

REFURBISHMENT CASE STUDY 35

LAURISTON TERRACE EDINBURGH

INSULATION WORK TO A 19TH
CENTURY TENEMENT



HISTORIC
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HISTORIC ENVIRONMENT SCOTLAND REFURBISHMENT CASE STUDY 35

LAURISTON TERRACE, EDINBURGH
INSULATION WORK TO A 19TH CENTURY TENEMENT

ROGER CURTIS

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I. INTRODUCTION

This case study describes work undertaken by Lister Housing Co-operative, a social housing provider, to a traditional domestic tenement from the early 19th century. The project was managed in partnership with Historic Environment Scotland (HES) with a view to expanding the project to other properties in the Co-operative's care should the initial trial prove successful. The measures installed were part of a programme of works to traditional and historic buildings conducted by HES as part of the Energy Efficiency Research Programme that has been running since 2009. The main outcomes of the programme are summarised in [Historic Environment Scotland Short Guide 1: Fabric Improvements for Energy Efficiency](#).

Unlike other studies by HES, this project looked at thermal upgrades in a traditional property where they had previously been carried out using modern materials. Despite these previous works in the 1990s, the property still did not reach the standard of energy efficiency required by future legislation under the Energy Efficiency Standard for Social Housing (EESH) in Scotland.

The primary aim of the project was to assess how increasing insulation affected the energy efficiency of the properties, as well as the effects this insulation might have on the masonry when the existing modern internal lining was not vapour open or 'breathable'. The monitoring carried out pre- and post-intervention was necessary to ascertain whether humidity or moisture became a problem in the walls following the insulation works. The project is relevant to many older properties in Scotland, because many have had previous insulation interventions using modern materials but may still fall short of energy efficiency standards. This is especially pertinent in the social housing sector, where there has been an ongoing programme of energy efficiency improvements.

2. THE SITE

Lauriston Terrace is owned and managed by Lister Housing Co-operative, who have a total of 185 properties in the Old Town area of Edinburgh. They are all tenement flats, a dwelling type popular in Scotland and very common in the older urban centres in the Central Belt. Many of the properties are listed.

Lauriston Terrace is a 6-storey tenement block (Figure 1), with one floor below street level. It comprises of twelve domestically let flats, six of which are located on the gable end and have three exposed sides. These six flats were the ones selected as the subject of this case study. The property is Category B listed and lies within Edinburgh's Old Town Conservation Area and Edinburgh World Heritage Site. To the south of the building is a modern office building development. The block sits at a right angle to the

main street axis of Lauriston Place and is accessible by a gated walkway at the front ground floor level.



Figure 1: Front elevation of Lauriston Terrace. The flats where work was carried out are the farthest tenements on the left.

The principal elevation faces east, giving the rooms to the front of the building a reasonable amount of light in the mornings and some solar gain. Each of the 12 flats have a floor area of 68m², which is comprised of two bedrooms, a kitchen, bathroom, living room, storage cupboards and hallway. The flats have slightly lower ceilings than what is normal for properties of this era, at about 3m in height. This, together with the sloping ground level, enabled the builders to fit six floors to the same roof height as the five-storey tenements the block is connected to (as seen to the right of the downpipe in Figure 1). Access to the building is via a pedestrian pavement only; vehicular access is from the main road, some 50m from the entrance to the tenement block.

The south gable wall is random rubble construction, and the east and the west façades are ashlar faced. A condition assessment showed that the external masonry was in good condition and dry. The chimney and skew copes of the gable had been well maintained and were in good condition. All rainwater goods functioned properly. The interior of the tenement block changed extensively as part of the works in the 1990s. All original lath and plaster linings were removed, and the walls were strapped and lined with

an insulated plasterboard comprising a 12mm gypsum layer with a 28mm polystyrene foam backing. The flats are heated by a relatively recent and efficient condensing gas boiler, but the tenants have been incurring rising utility bills over the last few years.

3. PROJECT OVERVIEW

Following successful thermal upgrade trials at Lauriston Place in 2010 (reported in [Historic Scotland Technical Paper 3](#)), the Co-operative wished to trial further improvements on other tenement flats they own. In particular, it was desirable to carry out improvements to the flats on the gable ends of tenements, as these are well known for being colder due to their increased external wall surface area. A gable end tends to take the brunt of the weather as it is more exposed to the elements than other elevations.

For these reasons, the tenement block known as Lauriston Terrace was selected for the improvement trials. It is aligned north-south, and since in Edinburgh most weather comes from the southwest, the gable end at the south receives wind and rain on the corner and the gable. It also has little shelter from adjacent buildings and could be considered reasonably exposed by urban standards. The building was of additional interest because of the extensive works in the 1990s, which meant the interior linings were mostly made of modern materials, such as insulated plasterboard. These changes are likely to have reduced the building's ability to cope with fluctuations in humidity.

The project objectives were:

- 1) Carry out technically appropriate thermal upgrades to the building fabric.
- 2) Minimise disruption to occupants and consult with them throughout the project.
- 3) Monitor the infilled cavity behind the modern insulated plasterboard and masonry for changes in relative humidity and temperature.
- 4) Conduct pre- and post- U-value monitoring to quantify the improvements.
- 5) Better understand the factors comprising an EPC and how to reduce the SAP (Standard Assessment Procedure) points to improve a building's EPC to a B and C rating.
- 6) Write up the project as a HES Refurbishment Case Study to disseminate the techniques and findings to a wider audience.

4. THE ENERGY PERFORMANCE CERTIFICATE

The energy performance of a building is assessed through an Energy Performance Certificate (EPC). The EPC methodology uses a series of assumptions based on fabric performance, occupancy and installed equipment to calculate the energy used in the property. This information is expressed as Standard Assessment Procedure (SAP) points, and the points are grouped into performance bands. Upcoming legislation for minimum standards of energy efficiency in social housing requires all social rented properties with mains gas heating to achieve a score of 69 SAP points in the EPC, equating to a Band C. Therefore, the correct understanding of how to achieve SAP points and the evaluation process is of great importance.

An EPC had been conducted on one of the flats in the block three years before the works (Appendix A) and this was considered to be indicative of the other flats. The EPC showed that this property met the Band C standard by one point, with a score of 70. The existing hot water and heating system, running on mains gas, is powered by an A-rated boiler which achieved a good score. The walls, however, scored poorly due being of solid masonry with modest insulation (and three are facing externally). Consequently, the walls were the main fabric element to be addressed in the works.

5. DESIGNING THE WORKS

HES had used a variety of materials in other refurbishment projects, and these were discussed with the Co-operative. Re-lining the walls would be too expensive and would require the tenant to move out, which was deemed too disruptive. Therefore, it was agreed that a polystyrene bead product blown into the cavity, behind the existing modern linings and the inner masonry face of the wall, was the best material. Upgrading the single-glazed sash and case windows was also considered, but the EPC for Flat 2/8 showed that the gain in SAP points was very small (less than 3 points) and was thus deemed not worth the cost.

The existing plasterboard had a 28mm layer of insulation on a metal frame, with approximately 40-50mm cavity space between this and the interior face of the exterior masonry wall. The insulating material was made up of polystyrene beads with a PVA (Polyvinyl Acetate) bonding agent to hold together the polystyrene beads within the void between the inside face of the external rubble wall and the back of the plasterboard and its insulation layer. The smooth face of the insulated plasterboard was important, as it enabled the polystyrene bead to move easily and fill the cavity areas. If it had been a traditional lath and plaster framework, the face would have been much rougher, and the gap between this and the inner face of the stone much more variable and quite small in places.

Insulation was placed on the three external walls: the living room (the front exterior wall with two windows, TV socket, panelling to reveals, gable wall, press, fireplace and one double-socket), bedroom one (gable wall with one window on upper flats and rear wall with one window on ground-floor and basement; press on rear wall in upper flats) and bedroom two (rear exterior wall with one window, and one uninsulated internal wall to common stair with electrical sockets). During the design work it was established that, due to the size of the gap to be filled (40-50mm), the work was not eligible for ECO (or what was then titled 'Green Deal') government funding.

In addition to the flat's exterior wall areas, the polystyrene bead was injected into other voids, such as behind the press cupboards and window reveals. The areas identified for insulation are shown in Figure 2.

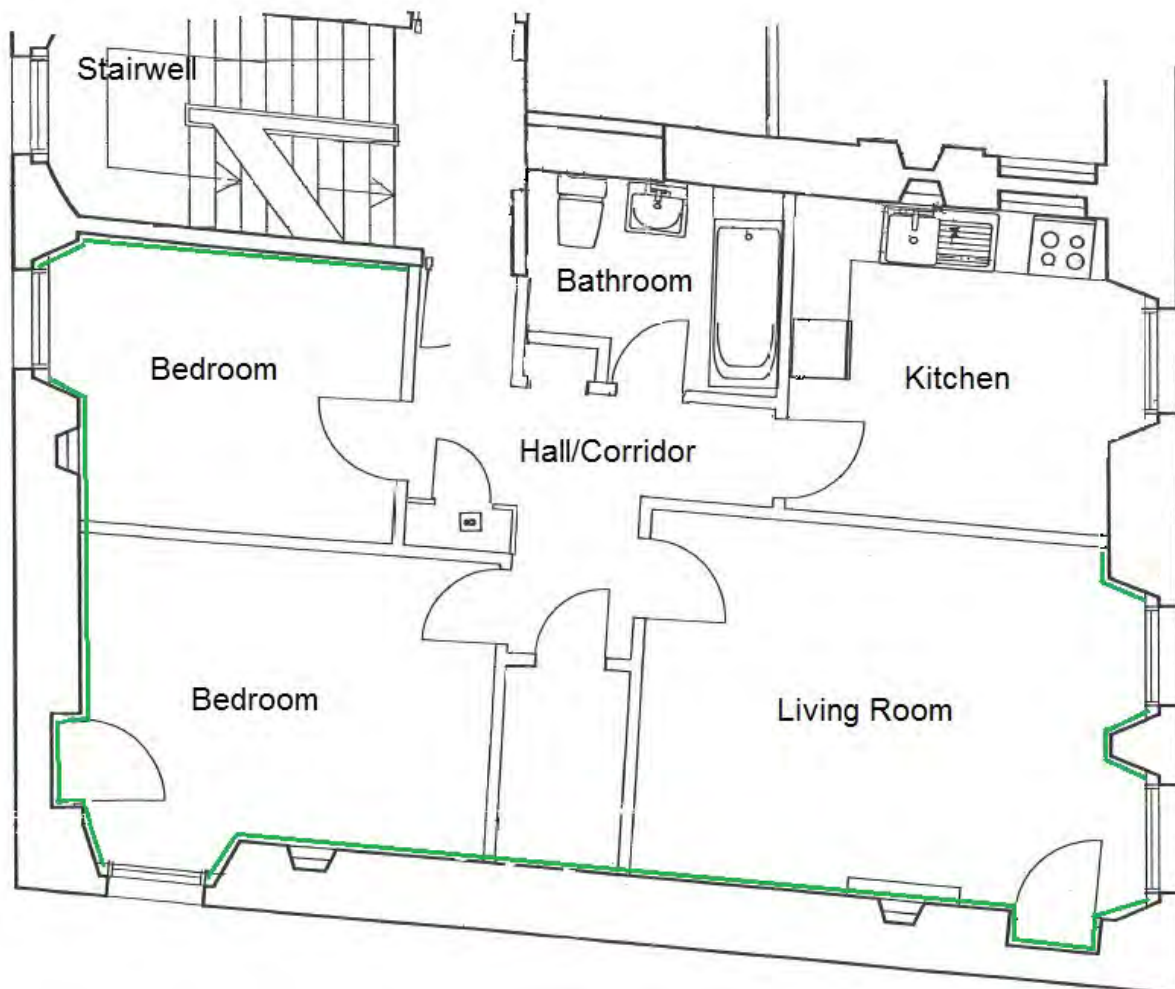


Figure 2. Plan of monitored flat in Lauriston Terrace (not to scale). The areas insulated with polystyrene bead are shown in green.

6. PRE-INTERVENTION ASSESSMENT

The extensive internal changes to the building in the mid-1990s meant that the building behaved more like a modern build than a traditional one. It was considered likely that adding further insulation behind the insulated plasterboard (a largely impermeable layer) would not affect the hygrothermal internal room conditions, but it would likely affect and improve the temperature and humidity conditions within the wall. In addition, the infilling of the former void behind the modern plasterboard would reduce the air movement in this space and dissipation of any moisture. This, however, brought forward considerations about the potential of the insulation work resulting in condensation.

In order to assess the risk of condensation, Glasgow Caledonian University (GCU) was commissioned to produce a report on the likelihood of condensation forming within the wall at Lauriston Terrace, following the addition of the polystyrene beads into the cavity. The risk assessment was carried out using the process outlined in BSEN 13788, sometimes referred to as the 'Glaser Method'. This methodology is common when planning solid wall insulation retrofit in various types of buildings in Scotland but was actually designed for timber-framed construction. Nevertheless, it was still deemed important to use this procedure as an indication of potential condensation problems. The assessment indicated a low risk of condensation within normal temperature ranges.

Besides the pre-works risk assessment, GCU was also commissioned to carry out in situ U-value measurements of Flat 2/8, before and after the injection of insulation, to monitor both, the room and external environmental conditions, and the relative humidity and temperature within the walls. This monitoring provided baseline conditions for the walls in the building and helped ascertain if there were any changes in conditions following the insulation work.

The in-situ U-value measurements for the walls were carried out in three locations on the gable wall. A heat flux plate was fastened to the wall and cables routed discreetly to a central logger box, from which data could be readily extracted. This monitoring required approximately three weeks of data, with a temperature difference of 10°C or more between the internal and external environment. Monitoring was carried out during November 2013. The heat flux plates are shown being installed in Figure 3.

To assess the conditions inside the flat, relative humidity and temperature data loggers were placed on the gable wall in the living room, the main bedroom wall, and the wall in the small bedroom adjacent to the staircase. Figure 4 shows the monitor in situ on the wall.



Figure 3. Installation of one of the heat flux plates.



Figure 4. Installation of one of the humidity and temperature sensors.

For external conditions, a temperature and relative humidity logger was fastened to the masonry at the base of the gable wall, but above head height to deter vandals. The information from the loggers and the heat flux plates was then collated and processed, ready to be compared with the results after the work. The equipment was removed for the insulation and the re-decoration work. However, due to an equipment malfunction, U-values for the main bedroom wall were not taken.

7. PROCURING AND DELIVERING THE WORK

Six flats were selected to have the insulation installed. One tenant declined to participate, changing the total to five. The contractor, BCA Insulation, was chosen by the Co-operative and were familiar with this type of work. They started in June 2014 and tenants were kept informed of the works and likely disruption.

In the past, there have been concerns that polystyrene bead insulation could damage PVC wiring cables. A change in the bonding agent used for the insulation, however, removed this risk and the contractor advised that it was safe to proceed with the work. To inject the material, 25mm diameter holes were drilled into the plasterboard at regular intervals. The actual installation was relatively straightforward (Figure 5), though it did require several holes to also be drilled across the top of each wall.



Figure 5. Blowing in the insulation.

Routes for the hoses carrying the insulation from the compressor, and a material supply vehicle, needed to be considered, especially as to where the vehicle could park. In this case, due to the orientation of the building, routes for the pipes to deliver the polystyrene bead were quite long and had to cross a pavement (Figure 6). Therefore, a parking permit had to be sought from the City of Edinburgh Council.



Figure 6. The pipes for the insulation crossing the pavement into Lauriston Terrace.

The pressure in the delivery hose was adjusted to ensure the material filled the void, and an infrared camera was used to check that the bonded bead had spread evenly. Once the material had set, the holes were patched over by the installers (Figure 7). This saved time for the decorators who came in shortly afterwards, with the initial filler already cured in the holes. It was estimated that the installation of the insulation would take four hours per flat to complete (doing two flats in a day). However, in reality, it took approximately six hours per flat.



Figure 7. Filling the holes following the injection of the bonded bead. Note the bead delivery nozzle, middle left.

In one flat, the polystyrene bead passed into the sash window pockets, blocking the movement of the sash weights. A subsequent inspection of most of the window splays showed that there was a board between the void and the sash case, except for this one. To resolve this, a joiner had to open the sash pocket and remove the beads. This incident showed that the material will travel to most voids behind linings under the set pressure. It also showed that the bonding agent in the polystyrene bead is not very strong; when the sash pocket was open, the beads were easily removed with a domestic vacuum.

8. RE-DECORATION

With the insulation work complete and the holes filled, the redecoration was a simple process using standard emulsion paint. While in most cases tenants are responsible for the decoration of their flats, as the disruption was originated by the landlord, this was paid for. Also, as a gesture of goodwill to the tenants disrupted by the operations, the affected rooms were wholly repainted and not just where work had happened. All works were completed by the end of June 2014 with a total project time of six weeks.

9. POST-INTERVENTION MONITORING

Following the works, the U-value monitoring equipment, consisting of four heat flux plates, was re-installed in the same places. This assessed the effects of the additional polystyrene insulation. As with the previous monitoring, it required a three week period of cooler outside temperatures, and a temperature difference of 10°C to minimise errors in the measurement. The results of the new U-values compared with the old values are in Table 1 and show an average improvement between 47% and 52%.

Wall	Before insulating cavity(W/m ² K)	After insulating cavity(W/m ² K)	Improvement %
Gable (living room)	0.57 ± 0.05	0.30 ± 0.03	52
Rear elevation (main bedroom)	Not measured due to error in equipment	0.31 ± 0.02	-
Stairwell (small bedroom)	1.34 ± 0.26	0.63 ± 0.11	47

Table 1. The pre-and post-intervention U-values for the monitored flat.

The humidity in the filled cavity behind the plasterboard was also monitored using temperature and relative humidity probes behind the existing plaster lining, over an 18-month period (from June 2014 to January 2016). This assessed how the wall conditions might have changed following the works and the standard level of humidity. Over the monitoring period,

the conditions within the walls at the interface between the insulation and the original masonry indicated no interstitial condensation, and the relative humidity remained below acceptable standards (Figure 8).

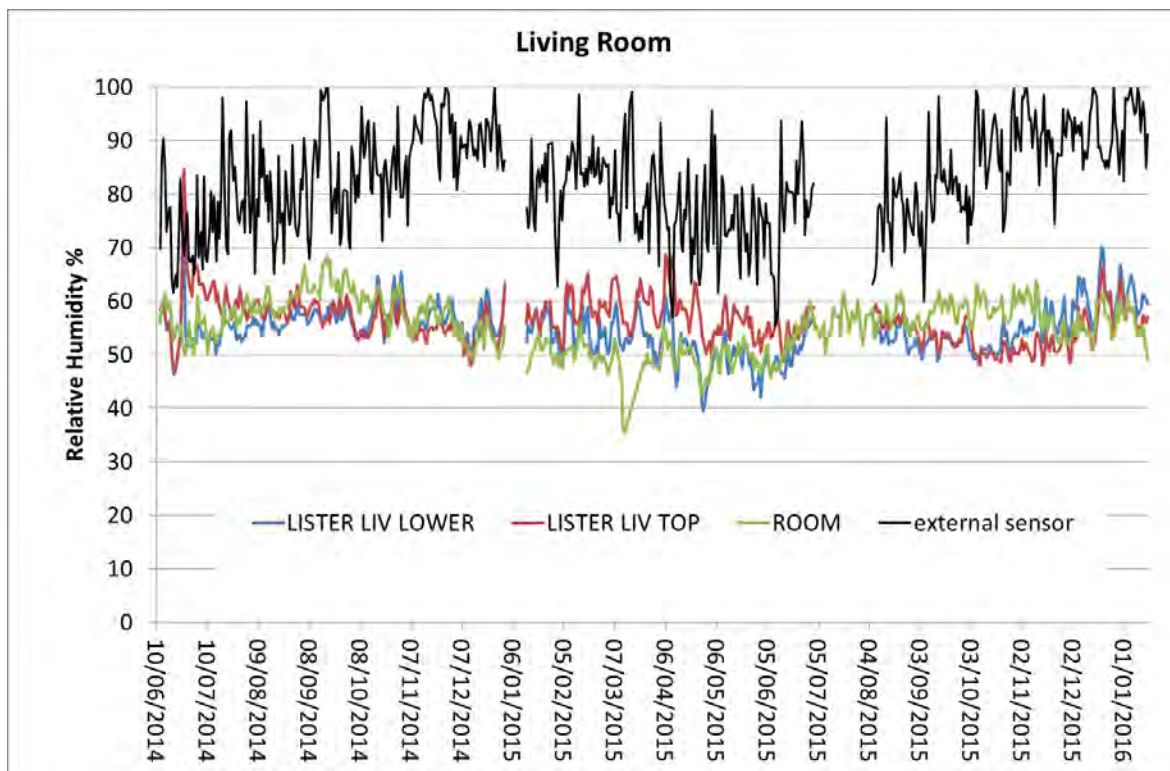


Figure 8. Monitoring of relative humidity within the wall of the living room.

10. POST-INTERVENTION EPC

While the improved thermal performance of the walls was important, it was equally important that this insulation work was reflected in an improved SAP rating, to put the property comfortably into the EPC's Band C that is required under EESH. An EPC for the monitored property was produced by an energy assessor (this EPC is in Appendix B), and showed a SAP rating of 75. This is in the upper level of Band C, an improvement of 5 points and, for an end terrace and solid wall property, a good result. As with the EPC conducted for Flat 2/8, replacing the single glazed windows with double glazing was recommended. However, it was decided not to go ahead with this replacement as the additional SAP points would be few (an estimated 2-3) and the minimum costs in the region of £3,500.

11. COSTS OF THE WORK

One of the objectives of the work was to establish costs for the polystyrene bead insulation in order to help the Co-operative plan future insulation works. For one flat the insulation work was £793.00 plus VAT, and the decoration work £846.00, giving a total of £1640.00. It should be

noted, however, that this cost is representative only if the work is being done at scale (that is for five flats or more). If such work was procured individually, the costs would be higher.

12. OCCUPANT FEEDBACK

To assess the impact of the works on residents, questionnaires were issued to the five households. The responses were generally positive and disruption was as modest as can be expected. The questionnaires showed that the works had mostly been very quickly and efficiently carried out, with minimal disruption, though one tenant expressed dissatisfaction at the dust and dirt created during the works. In contrast to the measured improvements in U-value, the tenants did not report significant improvements in thermal comfort. This, however, may be due to a number of reasons other than the actual thermal performance post the insulation works, such as the 'take back effect' where, due to the improved insulation, occupiers adjust their habits (such as dressing more lightly).

13. FUTURE WORK

Due to the U-value improvements and the lack of significant adverse change in the conditions within the solid walls, Lister Housing Co-operative decided to insulate approximately 40 other similar properties in the block, using the same approach as described in the case study. The additional installation received 40% funding under the Scottish Government HEEPS Cashback for Social Housing Providers scheme.

14. CONCLUSION

This trial project to upgrade the insulation in five traditional tenement flats has been proved successful. Concerns over interstitial condensation have been addressed with a condensation risk assessment and post-intervention monitoring that shows no build-up of moisture in the solid wall. The wall's U-values have also been lowered, indicating a reduction in heat loss. Importantly, the assessment methodology used to determine compliance with the EESSH legislation (i.e. the EPC) showed an improvement that met the required standard. The use of blown materials helped reduce costs, whilst minimising disruption to the occupants. The success of the work has allowed Lister Housing Co-operative to develop a refurbishment strategy and progress plans for insulation upgrades on more of their properties.

Energy Performance Certificate

Address of dwelling and other details


FLAT 10 2 LAURISTON
TERRACE
EDINBURGH
EH3 9EH

Dwelling type: Top-floor flat
Name of approved organisation: BRE Certification
Membership number: BREC000104
Date of certificate: 27 June 2011
Reference number: 2839-1024-7206-9829-3900
Type of assessment: RdSAP, existing dwelling
Total floor area: 67 m²
Main type of heating and fuel: Boiler and radiators, mains gas

This dwelling's performance ratings

This dwelling has been assessed using the RdSAP 2009 methodology. Its performance is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO₂) emissions. CO₂ is a greenhouse gas that contributes to climate change.

Energy Efficiency Rating

	Current	Potential
Very energy efficient - lower running costs		
(92 plus) A		
(81-91) B		
(69-80) C	70	70
(55-68) D		
(39-54) E		
(21-38) F		
(1-20) G		
Not energy efficient - higher running costs		
Scotland	EU Directive 2002/91/EC	

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Approximate current energy use per square metre of floor area: 194 kWh/m² per year

Approximate current CO₂ emissions: 37 kg/m² per year


Cost effective improvements

Below is a list of lower cost measures that will raise the energy performance of the dwelling to the potential indicated in the tables above.

Not applicable

A full energy report is appended to this certificate

Environmental Impact (CO₂) Rating

	Current	Potential
Very environmentally friendly - lower CO ₂ emissions		
(92 plus) A		
(81-91) B		
(69-80) C	70	70
(55-68) D		
(39-54) E		
(21-38) F		
(1-20) G		
Not environmentally friendly - higher CO ₂ emissions		
Scotland	EU Directive 2002/91/EC	

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.



Remember to look for the energy saving recommended logo when buying energy-efficient products. It's a quick and easy way to identify the most energy-efficient products on the market.

Information from this EPC may be given to the Energy Saving Trust to provide advice to householders on financial help available to improve home energy efficiency.

N.B. THIS CERTIFICATE MUST BE AFFIXED TO THE DWELLING AND NOT BE REMOVED UNLESS IT IS REPLACED WITH AN UPDATED VERSION

Energy Report



The Energy Performance Certificate and Energy Report for this dwelling were produced following an energy assessment undertaken by a member of BRE Certification. This is an organisation which has been approved by the Scottish Ministers. The certificate has been produced under the Building (Scotland) Amendment Regulations 2006 and a copy of the certificate and this energy report have been lodged on a national register.

Assessor's name: Gary Pearson
 Company name/trading name: Changeworks
 Address: 36, Newhaven Road, Edinburgh, EH6 5PY
 Phone number: 0131 538 7958
 Fax number: 0131 555 2768
 E-mail address: gpearson@changeworks.org.uk
 Related party disclosure: No related party

Estimated energy use, carbon dioxide (CO₂) emissions and fuel costs of this home

	Current	Potential
Energy use	194 kWh/m ² per year	194 kWh/m ² per year
Carbon dioxide emissions	2.5 tonnes per year	2.5 tonnes per year
Lighting	£37 per year	£37 per year
Heating	£416 per year	£416 per year
Hot water	£97 per year	£97 per year

The figures in the table above have been provided to enable prospective buyers and tenants to compare the fuel costs and carbon emissions of one home with another. To enable this comparison the figures have been calculated using standardised running conditions (heating periods, room temperatures, etc.) that are the same for all homes, consequently they are unlikely to match an occupier's actual fuel bills and carbon emissions in practice. The figures do not include the impacts of the fuels used for cooking or running appliances, such as TV, fridge etc.; nor do they reflect the costs associated with service, maintenance or safety inspections. Always check the certificate date because fuel prices can change over time and energy saving recommendations will evolve.

About the building's performance ratings

The ratings on the certificate provide a measure of the building's overall energy efficiency and its environmental impact, calculated in accordance with a national methodology that takes into account factors such as insulation, heating and hot water systems, ventilation and fuels used.

Not all buildings are used in the same way, so energy ratings use 'standard occupancy' assumptions which may be different from the specific way you use your home.

Buildings that are more energy efficient use less energy, save money and help protect the environment. A building with a rating of 100 would cost almost nothing to heat and light and would cause almost no carbon emissions. The potential ratings in the certificate describe how close this building could get to 100 if all the cost effective recommended improvements were implemented.

About the impact of buildings on the environment

One of the biggest contributors to global warming is carbon dioxide. The way we use energy in buildings causes emissions of carbon. The energy we use for heating, lighting and power in homes produces over a quarter of the UK's carbon dioxide emissions and other buildings produce a further one-sixth.

The average household causes about 6 tonnes of carbon dioxide every year. Adopting the recommendations in this report can reduce emissions and protect the environment. You could reduce emissions even more by switching to renewable energy sources. In addition there are many simple everyday measures that will save money, improve comfort and reduce the impact on the environment. Some examples are given at the end of this report.

Summary of this home's energy performance related features

The table below gives an assessment of the key individual elements that have an impact on this home's energy and environmental performance. Each element is assessed by the national calculation methodology; 1 star = very poor (least efficient), 2 stars = poor, 3 stars = average, 4 stars = good and 5 stars = very good (most efficient). The assessment does not take into consideration the physical condition of any element. 'Assumed' means that the insulation could not be inspected and an assumption has been made in the methodology based on age and type of construction.

Element	Description	Current performance	
		Energy Efficiency	Environmental
Walls	Sandstone, as built, no insulation (assumed)	★ ★ ☆ ☆ ☆	★ ★ ☆ ☆ ☆
Roof	Pitched, 300+ mm loft insulation	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Floor	(other premises below)	-	-
Windows	Single glazed	★ ☆ ☆ ☆ ☆	★ ☆ ☆ ☆ ☆
Main heating	Boiler and radiators, mains gas	★ ★ ★ ★ ☆	★ ★ ★ ★ ☆
Main heating controls	Programmer, room thermostat and TRVs	★ ★ ★ ★ ☆	★ ★ ★ ★ ☆
Secondary heating	None	-	-
Hot water	From main system	★ ★ ★ ★ ☆	★ ★ ★ ★ ☆
Lighting	Low energy lighting in all fixed outlets	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Current energy efficiency rating		C 70	
Current environmental impact (CO ₂) rating		C 70	

Low and zero carbon energy sources

These are sources of energy (producing or providing electricity or hot water) which emit little or no carbon dioxide into the atmosphere. There are none applicable to this home.

Renewable Heat Incentive

You could receive 20 years of RHI payments and help reduce carbon emissions by replacing your existing heating system with one that generates renewable heat and, where appropriate, having your loft insulated to 150 mm and cavity walls filled. The energy required for space and water heating shown below would form the basis of the payments. The Department of Energy and Climate Change has up-to date information on technologies supported and the support levels at www.decc.gov.uk/rhi.

This dwelling: Loft insulation 150 mm or more, Cavity walls not present

Heat demand for RHI	Existing dwelling	With loft insulation only	With cavity insulation only	With loft and cavity insulation
Space heating (kWh per year)	8509	-	-	-
Water heating (kWh per year)	2487			

Recommended measures to improve this home's energy performance

None

Further measures to achieve even higher standards

The measures listed below should be considered if aiming for the highest possible standards for this home. Some of these measures may be cost-effective when other building work is being carried out such as an alteration, extension or repair. Also they may become cost-effective in the future depending on changes in technology costs and fuel prices. However you should check the conditions in any covenants, warranties or sale contracts, and whether any legal permissions are required such as a building warrant, planning consent or listed building restrictions. The indicative costs are representative for most properties but may not apply in a particular case.

	Indicative cost	Typical savings per year	Ratings after improvement	
			Energy efficiency	Environmental impact
1 Replace single glazed windows with low-E double glazing	£2,500 - £6,500	£44	C 72	C 73
2 50 mm internal or external wall insulation	£5,500 - £14,500	£87	C 77	C 79
Enhanced energy efficiency rating			C 77	
Enhanced environmental impact (CO ₂) rating			C 79	

Improvements to the energy efficiency and environmental impact ratings will usually be in step with each other. However, they can sometimes diverge because reduced energy costs are not always accompanied by a reduction in carbon dioxide (CO₂) emissions.

About the further measures to achieve even higher standards

Further measures that could deliver even higher standards for this home. You should check the conditions in any covenants, planning conditions, warranties or sale contracts before undertaking any of these measures. If you are a tenant, before undertaking any work you should check the terms of your lease and obtain approval from your landlord if the lease either requires it, or makes no express provision for such work.

1 Double glazing

Double glazing is the term given to a system where two panes of glass are made up into a sealed unit. Replacing existing single-glazed windows with double glazing will improve comfort in the home by reducing draughts and cold spots near windows. Double-glazed windows may also reduce noise, improve security and combat problems with condensation. Building standards may apply to this work, so it is best to obtain advice from your local authority building standards department.

2 Internal or external wall insulation

Solid wall insulation involves adding a layer of insulation to either the inside or the outside surface of the external walls, which reduces heat loss and lowers fuel bills. As it is more expensive than cavity wall insulation it is only recommended for walls without a cavity, or where for technical reasons a cavity cannot be filled. Internal insulation, known as dry-lining, is where a layer of insulation is fixed to the inside surface of external walls; this type of insulation is best applied when rooms require redecorating and can be installed by a competent DIY enthusiast. External solid wall insulation is the application of an insulant and a weather-protective finish to the outside of the wall. This may improve the look of the home, particularly where existing brickwork or rendering is poor, and will provide long-lasting weather protection. Further information can be obtained from the National Insulation Association (www.nationalinsulationassociation.org.uk). It should be noted that planning permission might be required and that building standards may apply to this work.

What can I do today?

Actions that will save money and reduce the impact of your home on the environment include:

- Ensure that you understand the dwelling and how its energy systems are intended to work so as to obtain the maximum benefit in terms of reducing energy use and CO₂ emissions.
- If you have a conservatory or sunroom, avoid heating it in order to use it in cold weather and close doors between the conservatory and dwelling.
- Check that your heating system thermostat is not set too high (in a home, 21°C in the living room is suggested) and use the timer to ensure you only heat the building when necessary.
- Make sure your hot water is not too hot - a cylinder thermostat need not normally be higher than 60°C.
- Turn off lights when not needed and do not leave appliances on standby. Remember not to leave chargers (e.g. for mobile phones) turned on when you are not using them.
- Close your curtains at night to reduce heat escaping through the windows.
- If you're not filling up the washing machine, tumble dryer or dishwasher, use the half-load or economy programme. Minimise the use of tumble dryers and dry clothes outdoors where possible.
- Check the draught-proofing of windows and replace it if appropriate.
- If you have unused open chimneys consider blocking them off (making provision for a ventilation opening and a cowl on top of the chimney to avoid dampness).

For advice on how to take action and to find out about offers available to help make your home more energy efficient, call 0800 512 012 or visit www.energysavingtrust.org.uk.

Energy Performance Certificate (EPC)

Scotland

Dwellings

FLAT 8 , 2 LAURISTON TERRACE, EDINBURGH, EH3 9EH

Dwelling type:	Mid-floor flat	Reference number:	0176-1024-8208-9428-3904
Date of assessment:	03 August 2018	Type of assessment:	RdSAP, existing dwelling
Date of certificate:	06 August 2018	Approved Organisation:	Elmhurst
Total floor area:	69 m ²	Main heating and fuel:	Boiler and radiators, mains gas
Primary Energy Indicator:	172 kWh/m ² /year		

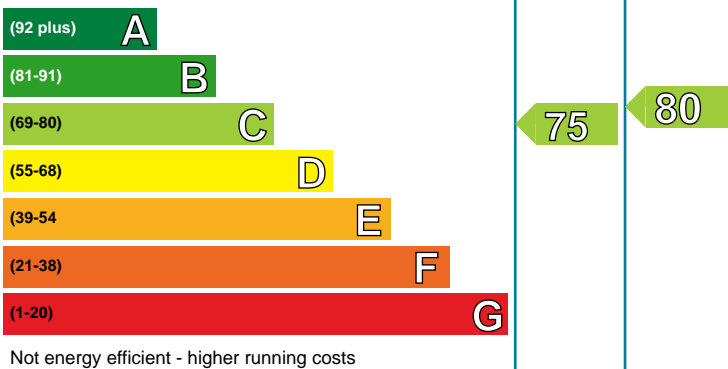
You can use this document to:

- Compare current ratings of properties to see which are more energy efficient and environmentally friendly
- Find out how to save energy and money and also reduce CO₂ emissions by improving your home

Estimated energy costs for your home for 3 years*	£1,560	See your recommendations report for more information
Over 3 years you could save*	£306	

* based upon the cost of energy for heating, hot water, lighting and ventilation, calculated using standard assumptions

Very energy efficient - lower running costs

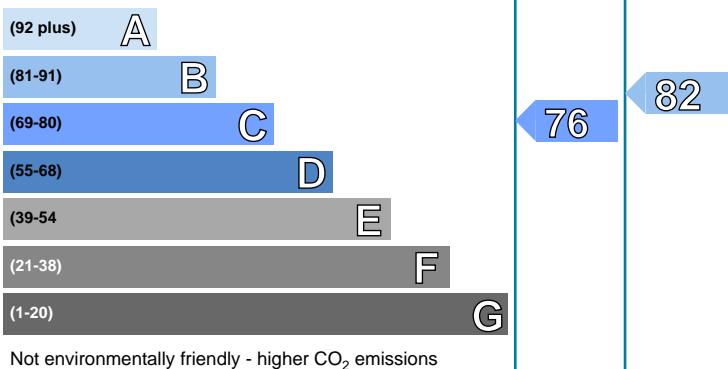


Energy Efficiency Rating

This graph shows the current efficiency of your home, taking into account both energy efficiency and fuel costs. The higher this rating, the lower your fuel bills are likely to be.

Your current rating is **band C (75)**. The average rating for EPCs in Scotland is **band D (61)**.

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.


Very environmentally friendly - lower CO₂ emissionsEnvironmental Impact (CO₂) Rating

This graph shows the effect of your home on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating, the less impact it has on the environment.

Your current rating is **band C (76)**. The average rating for EPCs in Scotland is **band D (59)**.

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Low energy lighting	£35	£138.00	
2 Double glazed windows	£3,300 - £6,500	£171.00	

A full list of recommended improvement measures for your home, together with more information on potential cost and savings and advice to help you carry out improvements can be found in your recommendations report.



The Green Deal may allow you to make your home warmer and cheaper to run at no up-front capital cost. See your recommendations report for more details.

THIS PAGE IS THE ENERGY PERFORMANCE CERTIFICATE WHICH MUST BE AFFIXED TO THE DWELLING AND NOT BE REMOVED UNLESS IT IS REPLACED WITH AN UPDATED CERTIFICATE

Summary of the energy performance related features of this home

This table sets out the results of the survey which lists the current energy-related features of this home. Each element is assessed by the national calculation methodology; 1 star = very poor (least efficient), 2 stars = poor, 3 stars = average, 4 stars = good and 5 stars = very good (most efficient). The assessment does not take into consideration the condition of an element and how well it is working. 'Assumed' means that the insulation could not be inspected and an assumption has been made in the methodology, based on age and type of construction.

Element	Description	Energy Efficiency	Environmental
Walls	Sandstone or limestone, with internal insulation Solid brick, with internal insulation	★★★★☆ ★★★★☆	★★★★☆ ★★★★☆
Roof	(another dwelling above)	—	—
Floor	(another dwelling below)	—	—
Windows	Single glazed	★☆☆☆☆	★☆☆☆☆
Main heating	Boiler and radiators, mains gas	★★★★☆	★★★★☆
Main heating controls	Programmer, room thermostat and TRVs	★★★★☆	★★★★☆
Secondary heating	None	—	—
Hot water	From main system	★★★★☆	★★★★☆
Lighting	No low energy lighting	★☆☆☆☆	★☆☆☆☆

The energy efficiency rating of your home

Your Energy Efficiency Rating is calculated using the standard UK methodology, RdSAP. This calculates energy used for heating, hot water, lighting and ventilation and then applies fuel costs to that energy use to give an overall rating for your home. The rating is given on a scale of 1 to 100. Other than the cost of fuel for electrical appliances and for cooking, a building with a rating of 100 would cost almost nothing to run.

As we all use our homes in different ways, the energy rating is calculated using standard occupancy assumptions which may be different from the way you use it. The rating also uses national weather information to allow comparison between buildings in different parts of Scotland. However, to make information more relevant to your home, local weather data is used to calculate your energy use, CO₂ emissions, running costs and the savings possible from making improvements.


The impact of your home on the environment

One of the biggest contributors to global warming is carbon dioxide. The energy we use for heating, lighting and power in our homes produces over a quarter of the UK's carbon dioxide emissions. Different fuels produce different amounts of carbon dioxide for every kilowatt hour (kWh) of energy used. The Environmental Impact Rating of your home is calculated by applying these 'carbon factors' for the fuels you use to your overall energy use.

The calculated emissions for your home are 30 kg CO₂/m²/yr.

The average Scottish household produces about 6 tonnes of carbon dioxide every year. Based on this assessment, heating and lighting this home currently produces approximately 2.1 tonnes of carbon dioxide every year. Adopting recommendations in this report can reduce emissions and protect the environment. If you were to install all of these recommendations this could reduce emissions by 0.5 tonnes per year. You could reduce emissions even more by switching to renewable energy sources.






Estimated energy costs for this home



	Current energy costs	Potential energy costs	Potential future savings
Heating	£903 over 3 years	£744 over 3 years	
Hot water	£348 over 3 years	£351 over 3 years	
Lighting	£309 over 3 years	£159 over 3 years	
Totals	£1,560	£1,254	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances such as TVs, computers and cookers, and the benefits of any electricity generated by this home (for example, from photovoltaic panels). The potential savings in energy costs show the effect of undertaking all of the recommended measures listed below.

Recommendations for improvement

The measures below will improve the energy and environmental performance of this dwelling. The performance ratings after improvements listed below are cumulative; that is, they assume the improvements have been installed in the order that they appear in the table. Further information about the recommended measures and other simple actions to take today to save money is available from the Home Energy Scotland hotline which can be contacted on 0808 808 2282. Before carrying out work, make sure that the appropriate permissions are obtained, where necessary. This may include permission from a landlord (if you are a tenant) or the need to get a Building Warrant for certain types of work.

Recommended measures	Indicative cost	Typical saving per year	Rating after improvement		Green Deal
			Energy	Environment	
1 Low energy lighting for all fixed outlets	£35	£46			
2 Replace single glazed windows with low-E double glazed windows	£3,300 - £6,500	£57			

Measures which have a green deal tick  are likely to be eligible for Green Deal finance plans based on indicative costs. Subsidy also may be available for some measures, such as solid wall insulation. Additional support may also be available for certain households in receipt of means tested benefits. Measures which have an orange tick  may need additional finance. To find out how you could use Green Deal finance to improve your property, visit www.greenerscotland.org or contact the Home Energy Scotland hotline on 0808 808 2282.

Choosing the right improvement package

For free and impartial advice on choosing suitable measures for your property, contact the Home Energy Scotland hotline on 0808 808 2282 or go to www.greenerscotland.org.

About the recommended measures to improve your home's performance rating

This section offers additional information and advice on the recommended improvement measures for your home

1 Low energy lighting

Replacement of traditional light bulbs with energy saving bulbs will reduce lighting costs over the lifetime of the bulb, and they last many times longer than ordinary light bulbs. Low energy lamps and fittings are now commonplace and readily available. Information on energy efficiency lighting can be found from a wide range of organisations, including the Energy Saving Trust (<http://www.energysavingtrust.org.uk/home-energy-efficiency/lighting>).

2 Double glazed windows

Double glazing is the term given to a system where two panes of glass are made up into a sealed unit. Replacing existing single-glazed windows with double-glazed windows will improve comfort in the home by reducing draughts and cold spots near windows. Double-glazed windows may also reduce noise, improve security and combat problems with condensation. Building regulations apply to this work and planning permission may also be required, so it is best to check with your local authority on what standards need to be met. A building warrant is not required if the windows comply with the current requirements.

Low and zero carbon energy sources

Low and zero carbon (LZC) energy sources are sources of energy that release either very little or no carbon dioxide into the atmosphere when they are used. Installing these sources may help reduce energy bills as well as cutting carbon.

LZC energy sources present: There are none provided for this home

Your home's heat demand

You could receive Renewable Heat Incentive (RHI) payments and help reduce carbon emissions by replacing your existing heating system with one that generates renewable heat and, where appropriate, having your loft insulated and cavity walls filled. The estimated energy required for space and water heating will form the basis of the payments. For more information go to www.energysavingtrust.org.uk/scotland/rhi.

Heat demand	Existing dwelling	Impact of loft insulation	Impact of cavity wall insulation	Impact of solid wall insulation
Space heating (kWh per year)	4,270	N/A	N/A	N/A
Water heating (kWh per year)	2,490			

About this document

This Recommendations Report and the accompanying Energy Performance Certificate are valid for a maximum of ten years. These documents cease to be valid where superseded by a more recent assessment of the same building carried out by a member of an Approved Organisation.

The Energy Performance Certificate and this Recommendations Report for this building were produced following an energy assessment undertaken by an assessor accredited by Elmhurst (www.elmhurstenergy.co.uk), an Approved Organisation Appointed by Scottish Ministers. The certificate has been produced under the Energy Performance of Buildings (Scotland) Regulations 2008 from data lodged to the Scottish EPC register. You can verify the validity of this document by visiting www.scottishepcregister.org.uk and entering the report reference number (RRN) printed at the top of this page.

Assessor's name:	Mr. Gary Pearson
Assessor membership number:	EES/021696
Company name/trading name:	Changeworks
Address:	36 Newhaven Road Mid Lothian Edinburgh EH6 5PY
Phone number:	01315554010
Email address:	nmcleod@changeworks.org.uk
Related party disclosure:	No related party

If you have any concerns regarding the content of this report or the service provided by your assessor you should in the first instance raise these matters with your assessor and with the Approved Organisation to which they belong. All Approved Organisations are required to publish their complaints and disciplinary procedures and details can be found online at the web address given above.

Use of this energy performance information

Once lodged by your EPC assessor, this Energy Performance Certificate and Recommendations Report are available to view online at www.scottishepcregister.org.uk, with the facility to search for any single record by entering the property address. This gives everyone access to any current, valid EPC except where a property has a Green Deal Plan, in which case the report reference number (RRN) must first be provided. The energy performance data in these documents, together with other building information gathered during the assessment is held on the Scottish EPC Register and is available to authorised recipients, including organisations delivering energy efficiency and carbon reduction initiatives on behalf of the Scottish and UK governments. A range of data from all assessments undertaken in Scotland is also published periodically by the Scottish Government. Further information on these matters and on Energy Performance Certificates in general, can be found at www.gov.scot/epc.

Opportunity to benefit from a Green Deal on this property

Under a Green Deal, the cost of the improvements is repaid over time via a credit agreement. Repayments are made through a charge added to the electricity bill for the property.

To see which improvements are recommended for this property, please turn to page 3. You can choose which improvements you want to install and ask for a quote from an authorised Green Deal provider. They will organise installation by an authorised Green Deal installer. If you move home, the responsibility for paying the Green Deal charge under the credit agreement passes to the new electricity bill payer.

For householders in receipt of income-related benefits, additional help may be available.

To find out more, visit www.greenerscotland.org or call 0808 808 2282.



THE ENGINE SHED

The Engine Shed is Scotland's building conservation centre. It is a hub for everyone to engage with their built heritage. We offer training and education in traditional buildings, materials and skills. For more information, please see our website at www.engineshed.scot/



SCOTLAND'S BUILDING CONSERVATION CENTRE

REFURBISHMENT CASE STUDIES

This series details practical applications concerning the conservation, repair and upgrade of traditional structures. The Refurbishment Case Studies seek to show good practice in building conservation and the results of some of this work are part of the evidence base that informs our technical guidance.

All the Refurbishment Case Studies are free to download and available from the HES website www.historicenvironment.scot/refurbishment-case-studies/

TECHNICAL PAPERS

Our Technical Papers series disseminate the results of research carried out or commissioned by Historic Environment Scotland. They cover topics such as thermal performance of traditional windows, U-values and traditional buildings, keeping warm in a cool house, and slim-profile double-glazing.

All the Technical Papers are free to download and available from the HES website www.historicenvironment.scot/technical-papers/

INFORM GUIDES

Our INFORM Guides series provides an overview of a range of topics relating to traditional skills and materials, building defects and the conservation and repair of traditional buildings. The series has over 50 titles covering topics such as: ventilation in traditional houses, maintaining sash and case windows, domestic chimneys and flues, damp causes and solutions improving energy efficiency in traditional buildings, and biological growth on masonry.

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SHORT GUIDES

Our Short Guides are aimed at practitioners and professionals, but may also be of interest to contractors, home owners and students. The series provides advice on a range of topics relation to traditional buildings and skills.

All the Short Guides are free to download and available from the HES website www.historicenvironment.scot/short-guides/



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Historic Environment Scotland is the lead public body established to investigate, care for and promote Scotland's historic environment.

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