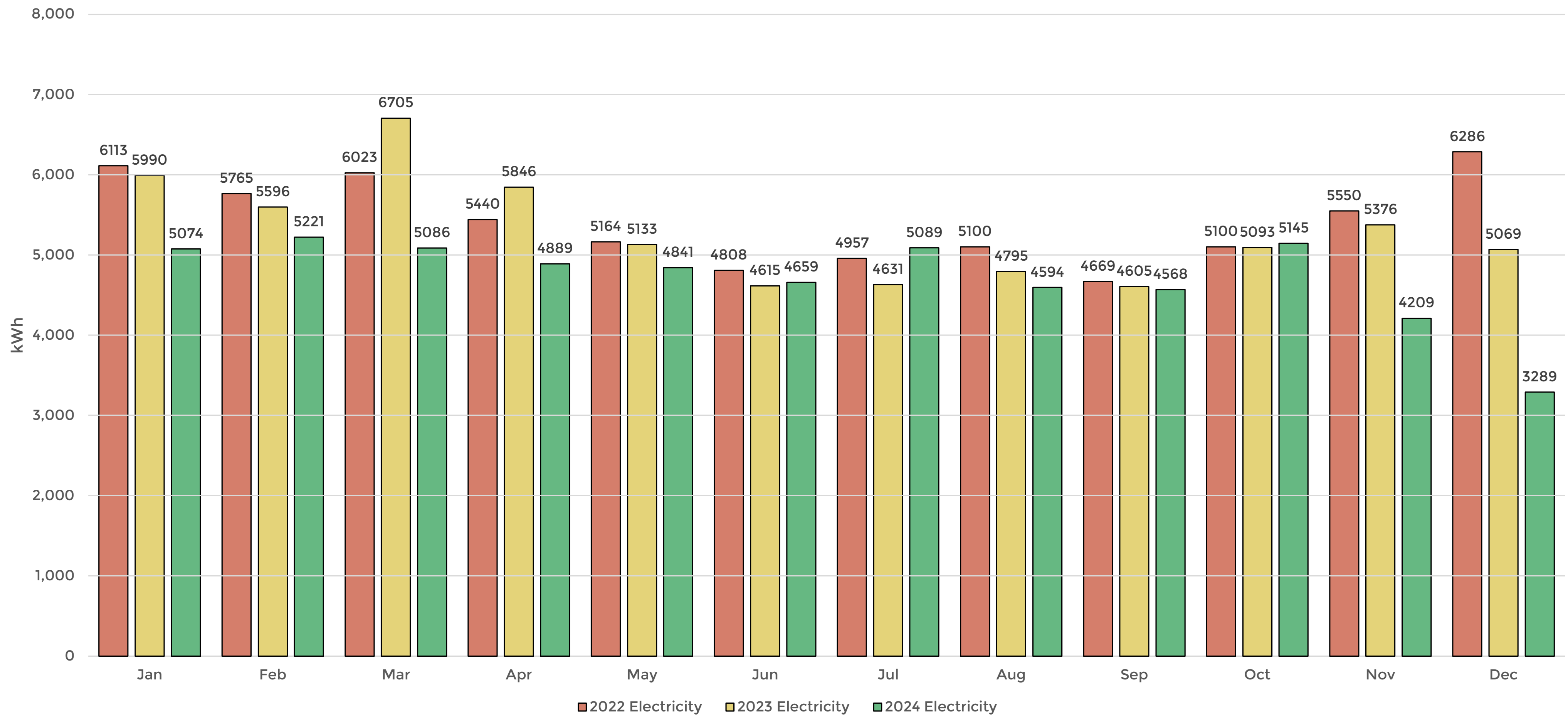
4.3 Metered Data

4.3.2 Metered monthly energy use

Electricity
The adjacent graph shows electricity consumption in kWh for Shire Hall per month for the period of January 2022 to December 2024.

Key observations across the figures are as follows:

- The final two months in 2024 are much lower than the rest of the months, it is unknown exactly what caused this, but it is likely due to a closure or a lack of events in this period.
- Electricity consumption was relatively consistent throughout the years: the lowest average monthly consumption is in September and was only about 32% lower than the highest monthly consumption in March.
- 2024 generally has lower monthly consumption
- The highest electricity consumption was found to be in the winter/early spring months of December to March. This may be attributed to some electric heating used in the gift shop.
- Electricity consumption in summer months is slightly lower, this could be a result of reduce monthly lighting usage as daylight is readily available in most spaces of the museum, or just indicating the electric heating not being used.



Shire Hall Museum metered electricity use per month (kWh) in the period Jan 2022-Dec 2024.

4.3 Metered Data

Gas (Space Heating)

The adjacent graph shows the metered monthly gas consumption for the museum. For comparison the estimated heating loads calculated with Heating Degree Days for Bournemouth (base temperature 17.5°C) has been included.

Key observations are as follows:

- The monthly heating usage is greatly below the estimated requirement to keep spaces comfortable. This is likely due to the building not being heated up to the standard comfort temperatures as have been used in the calculations.
- The monthly gas consumption appears to follow a seasonal profile tracking the shape of the heating degree days estimates, albeit significantly reduced.
- January through to March has the highest monthly consumption each year
- The consumption was 0 across June - September for most years showing the heating was off for these summer months.

Shire Hall Museum metered gas use per month (kWh) in the period Jan 2022-Dec 2024 with comparison between 2022, 2023 and 2024. Plotted against the estimated monthly heating loads based on Heating Degree Days for Bournemouth with a base temperature of 17.5°C.

4.4 Building Benchmarking

The adjacent graph shows Shire Hall's metered energy use and calculated operational baseline presented as kWh/m2 of gross internal floor area.

The metered energy use, particularly heating, is significantly lower than both the estimated (calculated) operational baseline, and typical and best practice.

There could be several reasons for this. The most likely scenario is that the building is not being heated up to standard comfort temperatures as have been used in the calculations or for the periods expected.

Fabric improvements and heating control improvements are therefore unlikely to reduce energy consumption but will instead raise internal temperatures and improve comfort conditions.

Should the Museum wish to increase revenues from hiring out spaces etc, it may be desirable to heat to a higher level, potentially resulting in increased energy use. For this reason, calculations have been based on the estimated operational baseline.

The building benchmarks would be based on the internal temperatures typical of this type of building, therefore warmer than in Shire Hall.

This building energy use and estimated baseline have been compared with the following industry benchmarks, which give an idea of the energy use expected in buildings of similar usage (museums):

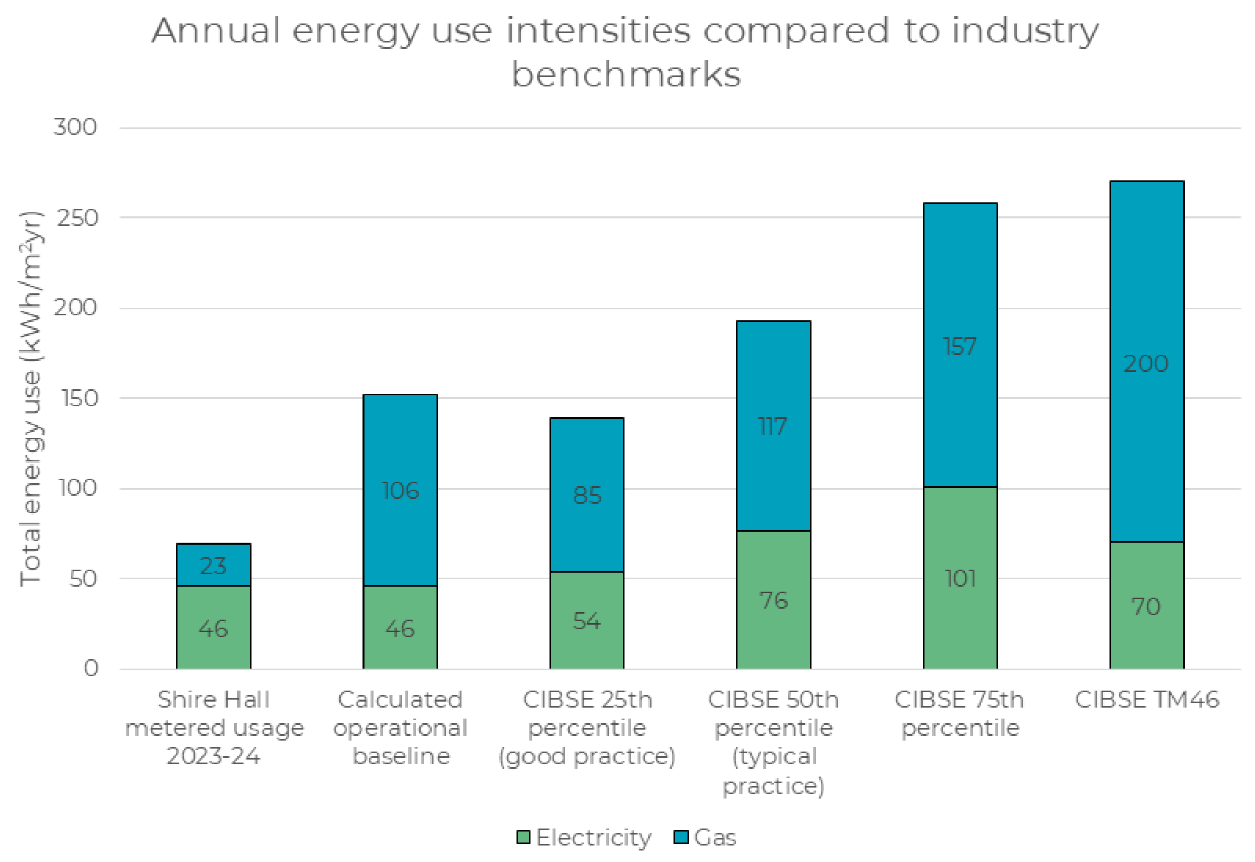
- CIBSE TM46 – A 2008 technical memoranda detailing energy benchmarks of building types.
- CIBSE benchmarking 25th percentile – For public buildings, museums. Stated source DEC (Display Energy Certificates). Aligns with good practice buildings.
- CIBSE benchmarking 50th percentile – For public buildings, museums. Stated source DEC. aligns with typical practice buildings.

The calculated baseline from degree days was for heating energy only, so the electricity energy intensity has been taken from the averaged metered value.

Key observations are as follows:

- The estimated (calculated) operational baseline for gas consumption is lower than the 50th percentile benchmark from CIBSE benchmarking based on museum DEC data. This indicates that if the museum would be heated comfortably, the building would still be in CIBSE's top 50%.
- The metered electricity usage, and thus the electricity baseline, was better than CIBSE's typical practice and TM46 benchmark for electrical energy use.
- Using the calculated required heating, the museum was found to be just below the typical practice range for its fossil fuel use. This is likely due to having electric domestic hot water heating.
- The calculated operational baseline is very similar to the typical practice standards for benchmarks.

Benchmarks are based on buildings of a similar use, and do not take into account the age or anything else that may affect the energy use, so are useful only to give a comparison of what might be expected.



Annual energy use intensities (kWh/m2yr) comparison between the Shire Hall Museum metered usage 2022-24, the calculated operational baseline, CIBSE museum benchmarks by percentile, and CIBSE TM46 benchmark.

OPTIONS APPRAISAL

5.1 Objectives

The purpose of the Options Appraisal is to assess the range of potential measures that could be implemented to reduce the energy use and carbon intensity of Shire Hall.

As part of the Whole Building Approach, Historic England recommends that interventions should be implemented according to the 'Energy Efficiency Hierarchy'.

This order of priority reflects not only the relative benefits, costs, and technical risks of interventions but the 'three pillars of energy transition' - sufficiency, efficiency, and generation:

- Firstly, reduce energy consumption in real terms (sufficiency)
- Secondly, minimise unavoidable energy use (efficiency)
- Lastly, generate energy from 'renewables', also known as low and zero carbon technologies, where possible (generation)

There are a number of benefits to reducing the buildings energy consumption:

1. Reduced CO2 emissions to align with net zero aims.
2. Reduced strain on utility infrastructure e.g. electricity grid.
3. Reduced running costs.
4. Improve occupant comfort e.g. through thermal comfort, reduction of draughts etc.
5. Reduced capital cost for new plant e.g. reduction in heat pump size.

A strategic approach to decarbonisation ensures that the most effective and beneficial measures are implemented first, providing a clear roadmap for energy-efficient retrofitting.

Shire Hall's established aims and objectives for the decarbonisation strategy include:

1. Gain a better understanding of the performance of the existing building and its service systems.

2. Address defects and deficiencies in the existing systems and fabric.

3. Identify opportunities to reduce energy demand; improve energy efficiency and transition towards low or net zero carbon services.

4. Improve thermal comfort and indoor environmental quality, including increased control of environmental conditions for occupants.

5. Reduce energy bills wherever possible, to help with ongoing financial constraints

6. Increase the intensity of use of the building in order to generate further revenue to secure the long-term resilience of the organisation.

The analysis of the building showed low energy use compared to industry benchmarks, however there are known issues with thermal comfort and the building is not used as intensively as desired.

Increasing the use of the building may increase energy consumption, therefore improving the control and efficiency of building services and improving fabric performance are key priorities to avoid an increase in running costs.

The issues around damp and non functioning existing ventilation systems should also be key priorities to address through the introduction of any new decarbonisation measures.

Repair and maintenance of existing systems should be prioritised as a starting point, in order to ensure the existing building is running as efficiently as intended.

5.2 Energy Use Intensity Targets

The UK Net Zero Carbon Building Standard (UKNZCBS) Pilot Version was published in 2024 with the aim of providing a clear framework for achieving net zero carbon in the built environment. The guidance provides set energy use intensity targets as part of the Net Zero Operational Carbon definition.

These targets measure the total energy use (excluding on-site renewables) to achieve an energy use intensity compatible with the expected availability of renewables in 2040, the deadline which the standard sets.

The standard gives guidance for a "stepped" and "one-go" retrofit. In the stepped retrofit, guidance is given for the progressive reduction of energy use intensity year-on-year.

The "one-go" retrofit assumes all the improvement works will be carried out in one go, and no improvements will be made following this. The targets are more lenient for earlier starting dates, under the assumption that technology and knowledge will improve which will make carbon reduction easier.

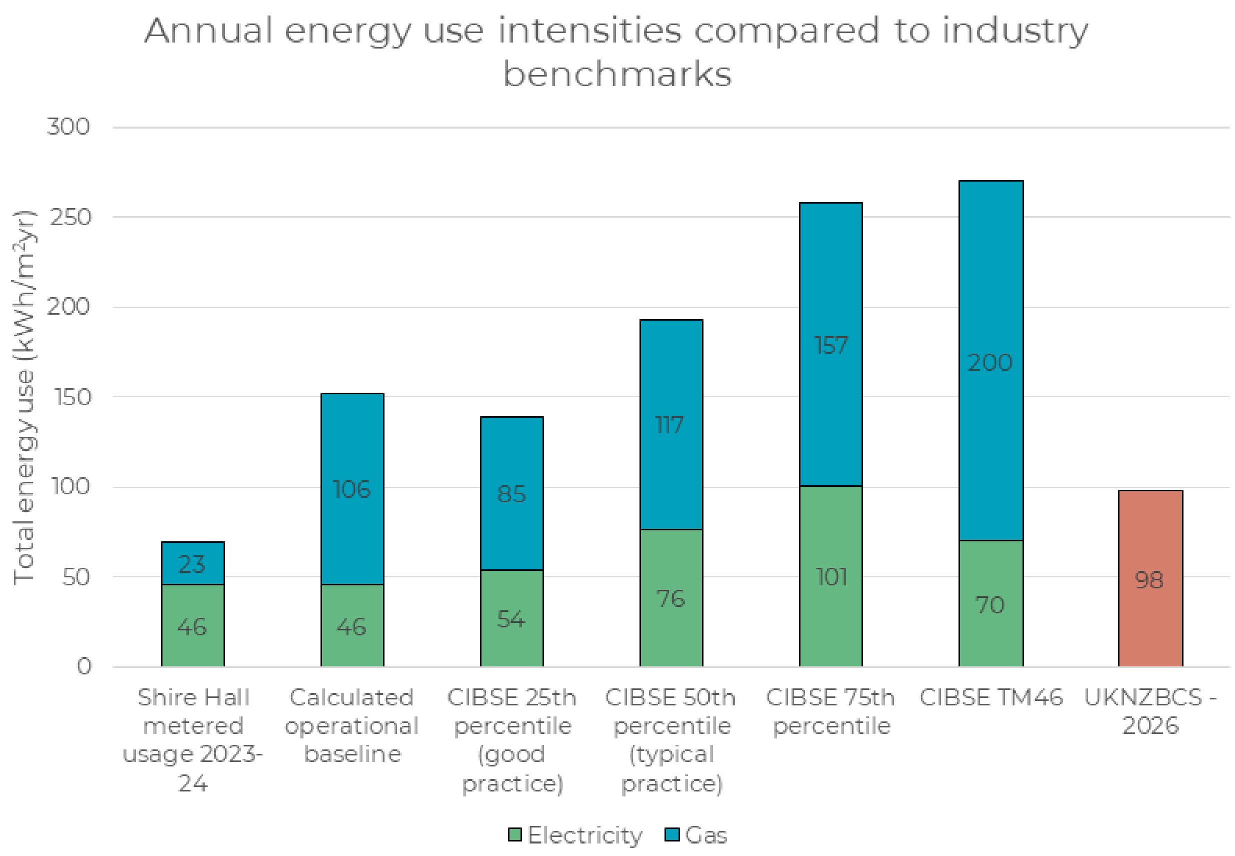
For the purposes of this exercise, the "one-go" EUI target has been applied.

Based on a 2026 start, the energy use intensity for a "Cultural & Heritage – Collection" building is: 98 kWh/m2yr.

If demand can be reduced sufficiently to meet these emissions and the remaining energy for operations is supplied by on or off-site renewable, zero carbon sources, the building can be considered Net Zero Operational Carbon according to these definitions.

Key observations for Shire Hall are as follows:

- The metered data is already significantly below the target for total energy usage.
- Changing the heating system to an electric system, ideally a heat pump, and ensuring all electricity is purchased through a renewable only tariff, the building could meet the net zero definitions. However, this would likely go up if typical comfort conditions were met, as discussed above.
- The calculated operational baseline requires a 36% overall energy reduction to align with the UKNZCBS target. Again, changing to a heat pump would provide this.
- The gas consumption makes up for the largest proportion of the estimated emissions. Reducing heat load and changing to a heat pump would be areas to focus on.



Annual energy use intensities (kWh/m2yr) comparison between Shire Hall metered usage 2022-24, the calculated operational baseline, CIBSE benchmarks and the UKNZCBS

5.3 Reducing Energy Consumption

A range of opportunities to reduce energy consumption have been explored, including building fabric improvements, services upgrades, system efficiencies, metering and controls. The relative benefits and risks of potential interventions are captured within the Options Appraisal table in section 5.5, and summarised below.

5.3.1 Building fabric

Owing to the historic and listed nature of the building fabric there is limited opportunity for internally or externally insulating existing walls or insulating the existing floors.
The main building roof was insulated during the 2017 works and the build up of the lower extension roofs is unknown.

The area of building fabric that appears most suitable for improvement is the glazing, as many of the existing windows are single glazed timber sash windows in reasonable condition.

This could either be done through adding secondary glazing, re-glazing the existing frames with new slim-line double-glazed units or vacuum glazing, or by replacing the windows with new double glazed sash windows to match the existing. However, any works to the existing windows would need to be informed by a detailed assessment of the significance and condition of both the frames and glazing, and would be subject to listed building consent.

5.3.2 System efficiencies

Lighting is already largely LED although some fluorescent fittings can be found. Lighting is manually controlled within most areas, though PIR sensors are present in some WCs and storerooms.

Replacing any remaining non-LED fittings for a more efficient LED counterpart and adding improved lighting controls, e.g. presence detection-based dimming in circulation areas and areas not in regular use, would give a slightly improvement to the building's energy consumption.

5.3.3 Metering

Metering is an effective method to reduce consumption and is often relatively low cost to implement. Shire Hall's current metering system could not give detailed data to interrogate its energy usage.

Metering of individual systems can help determine the separate usages within the building, allowing savings to be made within those areas.

5.3.4 Controls

There are a number of opportunities to improve control of systems within your building and reduce energy consumption. Use of local controls can reduce the unwanted use of energy in unoccupied rooms and smarter controls such as PIRs and temperature sensors can further improve this. A more sophisticated but costly method would be to implement a BMS system to monitor and control the entire building independently.

Improving the controls of the heating system would provide several benefits to the museum, Technologies such as smart radiator valves will allow for more zonal controls of the heating, reducing usage within unoccupied rooms. Additionally, this can provide more comfort to spaces as they can be programmed to heat rooms to comfort temperature in advance of occupancy.

5.4 Low/Zero Carbon Technologies

Along with the building fabric improvements, services upgrades, and energy saving measures discussed in the previous section, the implementation of low/zero carbon (LZC) technologies will play a key role within the carbon reduction strategy.

Key opportunities for implementing LZC technologies on site at Shire Hall have been reviewed and their application to Shire Hall analysed below.

The following LZCs have been reviewed for their suitability at Shire Hall:

- Photovoltaics
- Solar thermal
- Heat Pumps
- Biofuels
- Variable refrigerant flow

5.4.1 Photovoltaics

Photovoltaic (PV) panels use photons in sunlight to create an electrical current. They are typically placed in an exposed location where they have access to bright, unshaded sunlight. Based on current developments in this technology, the maximum efficiency of panels is around 25%. In the UK, the optimal position for a panel is south facing and pitched between 20-35 degrees to the horizontal. Panels should be arranged to avoid shading from adjacent buildings, trees etc.

There is precedent for PVs on Grade 1 listed buildings however, this often comes with a requirement for them to be well hidden. In the case of Shire Hall, the south pitched roof would be the most advantageous location for PVs however placements here may be visible from the street.

Solar slate technologies are available which aim to mimic traditional slate tiles to provide an integrated aesthetic. However, they are currently expensive with long paybacks and shorter life spans than original slates. If new panel installation is deemed appropriate it would be subject to planning and listed building approval.

5.4.2 Solar thermal

The Shire Hall Museum does not currently house a centralised domestic hot water (DHW) system. In order to effectively utilise solar thermal technology, a new DHW system would need to be implemented throughout the museum.

Considering the low DHW load required at the museum compared to the amount of infrastructure required to implement solar thermal, this would not be feasible as a means of decarbonising Shire Hall. It is also not possible to export unused hot water from solar thermal panels, unlike surplus electricity with PVs which overall offer a simpler solution to generating power effectively.

5.4.3 Air-source heat pumps (ASHP)

Air Source Heat Pumps (ASHPs) are low-carbon heating systems that extract heat from the outside air—even at low temperatures—and use it for internal heating. They operate using electricity only. ASHPs typically have efficiencies of 2.5 to 4, meaning they can produce 2.5 to 4 units of heat for every unit of electricity used. This high efficiency, combined with the ability to pair ASHPs with renewable electricity (e.g. from solar panels or green tariffs), makes them a key technology in the push to decarbonise buildings and meet climate targets.

New air-source heat pumps could be installed externally on the flat roof of the rear extension. These could be screened for acoustic and visual comfort if required.

Two ASHPs would allow the site to be entirely heated with air-source heating, which could provide a long-term low carbon solution particularly as imported electricity carbon factors reduce with grid decarbonisation. Immediate carbon reductions could be seen as this will replace all gas heating and the carbon factor of heating would reduce by nearly 77%.

Decentralised ASHP

These heat pumps are mounted on external walls, directly adjacent to the rooms they are serving, and therefore have a visual impact on the exterior. Most of the external walls at Shire Hall are of historic construction and high heritage significance, which restricts the number of spaces which can utilise this technology.

Exhaust ASHP

This technology could be used to heat spaces with exhaust heat from the current ventilation systems. If the building's heating system was replaced with this technology, an upgrade to the current ventilation distribution would also be required.

Additionally, due to the heater being on the air supply, the ventilation would need to be used constantly during open hours to provide heat to the spaces, and alternative heating measures would be needed to provide space heating if ventilation was not wanted.

Domestic hot water ASHP

The internal plant space in Shire Hall is extremely limited. Fitting an ASHP for DHW heating would be very constrained and, depending on the location, this technology would likely also require additional DHW distribution systems to be in place to benefit. This technology is not feasible to implement.

5.4.4 Ground-source heat pump: open or closed loop

The requirement of a large space for boreholes makes this technology inaccessible for Shire Hall as it has no external grounds to utilise.

5.4.5 Surface water-source heat pump

Despite a tributary of the river Frome within the proximity of Shire Hall, it is still in excess of 200m therefore expensive and complicated. As a result, this technology is not suitable for the Shire Hall Museum.

5.4.6 Biofuels

The storage or delivery requirements are difficult particularly in the city centre location which appears unfeasible given the amount of delivery required.

5.4.7 Variable refrigerant flow (VRF)

Variable refrigerant flow uses the refrigerant as the primary medium for heating and cooling. The technology is well-controlled as it is one proprietary system, improving maintenance.
They provide good coefficient of performance values; however, similar performances can be obtained from alternatives with much lower embodied carbon due to the amount of refrigerant in VRF.

For this reason, the technology has not been considered as suitable for Shire Hall.

5.5 Option Evaluation

Evaluation methodology

The potential measures to reduce energy consumption and carbon emissions have been assessed against a range of criteria and considerations including:

1. Implementation
2. Heritage sensitivity
3. Indicative capital cost
4. Estimated energy /carbon reduction
5. Cost per tonne CO_2 saved ('energy cost effectiveness')

Implementation

This considers the challenges of implementing the proposed measure within the context of the specific building or site. These will vary from building to building but may include:

- Logistical challenges such as impact on occupation or decant requirements.
- Interfaces with adjacent fabric, both internally and externally.
- Impact on existing retained building services and systems.

Heritage sensitivity

Informed by the hierarchy of significance, this assesses the relative sensitivity of the proposed measure with respect to heritage values, including visual / aesthetic, evidential and historic.

It does not include a full impact assessment as required for planning and listed building consent, nor identify the potential public benefits. It is intended to provide a preliminary consideration of heritage sensitivity in order to guide further investigation at the next design stage.

Indicative capital cost

The cost assessment represents indicative estimates of the likely costs to implement the carbon reduction improvements as described in this study, as a starting point for decision making. It is important to recognise the assessments are based on the limited information currently available. As with all construction works it is advised that further cost checks are carried out at each design stage. The current costs should be viewed as at RIBA stage 0/1.

The allowances currently assume each item is carried out via a direct contract with the supplier, rather than delivered through a Main Contractor. Appointing a main contractor to undertake a work item will lead to additional costs through management and profit layering. Conversely if the works are linked to a wider scope and form part of a larger scope economies of scale may arise.

Note that all costs are current day, 3rd quarter 2025. An adjustment for inflation will be needed once a delivery programme is established. Contingencies should also be considered; design, construction and client contingencies are recommended.

Estimated energy / carbon reduction

This provides an estimate of the potential energy savings and carbon reduction associated with the proposed measure, compared to the baseline developed during the survey and assessment process.

It provides a high-level guide as to the relative scale of reductions achievable with each measure under consideration.

Energy-Cost effectiveness

This provides an indication of the scale of carbon reduction relative to the capital investment required to implement each measure.

It provides a more consistent method of evaluating the relative cost effectiveness of different measures than payback periods, which are influenced by changing energy prices and tariff types.

The costs identified in the table represent indicative estimates of the likely costs to implement the carbon reduction improvements as described in this study.

The costs form a starting point for decision making. It is important to recognise the assessments are based on the limited information currently available. As with all construction works it is advised that further cost checks are carried out at each design stage. The current costs should be viewed as at RIBA stage 0/1.

The allowances currently assume each item is carried out via a direct contract with the supplier, rather than delivered through a Main Contractor. Appointing a main contractor to undertake a work item will lead to additional costs through management and profit layering. Conversely if the works are linked to a wider scope and form part of a larger scope economies of scale may arise.

Please note all costs are current day, 3rd quarter 2025. An adjustment for inflation will be needed once a delivery programme is established. Contingencies should also be considered; design, construction and client contingencies are recommended.

General exclusions

- Removal and reinstatement of furniture and fittings to enable works to be completed
- Structural enhancements to the existing building to accommodate decarbonisation proposal
- Professional Fees
- Contingencies: design, construction, client
- Inflation
- Finance Charges
- VAT
- Client direct costs including loss of earnings, operating costs etc.

5.5 Option Evaluation

NOTE: Cost scale values are high-level estimates and should only be taken as indicative for comparison purposes. Specific figures should be confirmed with a Quantity Surveyor before implementation.
Low: < £100k
Medium: £100k - £1m
High: > £1m

Element	Energy saving opportunities	Difficulty of implementation	Heritage sensitivity	Indicative capital cost	Estimated energy/carbon reduction	£ / tonne CO2 reduction	Maintenance and Repair requirements	Notes / other considerations
BUILDING FABRIC								
Windows • Original timber framed sash windows in the Crown Court, with secondary glazing • Modern secondary glazing in the Grand Jury room • Most other windows are single-glazed timber sash.	Option 1 • Replace the existing windows with new double-glazed timber sash windows to match existing. • Assumed U-value improved from 4.8 to 1.8	Medium - High Frames can be removed and replaced simultaneously, reducing need for temporary weather protection.	High The existing window frames and the glazing itself may be evidentially significant	£154,000	High -17% of heating energy and carbon emissions from gas 1.05 tCO2/yr	£146,666	Low Windows are generally fair condition, with some misalignment. Redecoration and limited timber repairs anticipated within 3 years Major overhaul anticipated in 6-10 years	• Replacing the windows would improve thermal performance and air tightness, reducing heat loss by building infiltration. • Replacement of the existing windows is largely disruptive for a heritage building and only offers 1% savings additional to the secondary glazing alternative. • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)
	Option 2 • Add secondary glazing to all windows that are currently single glazed. • Assumed U-value improved from 4.8 to 2.4	Low Works should include refurbishent and draught-sealing of existing windows prior to installation of secondary glazing	Medium Low visual impact externally but will alter the internal appearance.	£105,000	High -16% of heating energy and carbon emissions from gas 0.98 tCO2/yr	£107,142		• This would benefit the thermal performance and air tightness similarly to the double-glazing upgrades. • Although it has slightly reduced energy savings, it would be less disruptive and a lower cost alternative
	Option 3 • Refurbish and re-glaze the existing single-glazed sash windows with slimline double glazed units or vacuum glazing. • Assumed U-value improved from 4.8 to 2.1	Medium - High Windows may need to be removed and refurbished offsite.. Sash weights would need adjusting requiring intervention to internal joinery.	Medium - high Impact depends on whether the existing glazing is of individual significance. Original glazing would be considered of high significance and may be unsuitable for replacement.	£135,000	High -17% of heating energy and carbon emissions from gas 1.05 tCO2/yr	£128,571		• Offsite work required to refurbish existing frames. Temporary weather protection required with impact on use of internal spaces. • Existing frames must be suitable for the additional weight and sash windows will require rebalancing. • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)
	Option 4 • Add low-e film/coatings to the existing historic windows which cannot be replaced • Historic glazing U-value improved from 3.0 to 2.7	Low	Medium Could alter external appearance of listed building	TBC	Low -0.3% of heating energy and carbon emissions from gas 0.02 tCO2/yr	-	Low Historic windows are unlikely to be replaced - film coating would provide for its entire lifetime	• This would be a relatively simple intervention to achieve, however this provides very minimal benefits and could possibly alter the look of historic windows

5.5 Option Evaluation

Element	Energy saving opportunities	Difficulty of implementation	Heritage sensitivity	Indicative capital cost	Estimated energy/carbon reduction	£ / tonne CO2 reduction	Maintenance and Repair requirements	Notes / other considerations
Roof Lantern • 2 no single glazed roof lanterns on lower extension to rear	• Replace the two existing single glazed roof lanterns with double glazing. • Lantern glazing U-value improved from 6.5 to 2.4	Medium May be structural implications eg scaffolding required within the building to protect the laylights.	Low	£79,000	Medium -2.4% of heating energy and carbon emissions from gas 0.16 tCO_2/yr	£493,750	Low Lanterns are in fair condition Isolated repairs anticipated in 4 years. Full replacement anticipated in 6-10 years.	• Works would need to take place around access route to flats • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)
Roofs • The main building roof has some mineral wool insulation between the ceiling joists. • The rear extension roof construction is unknown - a small, insulated layer has been assumed.	• Add insulation to the rear extension roof • Extension roof U-value improved from 0.65 to 0.22	High All rooftop plant and access walkways would need to be removed and reinstalled	Low	£93,000	Medium -4.6% of heating energy and carbon emissions from gas 0.31 tCO_2/yr	£300,000	Medium Roof condition not picked up on condition survey Bitumen covering appears in fair condition but rainwater goods require overhauling and have contributed to water ingress issues	• Thermal performance of the solid roof areas would improve. • As this is in the extended section of the museum it would likely not have an impact on the heritage significane of the existing building • Further investigation to the roof build up would be required to confirm assumptions • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)
	• Add insulation to the main building roof • Building roof U-value improved from 0.25 to 0.18	Low	Low	£32,000	Low -0.8% of heating energy and carbon emissions from gas 0.053 tCO_2/yr	£603,773	High Condition survey highlights poor condition of the original timber roof structure which will likely remediation in the near future	• Thermal performance of the main roof areas would improve very slightly.
External walls • The external walls are assumed to be typically solid masonry with no insulation.	• Add vapour permeable insulation to the inside of west-facing external walls • West external wall U-value improved from 0.94 to 0.3	Medium	Medium	£70,000	Medium -3.7% of heating energy and carbon emissions from gas 0.25 tCO_2/yr	£280,000	Low	• Thermal performance of the walls would improve, but insulation type would need to be carefully specified and detailed to mitigate risk of interstitial condensation. • Installation would be relatively disruptive in the café areas and flats, and would alter the appearance of the listed building, and slightly reduce the size of the rooms. • Further investigation to the wall build up would be required to confirm assumptions • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)
	• Add vapour permeable insulation to the inside of north facing external walls • North external wall U-value improved from 0.94 to 0.3	Medium	High	£97,000	Medium -5.6% of heating energy and carbon emissions from gas 0.37 tCO_2/yr	£262,162		• Thermal performance of the walls would improve, but insulation type would need to be carefully specified and detailed to mitigate risk of interstitial condensation • This would be relatively disruptive in the Crown Court and flats, and would alter the appearance of the listed building, and slightly reduce the size of the rooms. • Further investigation to the wall build up would be required to confirm assumptions • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)

5.5 Option Evaluation

Element	Energy saving opportunities	Difficulty of implementation	Heritage sensitivity	Indicative capital cost	Estimated energy/carbon reduction	£ / tonne CO2 reduction	Maintenance and Repair requirements	Notes / other considerations
	• Add vapour permeable insulation to the inside of south facing external walls • South external wall U-value improved from 1.4 to 0.3	Medium	High	£81,000	High -8.8% of heating energy and carbon emissions from gas 0.58 tCO2/yr	£139,655		• This would be highly disruptive in the Crown Court, Grand Jury Room and flats, and would require (likely unacceptable) alterations to significant internal features. • Further investigation to the wall build up would be required to confirm assumptions • External fabric upgrades/repair may need to be carried out by Dorset Council (TBC)
	• Add insulation to the inside of east walls	N/A	N/A	N/A	N/A	N/A	N/A	• Not considered as assumption on adjacent building being heated similarly means no heat loss through this wall
	• Add insulation to the external facades of the ground floor rear extension • External wall U-value improved	Low	Low	TBC	Cannot be quantified without more detailed knowledge of existing wall build up	-	Low	
Floors • Generally, the museum mostly has concrete floors • Basement floor is brick only	• Add insulation to the basement floor • Floor U-value improved from 0.38 to 0.25	High	High Basement/cell brick floors original to historic use	£240,000	Low reduction -1.0% of heating energy and carbon emissions from gas 0.07 tCO2/yr	£3,428,571	Low	• Insulation to floors would have very high level disruption, and high cost for low benefit.
	• Add insulation to the main floor • Floor U-value improved from 0.49 to 0.25	High	High Many floors original to historic use	£282,000	Low reduction -1.5% of heating energy and carbon emissions from gas 0.10 tCO2/yr	£2,820,000		
LIGHTING								
• Lighting is already largely LED although some fluorescent fittings can be found. • Manual control within most areas. PIRs in WCs and stores	• Replace any remaining non-LED bulbs for more efficient LED bulbs/ fittings	Low Disruption could be minimised if upgrades are phased with regular maintenance.	Low	£39,000	Cannot be quantified specifically for Shire Hall without detailed knowledge of existing installation	-	Low	• Where LEDs are not currently fitted some energy reductions would be possible • Simple intervention to achieve and has a very short payback
VENTILATION								
	• Add improved lighting controls, e.g. presence detection-based dimming in circulation areas and areas not in regular use	Low	Low	£13,000	Cannot be quantified specifically for Shire Hall without detailed knowledge of existing installation	-		• Guest experiences unaffected • Increasing control will reduce lighting energy use.

5.5 Option Evaluation

Element	Energy saving opportunities	Difficulty of implementation	Heritage sensitivity	Indicative capital cost	Estimated energy/carbon reduction	£ / tonne CO2 reduction	Maintenance and Repair requirements	Notes / other considerations
• The ventilation strategy is unclear • WCs have mechanical ventilation on PIRs • Some museum spaces have mechanical ventilation • Grand Jury Crown Court have MVHR unit	• Repair and implement use of current ventilation systems	Low	Low No change to current building	£16,000	Likely increase energy usage	-	High Ventilation systems currently not working properly and require repair to improve occupant comfort	• Would have significant impact on occupant comfort and internal air quality, particularly in flats.
	• Provide occupancy linked ventilation controls to extract fans	Low	Low	£12,000	Cannot be quantified specifically for Shire Hall without detailed knowledge of existing installation	-		• Offers reductions which may make any disruption worthwhile • The effect will only be beneficial if ventilation is working and turned on (not currently)
	• Provide temperature/ CO2 linked ventilation controls	Low	Low	£12,000	No reduction or gain expected Seasonal effects balanced. Recommended for occupant comfort and building fabric longevity.	-		• Payback often long when considering carbon and energy only • Shorter payback possible if occupant comfort and condensation benefits incorporated. • The effect will only be beneficial if ventilation is working and turned on (not currently)
	• Convert current non heat recovery ventilation units to MVHR	Low Replacement to current units	Low No change to current building	£118,000	Low -2.2% of heating energy and carbon emissions from gas 0.15 tCO2/yr	£786,666		• The effect will only be beneficial if ventilation is working and turned on (not currently)
HEATING DISTRIBUTION AND CONTROLS								
• Heating split into two zones. • Heat emitters are mainly radiators with TRVs. • No regular heating strategy. Staff adjust heating based on feedback.	• Add zoning valves, heat meters, and variable speed pumps to the primary boiler room heating circuits • Implement zonal heating for occupied zones only, with unoccupied zones at a setback temperature	Medium Detailed design required	Low	£35,000	Detailed design required in order to understand potential improvement.	-	Low	• Low cost and straightforward solution which facilitates future energy reductions and monitoring benefits. • Required for other heating and distribution controls recommendations. • Only beneficial if heating is used more than currently

5.5 Option Evaluation

NOTE: Capital cost values are high-level estimates and should only be taken as indicative for comparison purposes. These values do not allow for energy centre infrastructure, controls, or other ancillary equipment which would be common to all options. Specific figures should be confirmed with a Quantity Surveyor before implementation

LZCT Opportunities	Difficulty of implementation	Heritage sensitivity	Capital cost scale	Operational cost	Total energy output (relative to total site demand)	Estimated energy/carbon reduction	Other considerations
Photovoltaics	Low • Can be integrated onto existing roofs, although there will be visual considerations and structure will need to be checked.	Low Rooftop PVs unlikely to be visible from ground level	£62,000 - £73,000	Very low: Minimal running cost and periodic maintenance only	23% of current total energy usage, 34% of electrical demand (best case)	-18% of total carbon, -32% of electricity carbon emissions	• New meter will be required but unlikely to be problematic. • Planning and listed building consent will be required however the main roof location appears to be feasible
Air-source heat pumps	High • Space required on roof may be difficult to achieve. Potential structural implications. • All heating pipework and radiators would need to be replaced as well.	Medium/high A plant enclosure on the roof may be too visible however a remote enlcosure within the rear yard could be considered	£226,000 - £267,000	Medium/high: Subject to electricity tariffs, CoP and seasonal variation	100% of heating demand	-33% of total carbon, -77% of total heating carbon emissions	• From the information available, it is possible that the existing electrical supply is adequate, however this will need to be developed further. A new supply may be required. • Heat pump redundancy needs to be considered. • Planning and listed building consent will be required. • External car park / garden location could be considered to minimise impact on roof construction.
Decentralised ASHPs	Medium • Proximity of west-facing external wall to neighbouring building, and the location of existing ventilation plant on the North facing side may make installation and maintenance of this technology difficult.	High External units would not be acceptable on any facade	£96,000 - £113,000	Medium/high: Subject to electricity tariffs, CoP and seasonal variation	Subject to detailed design	Subject to detailed design	• Planning and listed building consent will be required

DESIGN DEVELOPMENT

6.1 Key Recommendations

The recommended options for the museum to implement to reduce energy consumption and introduce low and zero carbon technologies are listed below. These have been selected by the consultant team, in discussion with the client, as the options with the most favourable outcomes when assessed against the options appraisal criteria.

As Shire Hall do not have any current planned projects or identified funding streams, there has been little influence of client priorities on option selection, though the ambition to intensify use of spaces has been considered.

Building Fabric

- Upgrade thermal performance of current single glazed windows
- Replace the existing single glazed roof lanterns with double glazed units.
- Insulate external wall and roof of lower rear extension

Service Systems

- Replace non-LED light fittings
- Introduce lighting controls to allow automatic dimming/switch off when unoccupied
- Add zoning valves and controls to the existing heating system to enable zonal and scheduled heating
- Establish effective sub-metering
- Establish occupancy ventilation control for larger spaces

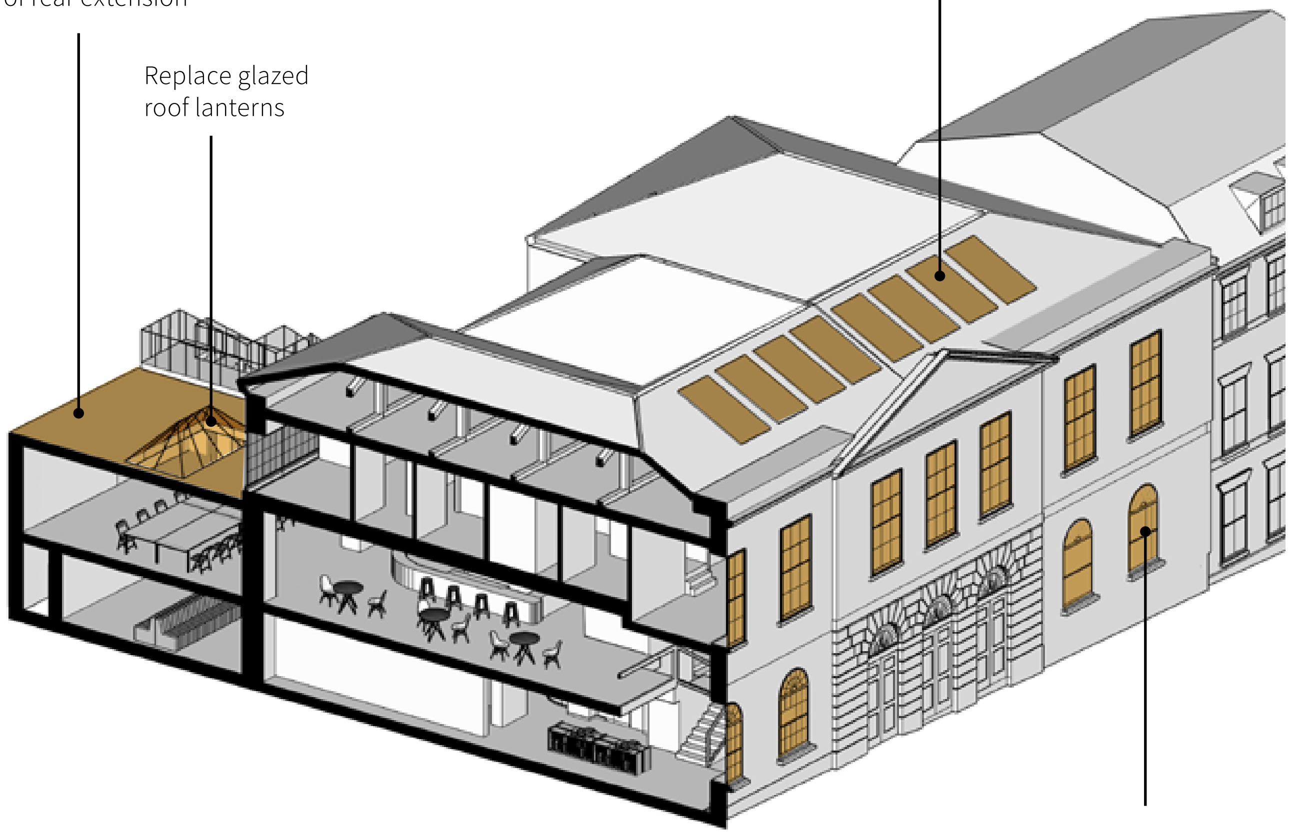
Low/Zero Carbon Technologies

- Photovoltaics (PVs)
- Air Source Heat Pumps

Maintenance & Repair

In addition to implementing new improvement measures identified through the appraisal process, it is equally important to ensure that existing systems are operating efficiently and as originally intended. The following recommendations were identified by the consultant team during the survey and assessment of the existing building.

- Ventilation systems reviewed, repaired and utilised.
- Flat ventilation systems repaired or replaced
- Internal temperature is monitored to ascertain occupant comfort.
- Market research to understand who may want to hire spaces and their expectations.
- Staff members and volunteers to be trained in control of the building systems.
- Air Source Heat Pumps



6.2 Building Fabric

6.2.1 Facade Glazing

Some secondary glazing has been installed in the Crown Court and Grand Jury rooms however the vast majority of windows are single glazed. The results of the thermal imaging survey demonstrated the difference the secondary glazing makes to the thermal performance of the windows when compared to those that are single glazed.

The options appraisal showed that addressing the single glazed windows, either through adding secondary glazing, re-glazing the existing frames or replacing entirely with new double glazed units, would have a high impact in reducing the building's energy consumption, and would also improve occupant thermal comfort by reducing draughts.

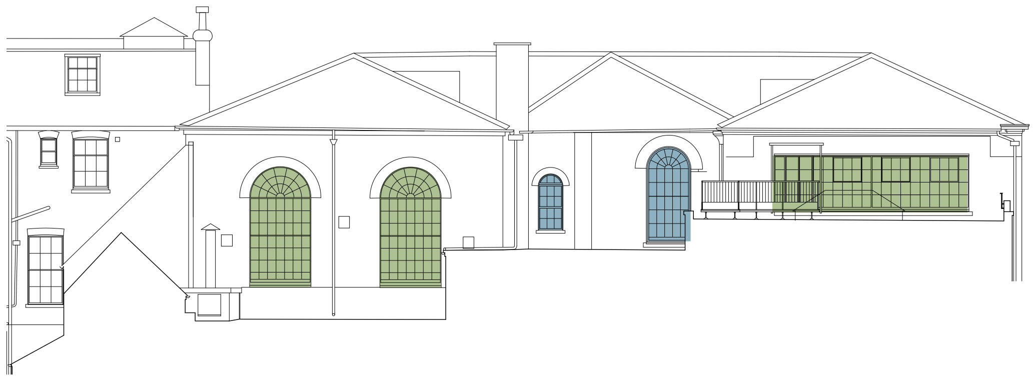
The windows appear in good condition so no immediate action is required, however repairs should be assumed to be needed in the medium term.

A more detailed study should be carried out to assess which method of upgrading the glazing (secondary glazing, re-glazing or double glazing) is most appropriate, factoring in heritage significance, detail design cost and relative improvement benefit.

Upgrading the windows will require planning and Listed Building consent and possibly scaffold access, and therefore it would be more efficient to address all windows at the same time, rather than a room by room approach.

It is important to ensure the mechanical ventilation systems have been repaired and are functioning correctly before the windows are upgraded, in order to reduce the risk of condensation and mould.

Front elevation



Rear elevation

Side elevation

Existing secondary glazed windows

Existing single glazed windows

6.2 Building Fabric

6.2.2 Roof Lanterns

The Thermal Imaging survey showed heat loss through the two single glazed roof lanterns.

Replacing these with new double glazed units would give a small energy saving and would improve thermal comfort for occupants, particularly in the classroom space which Shire Hall are keen to use more intensively.

The condition survey showed these roof lanterns to be in fair condition currently, recommending replacement in 6-10 years.

Logistically, replacing the lanterns may be complex due to the adjacent plant equipment, possible implications on the roof structure, and requirement of the access route to the flats to be kept open.

It may make sense to carry out replacement of the roof lanterns in conjunction with other works to the roof, such as upgrading insulation and waterproofing and replacing ventilation plant.

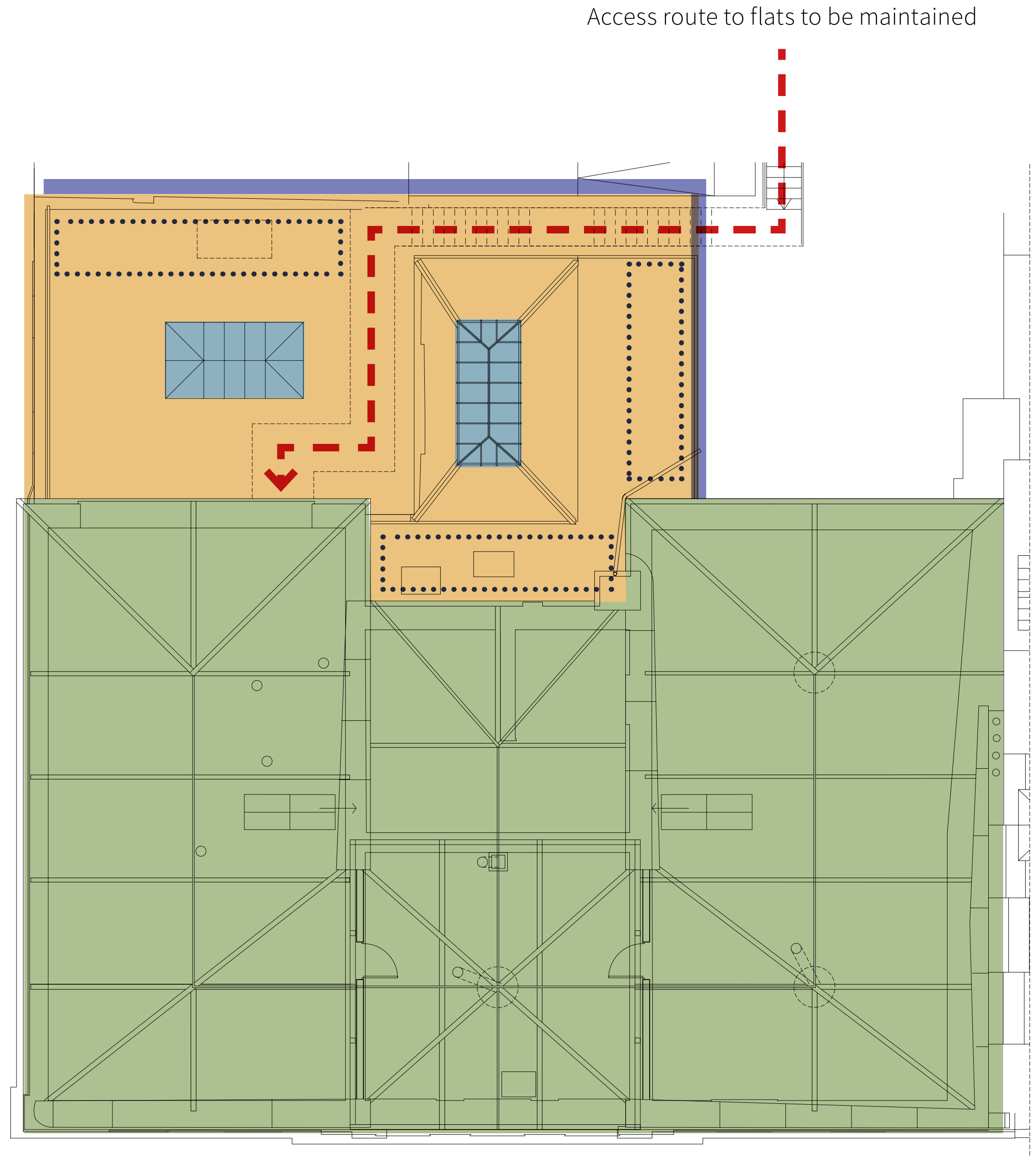
6.2.3 Insulation

The main pitched roof was insulated during the 2018 refurbishment works. While increasing the insulation thickness is possible, it would result in only a marginal improvement in thermal performance, which may not justify the associated effort and cost.

The level of insulation to the flat roof areas to the rear is unknown, though it is likely to be minimal if it is insulated at all. Improving the insulation to this area would generate a medium reduction in energy consumption and again improve the thermal comfort in the classroom space.

As with the roof lanterns, it would be practical to consider upgrading the flat roof insulation in conjunction with other roof-level works—such as the replacement of the roof lanterns and ventilation plant—given the logistical constraints related to access and structural considerations.

It is unlikely to be feasible to insulate the majority of the external walls due to their heritage significance. The external wall of the rear extension however, appears to be a later addition and has a rendered finish. This wall could be insulated externally, in conjunction with roof insulation to the extension area to maximise potential improvements.



Roof Plan

- Roof Lanterns
- Existing insulation to main roof
- New insulation to flat roof
- Existing rooftop plant zones
- New insulation to external wall

6.3 Service Systems

6.3.1 Ventilation

A large portion of current ventilation systems within the building are currently unused or non-functional. Repairing these units and controllers along with teaching building management correct use of them would lead to an improved comfort within many spaces, along with helping to maintain historic building fabric. This may increase energy use, however, it is believed some of the unused ventilation has heat recovery available allowing for more efficient ventilation, which reduce window opening.

To improve the ventilation efficiencies, occupancy controls should be installed to ensure ventilation is only used where required. Installing CO2 sensors within the museums spaces, particularly where Shire Hall plan to have spaces hired, would allow minimal ventilation as required.

6.3.2 Lighting

A few strategies can be employed to improve efficiency of lighting within the museum. Most importantly, any fluorescent fittings should be replaced with reasonable LED replacements. Further to this, absence detection can be used to reduce lighting use in unoccupied spaces. For the museum spaces this is likely not reasonable due to the nature of the museum's tour experience, however, back of house areas and let spaces would benefit from this.

6.3.3 Metering

Existing metering is very limited throughout the museum, meaning it is hard to monitor and assign energy consumption to specific end uses. By metering data more accurately, evaluating and optimising energy usage becomes easier.

Shire hall's meter data was limited to the monthly totals. This meant we could only evaluate the buildings energy usage as a whole.

To improve visibility of specific energy use patterns, it would be beneficial to implement sub-metering to monitor specific energy uses more closely.

Ideally any metering system installed would collect data and provide reporting on these items. This would allow monitoring, analysis, and corrective actions to be taken. CIBSE Guide F indicates that savings of around 5-10% are typically possible with effective metering. This figure depends on the existing setup and ensuring actions to optimise energy are undertaken when identified.

There are a number of metering systems on the market which provide easy to use interfaces to log and monitor energy use.

6.3.4 Controls

Local controls

The building includes local controls to the heating system and MVHR systems throughout. A first step would be to repair and understand these systems so they can be used effectively. Upgrading to smarter controls may also allow a more straightforward centralised interface, and the MVHR manufacturer should be approached to find out what is available.

BMS controls

A centralised management system for the museum's services would allow for more efficient use of the building's heating and ventilation. A BMS can facilitate a timed or occupancy-based approach and allow centralised control and monitoring. This would improve comfort within the museum and avoid unnecessary heat loss through over heating or over ventilating.

Improved zonal heating system

The museum is not often at maximum capacity and the first-floor rooms that are hired can be left empty for periods of time. As some of these rooms are zoned with areas of the museum feature rooms, they will often be heated whilst empty. In a similar fashion, the Courtroom is zoned with the staff room – which we can assume is constantly heated for staff comfort will lead to the large courtroom being constantly heated even when empty. These clashing zones will account for some additional energy used for heating.

With improvements to the structure and control of the heating system, heating zones could be established and only zones with occupied rooms could be heated. It is recommended that the other zones are kept at a lower setback temperature, rather than being completely unheated. Knowing the museum wants to commercialise some of their spaces, this could be integrated with a booking system for the rooms to ensure comfort for occupants but efficiency for the heating system.

The use of LoRaWAN smart radiator valves would be a potential way to improve the control on individual radiators and allow for a centralised programmable system. This could allow the museum to begin using occupancy-based heating or limit heating overnight whilst ensuring the building is appropriately heated before opening. This avoids the need for changes to the pipework.

MClimate Vicki LoraWAN TRV

6.4 Low & Zero Carbon Technologies

6.4.1 Photovoltaics

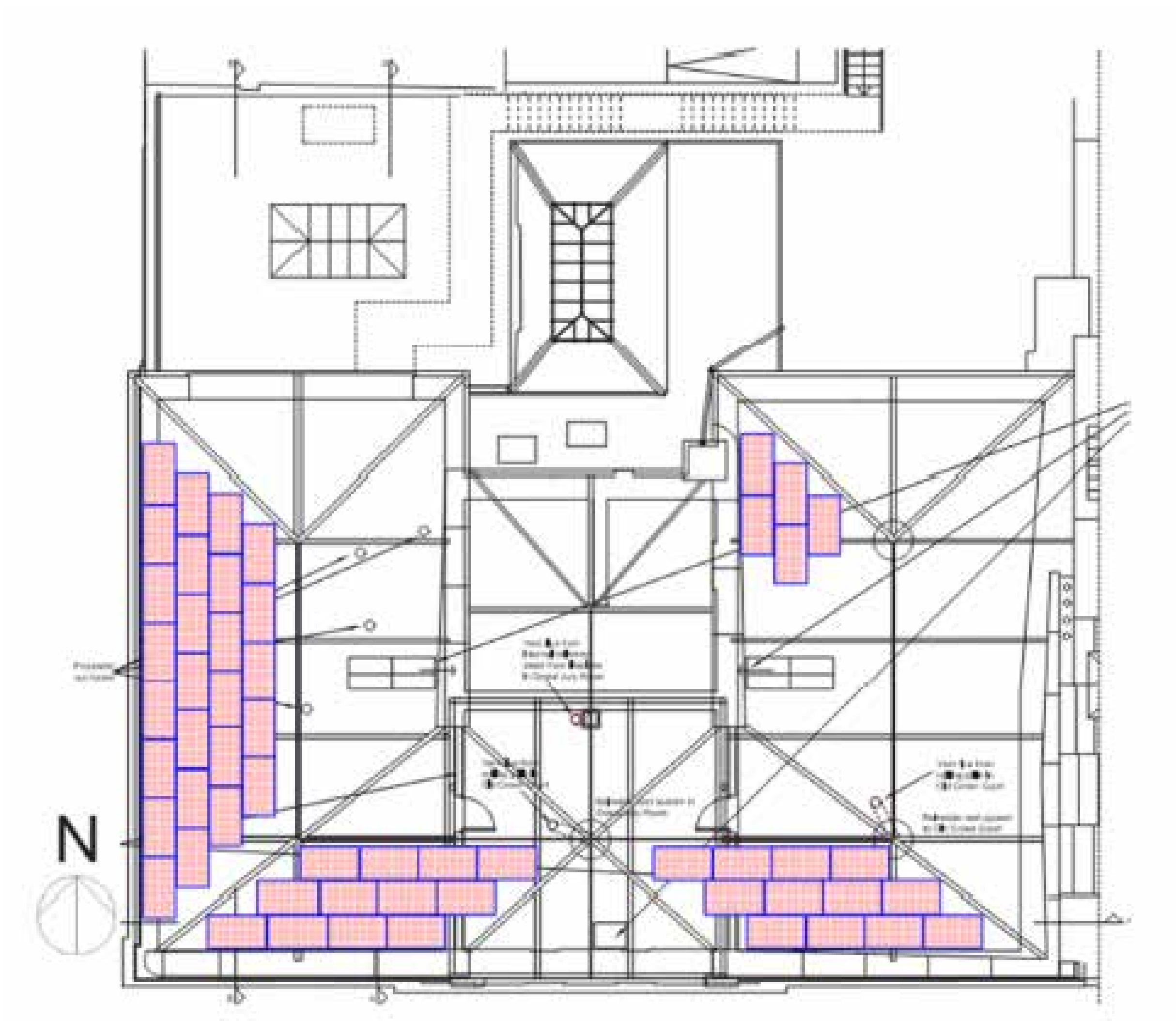
For estimation purposes the potential solar energy generation has been calculated using Maxeom 3 DC, 415 – 430W panels from Sunpower. This estimation has assumed a 40° pitch, arranged as indicated.

A PV installation of 54 panels as such would generate 21 MWhs annually – over 1/3 of Shire Hall's annual electricity usage. This would reduce the museum's carbon emissions by 2.7 tCO2 per year.

Prior to any additions to the roof, a structural analysis would be required to demonstrate that the existing roof has sufficient structural capacity.

Birds eye view of Shire Hall from Bing Maps

SunPower Maxeon 3 solar panel



Example arrangement of solar panels on Shire Hall Museum's roof

6.4 Low & Zero Carbon Technologies

6.4.2 Air Source Heat Pumps

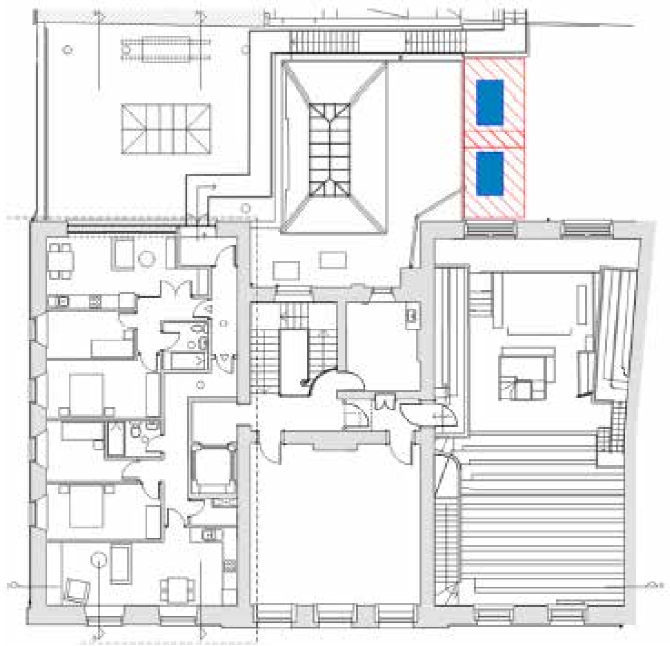
While the existing boilers are only seven years old, we have illustrated the potential size and location of heat pumps to replace the boilers in due course.

2No. new air-source heat pumps could be installed externally on the extension roof. This could be screened for acoustic and visual comfort if required. For this example, a pair of Clade ACER 65/50 Low Noise CO_2 based ASHPs have been used – the spacing requirements can differ between manufactures. These have been chosen for their low GWP requirement, low noise and high flow temperature.

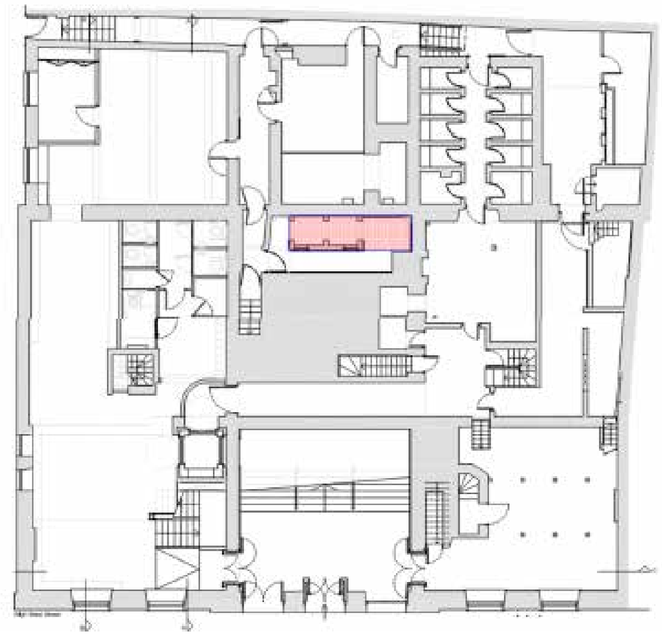
This arrangement would allow the site to be entirely heated with air-source heating, which could provide a long-term low carbon solution particularly as imported electricity carbon factors reduce with grid decarbonisation. Assuming the museum is being heated in accordance with the calculated baseline, immediate carbon reductions could be seen as this would replace all gas heating and the carbon factor of heating would reduce by nearly 77%.

As the ASHPs would be replacing the current heating systems, the space currently taken up by the 2No. gas boilers could be used to house a required buffer vessel. This would also limit the need for distribution upgrades as due to the high “dT” of CO_2 heat pumps, the existing pipework could be reused. Aspects requiring consideration in detailed design:

- 2No. ASHPs would result in additional electrical load of approximately 40kW, which may increase site loading beyond existing electrical capacity. Electrical infrastructure upgrades may be required and would be reviewed if this option were proposed.
- Noise to sensitive areas would need to be checked.
- Heat emitter outputs to be checked – heat emitters may require upgrade
- Heritage implications of external heat pumps
- Structural implications of heat pumps on roof
- Large buffer vessels required



Indicative location of 2No. Clade ACER 65/50 Low Noise ASHPs



Possible location for buffer vessels in basement plant room

Clade ACER 65/50 Low Noise

6.4 Low & Zero Carbon Technologies

6.4.3 Decentralised Air Source Heat Pumps

Decentralised air-source heat pumps are self-contained ASHPs that serve individual rooms. Rather than having units centralised in a plant space with distribution pipework throughout the building, these decentralised units are situated directly on the wall of each space to be served. S

The requirement of an external wall can constrain this technology slightly; however, Shire Hall has many spaces with an external wall.

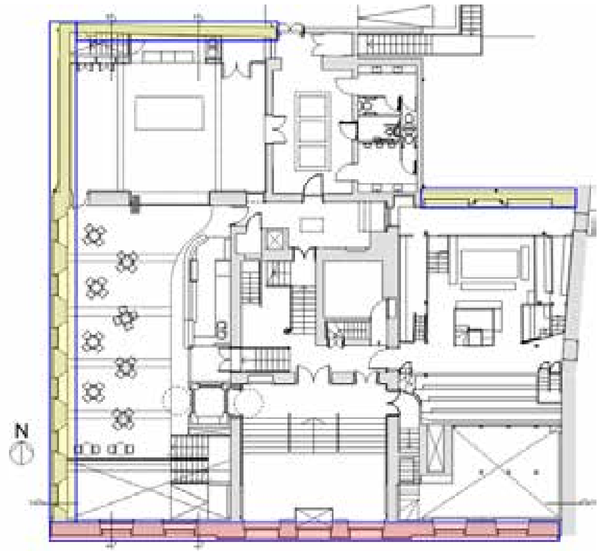
The south façade being historic construction and will likely not be permitted to have holes in. This restriction leaves only a few spaces available for this technology:

- The café
- The learning space
- The crown court
- The stairwell

Due to the Learning room and café being some of the most frequently occupied spaces, the switch to decentralised ASHPs in these spaces could likely offset a large amount of the museums required heating.

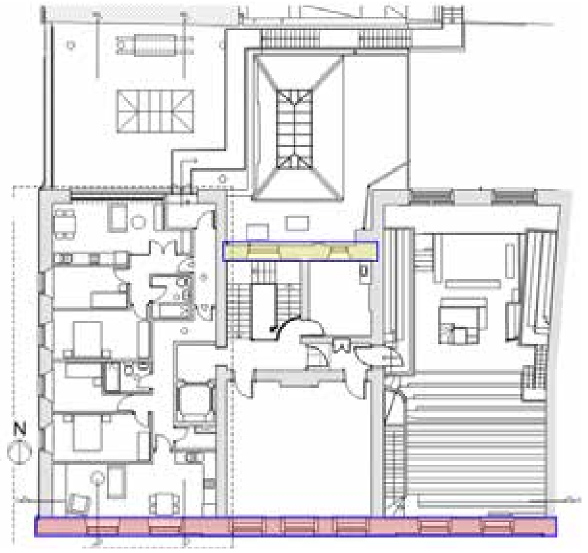
This technology could be a good method of reducing the buildings carbon emissions however alternative strategies will be required for other spaces of the museum.

Powrmatic AIRCO290 packaged wall-mounted twin duct heat pump



Upper ground floor plan with possible locations for a decentralised ASHP unit indicated in yellow

South facade considered unfeasible due to heritage sensitivity (shown in pink)



First floor plan with possible locations for a decentralised ASHP unit indicated in yellow

South facade considered unfeasible due to heritage sensitivity (shown in pink)

FORWARD PLAN

7.1 Decarbonisation Pathway

To support the progressive decarbonisation of Shire Hall, the recommended measures should be implemented incrementally. The sequencing of these interventions should be informed by both practical and logistical considerations, such as the availability of funding and alignment with existing or planned projects, as well as adherence to the principles of the Energy Efficiency Hierarchy, which prioritises actions based on their energy-saving potential.

The primary challenge at Shire Hall lies in the complexity of operating and maintaining the existing systems, which is largely due to a combination of service faults and a lack of in-house maintenance expertise.

While there is a clear aspiration to increase and intensify the use of Shire Hall, there is no capital project planned for functional or spatial alterations.

Given this context, the implementation pathway for the recommended measures has been more strongly guided by the Energy Efficiency Hierarchy and running costs than by client-driven priorities.

This phased approach not only provides a clear and structured route towards decarbonisation but also prioritises the implementation of simpler, lower-cost interventions in the short term, while reserving more complex and capital-intensive upgrades for the longer term.

Step 1: Maintenance and Repair

- Maintain and repair existing fabric and service systems

Step 2: Upgrade Services

- Replace non-led light fittings
- Introduce lighting controls to allow automatic dimming/switch off when unoccupied
- Add zoning valves and controls to the existing heating system to enable zonal and scheduled heating
- Establish effective sub-metering
- Establish occupancy ventilation control for larger spaces

Step 3: Upgrade Fabric

- Improve the thermal performance of single glazed windows
- Replace the existing single glazed roof lanterns with double glazing
- Insulate external walls and roof of lower rear extension

Step 4: Introduce Renewables

- Photovoltaics

Step 5: Decarbonise Heat

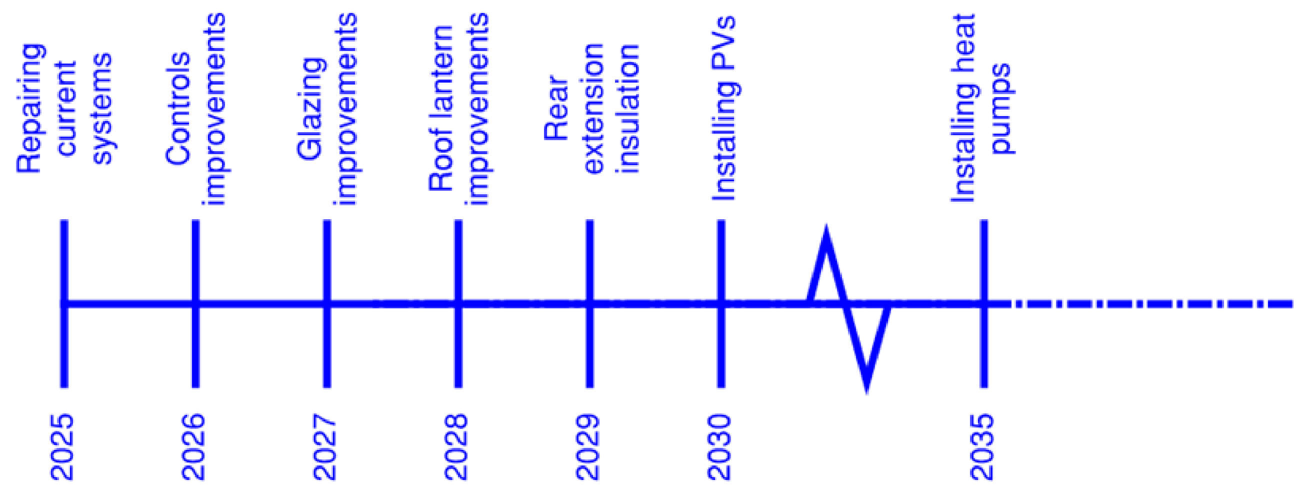
- Air source heat pumps

Achieving Net Zero Carbon

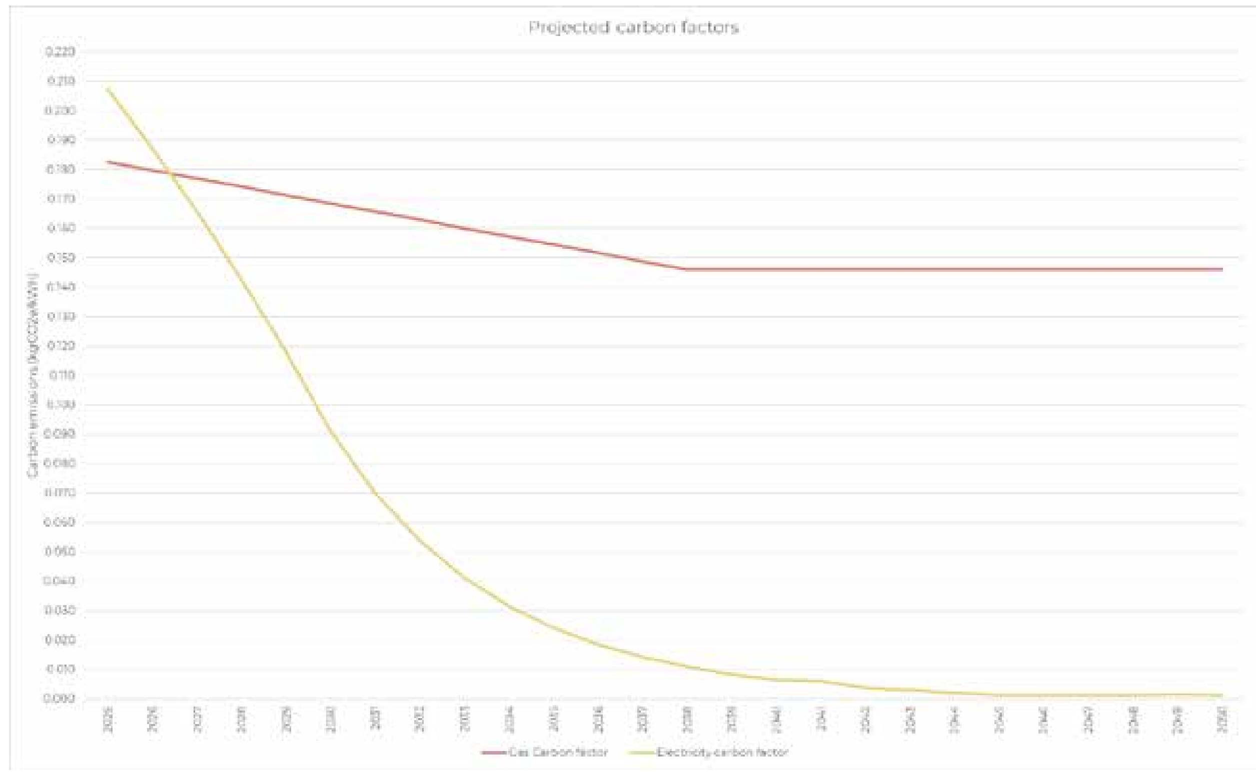
Combining both recommended energy reduction and LZCTs into a programme, we can project the museum's path to reaching net zero. Figure 7-3 shows the museum's predicted annual energy use and emissions up to 2050

The key intervention here is the addition of heat pumps to provide the total heating load to the building. In our suggested pathway this occurs during 2035 and causes a sharp decline in total energy use and carbon emissions. This is largely due to the projected carbon factor of the grid in 2035 being 0.024 $kgCO_2/kWh$ against the gas carbon factor of 0.154$kgCO_2/kWh$.

PVs have been suggested earlier due to their potential for income generation.

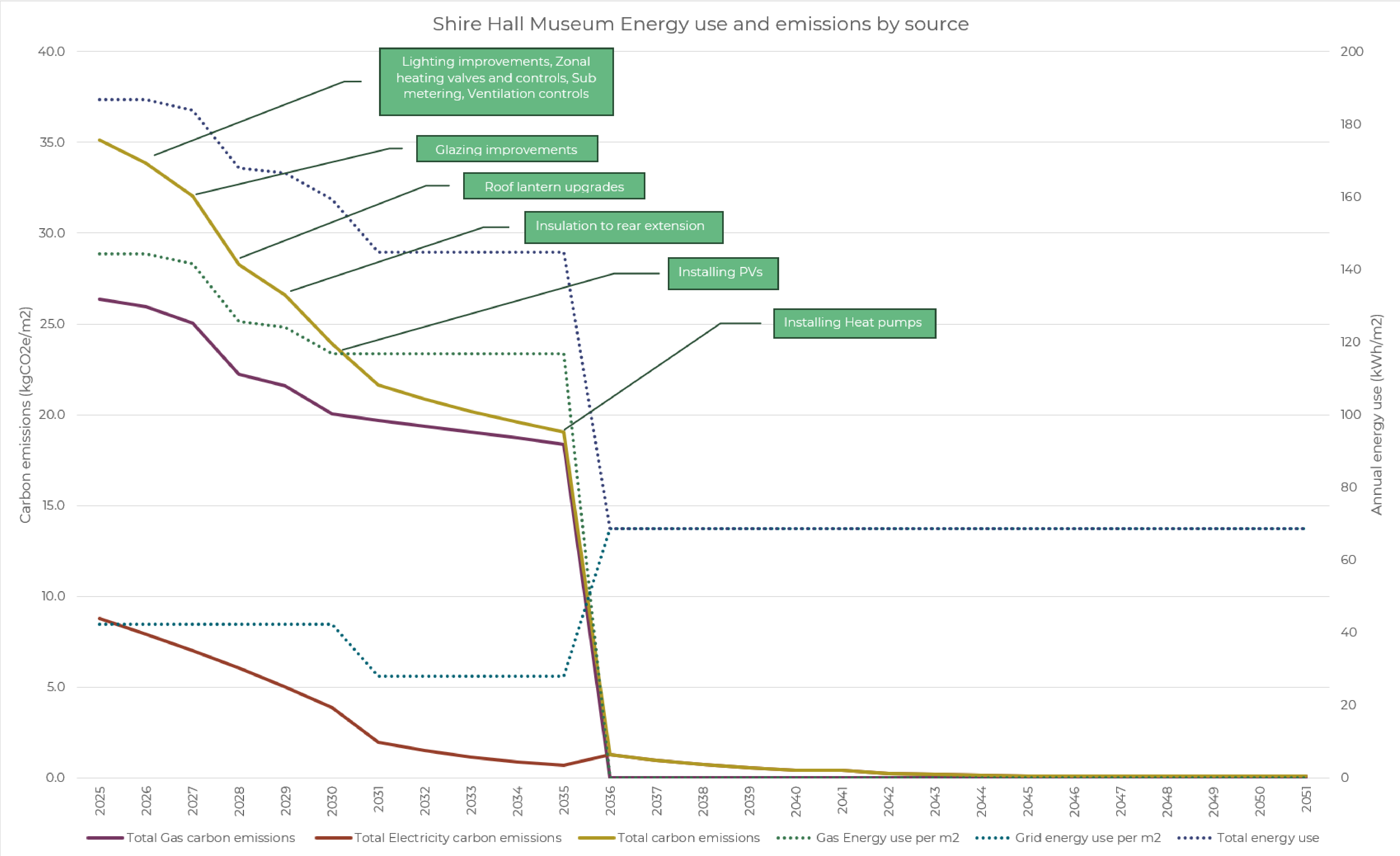


Timeline of suggested building improvements for Shire Hall Museum



Graph showing predicted future carbon factors for gas and electricity

7.1 Decarbonisation Pathway



Graph showing projected emissions of the Shire Hall Museum following suggested energy saving interventions

7.2 Next Steps

A series of next steps will be required to support the progression of the Decarbonisation Pathway and inform the design and sequencing of the improvement measures.

Identify potential funding
Targeted funding streams should be identified to informing timing and budget of implementing recommended works

Identify capital projects
Improvement options could be grouped together into larger capital projects or carried out individually in isolation, according to available funding and client priorities for progression.

Consultant team
The relevant consultant team will need to be appointed for each works project. This could range from a full design team if several works are progressed simultaneously or a single consultant if the work is limited to a specific option.

Additional surveys and assessments
Further investigation of the existing building will be required to develop some of the improvement measures in more detail – such as:

- Detailed survey of existing M&E installation, to identify what equipment is working, what repairs need to be made and if any equipment needs to be replaced.
- Detailed survey to identify outputs of the heat emitters in each space, to help inform the implementation of improvements to heating controls and zoning.
- Temperature monitoring in peak season to assess performance of control, to help inform the implementation of improvements to heating controls and zoning.
- CO2 monitoring in heavily occupied spaces, to assess performance of ventilation controls and identify improvements

Technical design studies
Further technical studies may be required for some improvement measures, to develop the detailed solution/proposal – such as:

- A study of the relative benefits and disadvantages of the options to upgrade the thermal performance of the glazing (secondary glazing, double glazing, re-glazing)
- Feasibility study of options to insulate the existing roof and rear wall of the rear extension.
- Feasibility studies for the implementation of new services such as PVs and Heat Pumps, to inform layouts, and identify other implications e.g. structure, integration with existing services etc.

Front cover image: courtesy of Shire Hall Museum

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