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Making the business case for social housing retrofit: monitoring, evaluation and data availability

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1. Executive summary

1.1 Background

Scottish social landlords face challenges accessing data and conducting monitoring and evaluation (M&E) to build financial business cases for retrofit programmes. To investigate this, we conducted a rapid evidence review and gathered stakeholder insights during an online workshop.

The Social Housing Net Zero Heat Fund (SHNZHF) has been a significant factor in shaping social housing retrofit in recent years, providing grant funding for 50–60% of eligible capital costs, and more in rural and island communities.

1.2 Findings

Social landlords face considerable operational and financial pressures. Limited resources must be shared between retrofit projects and other competing demands. Without statutory net zero standards, social landlords are likely to prioritise mandatory obligations.

There is also doubt among social landlords about the benefit of specific retrofit technologies – for example, the potential for increased damp and mould with the installation of insulation, or rising electricity costs for tenants associated with air source heat pumps. Although some energy efficiency interventions are well established, some social landlords are waiting for stronger, longer-term evidence – especially on the viability of clean heat measures.

Social landlords face multiple, overlapping M&E requirements from different strategies, standards and funds, while retrofit-specific obligations remain largely high-level and in transition. Overlapping and sometimes unclear requirements can cause confusion and duplicate effort in a resource-constrained context. There is significant potential to align M&E requirements across policy agendas, allowing a shared core of indicators and datasets

to serve multiple purposes and avoid parallel systems. There is also an opportunity to standardise M&E requirements for social housing retrofit across various Scottish Government policy areas, including the Fuel Poverty Strategy, Heat in Buildings Strategy, Just Transition monitoring framework, the Climate Change Plan, and in preparation for the Social Housing Net Zero Standard (SHNZS).

Currently, monitoring and evaluation (M&E) practices vary significantly between social landlords, reflecting differences in data availability and approaches to retrofit M&E. Workshop participants emphasised that the location and size of a housing association can influence capacity for M&E activities. Challenges include gathering pre-retrofit data, ensuring the quality of overall stock condition data, and having the resources and skills within the housing association or local authority to gather and analyse the data. Examples of good practice include the effective use of technology, sociotechnical approaches, and combining qualitative and quantitative data.

Publicly available data on the costs and benefits of social housing retrofit is scarce, particularly for Scotland. Sources analysed include domestic Energy Performance Certificates (EPCs), Energy Saving Trust's National Energy Efficiency Data-Framework cost evaluations, Household Energy Efficiency Statistics, and datasets from the Climate Change Committee. More efficient data collection and sharing, including by housing archetype, could deliver significant benefits.

Our analysis of the publicly available data found that costs of retrofit for social housing tend to be more expensive than for private dwellings. This is because prices appear to have increased in recent years, there can be hidden costs around disruption, and economies of scale can be gained for projects that address a large number of properties. Costs also vary depending on location. Workshop participants highlighted the issue of disparities between estimated and real-life cost data, including costs beyond installation such as maintenance and replacement.

Our evidence review found all new retrofit interventions save tenants money on energy bills, ranging from at least £70 a year with floor insulation to £1000 a year with solid wall insulation. However, payback times vary and it can take several decades for tenants' energy bill savings to equal the social landlord's capital investment in solid wall insulation.

Reduced energy bills for tenants can help alleviate fuel poverty. However, to make a financial business case, social landlords must also consider the financial benefits to them as the investing organisation. Benefits may include reduced void periods, less maintenance costs, and improved assets. Co-benefits of retrofit measures include improved air quality, reduced dampness, and improved comfort. However, there are few clear, practical methods for social landlords to quantify these non-energy benefits in financial terms.

We also found there has been an underspend of the SHNZHF. Workshop participants identified several challenges with the fund, including annual funding cycles that restrict project design, delivery and procurement; a lack of funding for M&E; and insufficient time to collect baseline/pre-retrofit data.

1.3 Conclusion

Significant work is needed to ensure that relevant data is reliable, reflects real-world and whole-life costs, and is shared in an accessible format for analysis. There is a strong case for better alignment and simplification of M&E requirements, especially across Scottish Government policy areas. Improving data collection and sharing will help advance retrofit programmes across Scotland's social housing stock.

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2. Glossary of terms/abbreviations

ABS	Area Based Schemes
ASHPs	Air Source Heat Pumps
CCC	Climate Change Committee
DCM	Dampness, condensation and mould
EESSH	Energy Efficiency Standard for Social Housing
EPC	Energy Performance Certificate
EWI	Exterior wall insulation
FEES	Fabric Energy Efficiency Standard
HUG	Home Upgrade Grant
LAD	Local Authority Delivery
LCITP	Low Carbon Infrastructure Transition Programme
M&E	Monitoring and evaluation
MVHR	Mechanical Ventilation with Heat Recovery
RER	Rapid evidence review
RSL	Registered Social Landlord
SAP	Standard Assessment Procedure
SFT	Scottish Futures Trust
SFHA	Scottish Federation of Housing Associations
SHDF	Social Housing Decarbonisation Fund
SHQS	Scottish Housing Quality Standard
SHNZHF	Social Housing Net Zero Heat Fund
SHNZS	Social Housing Net Zero Standard
VOCs	Volatile Organic Compounds
ZDEH	Zero Direct Emissions Heating

3 Introduction

In order to develop business cases for energy efficiency and clean heat retrofit programmes, social landlords must have access to reliable, relevant data on the costs and also the financial benefits. Monitoring and evaluation (M&E) of retrofit interventions both pre- and post-upgrade is a keystone of that data being available.

We conducted a rapid desk review of evidence on M&E, cost/ benefit public data availability, and landlord experience of accessing data to make a business case for retrofit projects. See Appendix A for detail on method. To test and discuss the findings of the desk review, in collaboration with the Scottish Federation of Housing Associations (SFHA) we conducted an online workshop with housing association representatives and other stakeholders from across the sector in February 2026. A transcription of the workshop was used to identifying key themes. This report combines findings from the desk review with themes from the workshop, using anonymised quotations from workshop participants to illustrate and highlight social landlord experiences and perspectives.

3.1 Context for social landlords

Participants in the workshop were eager to stress that building a financial business case for retrofit projects is not a challenge that can be considered in isolation. The Scottish Housing Regulator notes 'considerable operational and financial pressures' facing the sector (2025). Important contextual factors also shape the capacity and desire of decisionmakers to progress with retrofit projects.

A key concern is the **competing demands on resources. O**ne workshop participant commenting, "A lot of organisations are just strapped for cash, strapped for resources, a lot of things to do." Capital investment in potential retrofit projects is considered in the context of 5-year financial planning and 30-year asset-level management plans. These must fulfil the vast array of statutory responsibilities carried by social landlords, as well as other non-statutory concerns.

> "But it's the real-life experience that tenants are pushing back now at the Board because we're telling them, well, this is going to cost them between 50 and 90 million to achieve net zero. What does this mean for the development programme? What does this mean for the rents? What does it mean for the tenants?"

Another significant contextual factor for social landlords making a business case for retrofit is that there are currently **no statutory net zero standards** requiring retrofit**.** The 2021 Heat in Buildings Strategy committed to reviewing the Energy Efficiency Standard for Social Housing 2 (EESSH2) in 2023 with a view to aligning it with Scotland's net zero targets. This effectively placed these targets on hold. Interim guidance for social landlords was provided in October 2022 and a consultation on the proposed replacement SHNZS closed in March 2024. No publicly available synthesis of responses has been provided by the Scottish Government, nor has the standard yet been published. This lack of statutory standards makes retrofit difficult to prioritise against the backdrop of multiple other competing mandatory demands on resources.

> "There's, yes, maybe some hesitancy and, you know, it's still seen as quite a risk, you know. Boards are being asked to sign off budgets and investments for something that there isn't that, you know, rubber stamp on yet."

> "It's kind of, well, we're kind of grabbing in the wind… So our committee is very much, you know, we're not going to be, because everything has, unless you get funding for everything, it's coming out of tenants rent money. And we don't, we can't justify that in our view at the moment."

Even when standards are finalised and published in the future, there was indication in the workshop that some housing associations may wait to ensure that the agreed standards are going to be long-term. This is based on previous experience of having "had my fingers very badly burned with the Scottish House and Quality Standard, Mark 1, and then it was replaced a few years later with Mark 2".

There is also **doubt about the benefit of retrofit technologies**. Retrofit measures have been considered as potential solutions to issues of indoor air quality, recognising health issues from humidity, damp, mould, and the build-up of noxious gases. When tenants suffer from damp, condensation or mould (DCM) in the home, The Investigation and Commencement of Repair (Scotland) Regulations 2026, enacting 'Awaab's Law' in Scotland, requires social and private landlords to investigate DCM within 14 days and start repairs within 7 days of inspections. However, recent evidence on **problems with damp and mould** has resulted in certain retrofit measures being treated with caution.

> "There's some now where we've done works and we've now got issues with damp and mould within them. So, it's looking at the implications that these measures could have long-term."

Similarly, installing clean heat measures may stand in tension with social landlords' imperative to reduce fuel poverty. This is a significant concern for the sector given tenants in social housing face acute energy inequity, with fuel poverty rates in 2024 of 61%, compared to 34% in the wider population, and extreme fuel poverty of 32% (Scottish Government, 2024a). Improving energy efficiency and clean heat potentially offers a mechanism to reduce the cost of energy for tenants. However, due to electricity prices, installing heat pumps, may result in **increased energy costs**.

> "There's a lot of cynicism, certainly in terms of perhaps putting some tenants into fuel poverty, rather than helping them out of fuel poverty, because obviously due to the cost of electricity it's the running cost [of the heat pumps] compared to gas central heating."

There was also evidence at the workshop that as many of the clean heat technologies are still new, or perceived as new, some housing associations may wait to invest in adoption until there is **stronger, longer-term evidence** of their benefits and viability.

> "Do we need to kick it down the road until we see the real-life benefits coming out of this for tenants? That's the push back I'm getting [from the Board]."

Even in situations that retrofit measures could deliver significant energy efficiency savings and other benefits, participants at the workshop highlighted that **tenant behaviour** significantly impacts whether these are realised. Examples include using more heating once a heat pump is installed and ventilation use patterns. One commented, "At the end of the day, all of the optimisation lies in the hands of the tenants."

Finally, retrofit for social housing sits in the wider context of challenges for retrofit in Scotland across all tenures. Workshop participants highlighted the **lack of skills and supply chain for delivery**.

> "If [Scottish Government] won the lottery tonight [….] I still don't think it would make any difference because I think we still have to come back to the elephants in the room, which is the lack of supply chains, labour, you know, technologies."

3.2 Grant funding

In 2023-24, social landlords were able to draw on Social Housing Net Zero Heat Fund for up to £250,000 towards activities to prepare for a funding application. This included feasibility studies, research, stock analysis and pre-capital support activities. This money was fully spent, suggesting high demand. The Scottish Government has stated that it will continue to consider options to support the development of a pipeline of projects to decarbonise the housing stock of social landlords (Scottish Government, 2023). Recommended by the Green Heat Finance Task Force, a project support unit could include support for the project development phase to help housing associations, particularly smaller ones, get projects ready for investment (Scottish Government, April 2025). Participants at the workshop confirmed that a support unit could play a valuable role regarding M&E and data to support business cases.

> "A support unit could do in that space of [....] monitoring evaluation data, kind of a support and stuff as well, [….] the ability to, in a way, be a repository for information data, which is then helpful for individual social landlords and stuff to build the cases around [….] sort of like remove the need for everybody to have the capacity."

The Social Housing Net Zero Heat Fund (SHNZHF) provides grant funding to social landlords. Launched in 2020, it was intended to make at least £200 million available to social landlords for the retrofit of their existing housing stock up to 2026. A subsequent review changed some of the details of the fund, including increasing the average grant per property cap for rural and remote rural projects by 11% and 22%. However, based on data for 2021/22 – 2024-25, there was a significant underspend of the SHNZHF. In response to a question in Parliament, data has been published showing that of the total allocated funding of £124.5m for financial years 2021/22 – 2024/25, only £69.7m was spent (56%) (Scottish Parliament, 2025). This does not include funding allocated and spent for 2025/26 and accordingly, allocation and spend figures will have increased. (See Appendix B for more detail.) There could be many reasons for this underspend, such as applications being low in the early years of the fund as the sector recovered from the impact of the pandemic. Some social landlords have applied to SHNZHF with projects ready to deliver, but were not awarded the grant. Given the overall financial limitations of Scottish Government, research into the reasons for unsuccessful bids would be useful, for example how many applications did not meet the

minimum criteria set out in the Fund guidance each year. This could inform the structure of future grant funding streams and further inform housing associations in how to successfully to apply for them.

The Scottish Housing Regulator has published a list of 'Systemically important Registered Social Landlords', selected on the basis of size, financial turnover, level of debt and regional significance. This list is used for closer monitoring of the sector. Nine out of twenty (45%) Systemically Important social landlords did not have SHNZHF funded projects at the time of writing. These social landlords would be particularly well placed to shed more light on issues and challenges encountered to make the business case for energy retrofits of their housing stock.

Workshop participants identified several challenges with the structure of SHNZHF, with many also expressing frustration with the process. The challenges can be grouped into three broad categories:

- Annual funding restricting project design, delivery and procurement

  > "Applications would go in May. We wouldn't hear about award until August. Projects are then being delivered through the winter in vulnerable tenants' homes. And it's just absolutely bonkers that they couldn't just be switched around so that at the absolute least the applications could go in for next financial year and deliver projects in the summer."

- Not including funding for M&E, only capital costs

  > "But the way that it's formulated means that it is impossible to line up future projects in such a manner that you can install IoT sensors to get a baseline energy usage for the property."

- Timeline not allowing for baseline or pre-retrofit M&E

  > "If the SHNZ funding gave you a longer lead in time and funded IoT sensors, we would have a much clearer understanding of how effective an intervention has been before and after."

4. Monitoring and evaluation

Engaging actively with M&E is essential for ensuring retrofit projects achieve their intended outcomes and for building robust, evidence-based business cases for future investment. At a system level, M&E offers better value for money by enabling continuous learning, reducing uncertainty, enabling long-term planning and aligning delivery with national policy objectives. The outputs of M&E will often be used to respond to scheme evaluations, or as part of bidding processes for new award applications. Efficient and relevant M&E evidence, either from previous programmes within their own stock, or from national data, can equip social landlords to substantiate the business case for retrofit programmes. However, current building regulations do not mandate evaluation, and monitoring requirements are poorly defined. Without agreed standardised protocols or tools, retrofit evaluations remain inconsistent and incomparable (Bhorkar et al., 2025, page 1).

4.1 M&E requirements

Social landlords face multiple, partly overlapping M&E requirements from strategies, standards and funds, whilst retrofit-specific obligations remain largely high-level and in transition. Along with the need to achieve minimum standards (an external push factor), M&E can provide data required to apply for new project funding (external pull factor). There are also general operational reasons for collecting data, including relating to the energy efficiency of and energy use within their housing stock (internal driver).

The 2021 Heat in Buildings Strategy committed to reviewing the EESSH2 in 2023 with a view to aligning it with the net zero targets. Interim guidance for social landlords was provided in October 2022. During the review period, landlords were advised to collect data on:

- the EE rating bands of stock (estimated or actual)
- the amount of investment committed to energy efficiency improvements in each year, and the funding source
- obstacles to improvements such as lack of consent
- projects that are deemed not to be cost-effective
- any review of options for energy efficiency improvements
- support for energy efficiency measures and zero direct emissions heating.

From 2024 onwards, progress reports have been supported by the Heat in Buildings Monitoring and Evaluation Framework. This implicates social landlords through the integration of data and indicators related to them. Appendix C provides an overview of key examples.

The interim guidance recommends consideration of installing monitoring equipment to test the performance of efficiency measures and encourage behaviour change. The interim guidance also notes the risk of insulation measures on air quality and monitoring-enabled targeted ventilation installation; that monitoring equipment costs may be outweighed by future savings, and that it is at the landlord's discretion if monitoring equipment is installed.

Industry standards such as PAS 2035 are also relevant for Scottish social landlord retrofitting. PAS 2035 is the British standard framework for energy-efficient retrofitting of existing residential buildings, introduced in 2019 to ensure high-quality, "whole-house" improvements. The standard is designed to encourage safer, more efficient, and properly

installed retrofits by certified professionals. The standard is increasingly reflected in public procurement, funding conditions and good-practice expectations for social landlords and, again, implicates data collection. A basic evaluation, required for all PAS 2035 certified completed domestic retrofit project requires "a measure-specific questionnaire distributed to the client and the occupant(s) (if different) of the dwellings that have been retrofitted."

A consultation on the proposed replacement SHNZS closed in March 2024. The new SHNZS is likely to come with revised indicators and reporting expectations. As part of the desk review for this project the publicly available responses to the call for views on the proposed SHNZS were reviewed from a number of social landlords, membership bodies and other organisations. Key themes related to M&E included (See Appendix D for more detail):

- the limits of modelled performance compared to how homes perform in reality
- the potential of a fabric-first efficiency rating e.g., the Fabric Energy Efficiency Standard
- real-world data and pilot monitoring
- structured monitoring frameworks for retrofit projects to enable standardisation of practice
- ventilation, health, and indoor environmental quality to also be monitored
- tenant experience and behaviour modelling.

Overlapping, sometimes unclear requirements can lead to confusion and multiplication of effort.

> "We have the Fuel Poverty Act, we've got the Heat and Buildings Strategy to become the Heat and Buildings Bill, we've got [upcoming] Social Housing Net Zero Standard, we've got the previous energy efficiency strategy for social housing, all of which don't point to a single identifiable destination. They all have pretty significant overlaps, but none of which you could say, well, that is the absolute certainty, that's the way marker and that's what we're heading for."

4.2 M&E alignment

Both our review of the evidence and opinion at the workshop indicated that there is significant potential to align M&E requirements for social housing retrofit across multiple policy agendas so that a shared core of indicators and datasets can serve multiple purposes and avoid parallel systems. These policy areas include the Fuel Poverty Strategy, Heat in Buildings Strategy, Just Transition monitoring framework, the Climate Change Plan and in preparation for the SHNZS. The same core concepts, indicators and datasets can serve multiple policy purposes rather than creating parallel systems. Alignment could streamline reporting for social landlords and ensure that outcomes at scheme or project level are coherent. This would also streamline Scottish Government work but would require inter-team working and coordination.

> "That is not just about contributing to sort of net zero because there's also a fuel poverty aspect of it and kind of that twin bed there [….] we want to try and sort of capture everything."

Project-level evaluations and national-level indicators can serve different analytical purposes (Drabble et al., 2024). Project evaluations can attribute change to a particular scheme or funding stream, whereas national indicators primarily show overall trends. It is possible to align pragmatic approaches with national frameworks so the same data can serve local assurance, scheme reporting, and national dashboards.

> "There's no point in us all doing things separately if we can't then somehow bring that together to give us that national picture on what's happening and what's been most effective."

To maximise the usability of data insights, aligning the following could ensure comparability between retrofit programme evaluations and national policy dashboards:

- definitions (e.g. "zero direct emissions heat" system or a "fuel poor household")
- spatial units
- time periods
- indicator lists

There was an extremely high level of interest amongst participants at the workshop in the development of a set of common M&E indicators:

> "We're absolutely very interested in the side of identifying common denominators."

> "I think it's just let's get a proper standardised impact evaluation methodology, which can then be rolled-out across the board. And then it also becomes cheaper because it's a standard thing that could be done, you know."

The evidence review suggests that minimum approaches may include:

- A basic pre- and post-retrofit dataset at dwelling level: measure type, property archetype, EPC band, fuel type, and installation date.
- Capturing simple pre- and post- retrofit performance indicators: EPC rating, modelled energy demand, and (where possible) annual bills or consumption from bills/smart meters for at least a sample of homes.
- Using a light-touch tenant survey template pre- and post-works.
- Keeping a short "installation and defects" record: quality issues, call-backs, damp/mould occurrences, and key repairs linked to retrofit measures.
- For projects funded via schemes such as SHNZHF, meeting the minimum scheme-specific requirements (e.g. measure-specific questionnaires).

However, as the expectations and objectives for each M&E exercise may differ, there would be a central requirement for explicit clarity on what each M&E activity is for. A counterpoint to the benefits of a common evaluation framework was suggested at the workshop, highlighting that flexibility in how much M&E was required would be necessary:

> "[….] at least have an adaptability element within the framework so that it can be drawn down or beefed up or scaled in, so on and so forth, according to its use context."

If a common framework is developed, then the governance infrastructure will need to be considered in depth and made explicit. At the workshop, someone asked, “So, is it that one RSL leads on those? Likely not. Is it something for the government perhaps to do through the Social Housing Net Zero Standard?”

4.3 Variability in monitoring and evaluation approaches

The May 2025 Scottish Government progress report on the SHNZHF (Scottish Government, 2025a) includes one-page summaries for each of the projects supported and grant figures at the time of award. These capture a range of M&E practices, including the following:

- the use of Wi-Fi adapters to allow for the monitoring of costs associated with Air Source Heat Pump (ASHP)
- pre-and post-installation consumption data
- tenant feedback
- heat, temperature, CO_2 and humidity records.

One project, Hawdene Zero-Emission Heating and Solar PV Energy Efficiency Project, emphasises a tenant centred approach, incorporating “intensive consumer engagement”. The variation in data and measures captured within the one-page summaries is illustrative of the diversity of social landlord M&E approaches.

> “That impact evaluation varies from the really in-depth stuff [….] versus the stuff that I see across the sector, which is anecdotal [….] ‘Aye, the tenants are comfy now’. You know, I've seen impact evaluation where basically the person that the tenant that complained the most hasn't complained for a while [….] that's not data.”

There are a range of reasons why M&E data is limited or uneven, and why approaches to retrofit M&E may vary. Within the workshop, discussions emphasised that the location and size of a housing association could influence capacity for M&E activities. There were also several housing associations that had drawn on the expertise of external organisations to deliver or contribute to retrofit M&E. Geographical consortia have been formed by some housing associations to pool resources and overcome variation.

> “I'm seeing a consortium of housing associations coming together to try and get that economies of scale to be able to manipulate and access data in a way that we just currently aren't able to do.”

Based on the evidence review, Table 1 provides a summary overview of dimensions impacting variation.

Table 1: Dimensions explaining varying approaches to retrofit social landlord retrofit M&E

Dimensions	Description
Scale and resources of the landlord	Larger landlords may have in-house M&E teams, dedicated retrofit roles, and capacity to commission specialist monitoring. Smaller landlords may not and/or may prioritise immediate maintenance and operation requirements.
Strategy and policy priorities	Different policies and schemes have varying M&E requirements. Landlords may focus on compliance or advanced M&E, e.g., that focus on mission-driven goals—such as fuel-poverty reduction or "deep retrofit" approaches.
Type, age, and density of housing stock	Landlords with hard-to-treat stock may run complex pilot schemes that require more intensive M&E. Landlords managing newer, easier-to-treat properties may use simpler, less granular evaluation methods, especially where installations follow more standardised packages.
Funding streams and reporting demands	Funding programmes often impose specific M&E requirements (e.g., pre- and post-installation surveys). Landlords that self-fund or rely on general capital budgets may regard M&E as optional.
Technical capability and external support	Social landlords may engage external evaluators, drawing on external capacity and expertise. Others may not have access to such resources and lack in-house expertise, therefore defaulting to simpler measures.
Attitudes to evidence, risk, and learning	Some landlords may see M&E as an opportunity for organisational learning, whilst others may regard it as a requirement. Preferences for quantitative, qualitative or mixed methods approaches vary, as does risk appetite. Organisations trialling new technologies or funding models may monitor more intensively to justify future investment decisions.
Tenant engagement and context	Some landlords may embed co-design or resident-engagement approaches, whereas others may treat retrofit as a technical intervention. Local demographics (e.g., remote, older-people–only schemes) can prompt landlords to tailor indicators - for instance, weighting reductions in fuel-poverty severity.
Extent of retrofit	Retrofits may be classified as 'deep' or 'shallow'. Shallow retrofit often includes single measures. Deep retrofits are major renovations involving a bundle of measures. The extent of retrofit will determine the focus of data collection.

4.4 Monitoring and evaluation challenges

Alongside the different dimensions that condition M&E approaches and lead to a wide range of M&E practices in the sector, there are several practical, delivery challenges. Evidence from the literature highlights:

- limited capacity for tenants to engage in data collection (Bhorkar et al., 2025)
- limited funding allocations towards M&E exercises within constrained budgets
- repeated time and effort diverted to funding applications, which reduces the time available for M&E work itself
- high tenant changeover rates which may influence data collection
- for rural social landlords in remote settings, the distance between housing
- tenants responding incorrectly to data collection exercises, including sending pictures of the wrong parts of bills when recording bill spend

- unintended occupant behaviour, including turning off monitors
- the extent to which the social landlord is directly and regularly engaged with tenants (Charles et al., 2025).

Within the limits of data that could be viewed publicly, there are indications of uneven and fragmented **pre-retrofit data**, including a particular lack of 'hard to get' data, such as fuel bills, and low-accuracy modelling outputs, which may not accurately reflect housing condition. Workshop participants stressed that significant gaps in pre-retrofit data and baselines for energy performance and usage, "Pre project data availability tends to be based on staff knowledge rather than being data led."

Workshop participants highlighted that this limits the ability to compare pre and post upgrade performance robustly, and therefore make a robust business case for future retrofit activity. Several also mentioned the role that the funding for a project plays in this.

> "It's really hard because often the money that comes for a project is about the delivery and everybody involved in the project is very much focused on delivery. Like, let's get the measures in! So you're not going to stall wall insulation being put in so that you can get better baseline data for another three months."

Challenges with baseline data are not limited to energy performance. Insufficient or inaccurate **overall stock condition data** prior to retrofit can also impact the planning and delivery of retrofit projects.

> "There is a real big gap in terms of the stock analysis information held across organisations and we see it time and time again just in terms of how projects are forced to evolve because the stock is in a very different place to what was expected."

> "They don't have, you know, the data is in a poor quality. They don't really know where to start. So, I think it's not a level playing field."

Underpinning all of the above challenges are the **resources and skills** needed to plan and deliver effective M&E, including analysing the data generated. There was evidence that within housing associations that are stretched for resources and staff capacity, M&E that there is no statutory requirement for can be deprioritised.

> "[….] the challenge is often just underestimating the resource requirements for good M&E … doing monitoring and evaluation in a good way, it just requires energy, resources and time."

There are not always the data skills within a housing association to analyse and use data, including collected through monitoring and evaluation. This can be a barrier to using it in building a strong business case.

> "It kind of requires a data specialist to look at it [….] for the people to know how to use it and have those skills and capabilities. And it's not something which is generally sits within a housing association, particularly smaller housing associations."

> "What we find is that even with [….] properties with IoT sensors, as we are inundated with data to the point of, well, how useful is that to know that on the 13th of February, there was a spike in humidity. What can we honestly do with that? And is there a case that too much data is not of benefit?"

4.5 Good practice

Table 2 provides example good practice data categories, measures and data sources, based on evidence from the wider literature and informal consultation with stakeholders.

Table 2: Good practice M&E approaches for Social Landlords by category of data collection

Category	Example measure	Example data source
Baseline performance/ pre-intervention	Energy use; temperatures; humidity; existing fabric performance; existing heating system efficiency.	Bills, smart-meter reading, spot meter reads; temperature; humidity data; EPC/SAP data; pre-works surveys.
Energy and emissions reductions	Energy consumption changes; modelled vs measured emissions; performance of low-carbon systems.	Smart-meter data; sub-metering of key systems; heat-pump performance logs.
Thermal comfort and indoor environment	Internal temperature profiles; overheating risk; relative humidity; mould/condensation risk.	Temperature and humidity; CO_2 and VOC sensors; thermographic surveys.
Indoor air quality and ventilation	CO_2 levels as a proxy for ventilation; VOCs and particulates; effectiveness of extraction systems.	Indoor air quality sensor datasets; fan power and run-time logs; spot flow-rate tests; inspection records.
Resident experience and satisfaction	Perceived comfort; disruption during work; understanding and use of new systems; satisfaction with bills, aesthetics and control.	Standardised resident surveys (pre- and post-retrofit); structured interviews or focus groups; complaints and compliment logs.
Behaviour and energy use practices	Changes in heating schedules; window-opening and ventilation habits; appliance use.	Home energy diaries; surveys; qualitative interviews.
Technical quality and defects	Installation quality; airtightness; cold bridges; damp and mould occurrences; component failure rates.	Inspection lists; photographic records; airtightness tests; thermographic imaging; defects database.
Health and wellbeing outcomes	Self-reported health and wellbeing; respiratory conditions linked to damp and cold; mental wellbeing.	Health and wellbeing surveys; linked referral data; qualitative interviews on sleep, stress and comfort.
Cost, bills and affordability	Change in energy bills; incidence of fuel poverty; landlord operating and maintenance costs.	Tenant bill data; modelled vs actual bill comparisons; landlord repair cost records; arrears statistics.
Portfolio and asset strategy learning	Payback periods; impacts on EPC bands; targeting for future tranches.	Project evaluation reports; stock-condition data; cost–benefit.

Category	Example measure	Example data source
Delivery quality	Effectiveness of resident engagement; delivery timescales; coordination with contractors.	Process evaluations; project management data (programme, resident engagement logs).

Good practice approaches to M&E also need to be realistic approaches that social landlords can undertake with the limits of current resources, and that can be scaled-up. Discussion at the workshop highlighted the use of technology, archetypes, sociotechnical approaches, and the value of qualitative alongside quantitative data to M&E as good practice.

Using **technology** embedded within homes, including built into retrofit measures, is increasingly being used to monitor interventions and gather data. Rapid advances in sensor technologies have opened the door to collecting a lot more data, with high temporal granularity. This includes energy use, indoor temperatures and indoor air quality before and after an energy efficiency retrofit (e.g. Boerefijn et al., 2018; Jnat et al., 2020). Such sensor data can be used to closely monitor and communicate tenant benefits from energy efficiency retrofits.

> "[….] significant differences between the modelled performance of a property versus the real-world performance, and I think that's where our preference is to have the real-time data monitoring available [....] what we now call connected assets, a heat pump is able to have a dongle installed that will give me its readings and I can use that across the entire year."

There has also been a progression of technologies that attempt to 'design-out' behaviour that is wasteful from an energy efficiency perspective. Examples range from remotely radio-controlled boilers and storage heaters on night tariffs, to lights with motion detectors and mechanical ventilation with heat recovery, combined with limited window opening options. The functioning of such technologies can often be monitored with built-in sensors, enabling an evaluation of specific technologies in situ.

> "The pre- and post-performance of a property is really helpful, obviously, in terms of measuring how effective the interventions have been. And we would do that through using the Internet of Things, sensors to be put into people's homes."

However, there are currently significant barriers to implementing such digital monitoring systems. These include financing them, technical skills (installation and analysis), privacy regulations, data security, legal agreements with data providers and intermediaries (e.g. smart meter energy consumption data), and tenant consent and engagement. This data reveals aspects of the presence and behaviour of tenants in the privacy of their home. Collecting such data sits within a wider managerial, social and ethical context. One workshop participant indicated they have encountered different types of data protection issues.

> "I'm afraid that our customers routinely do not want any sensors in their homes, given that they're already concerned with things like smart meters, etc. So having a digital device in place in situ that is whilst it's just monitoring humidity levels, temperature, etc. There is apprehension to have it there in the first place."

The literature on good practice principles and approaches includes a focus on **'socio-technical lenses'** - those that assess the technical and social aspects of building performance, and, therefore, the interaction between occupants and buildings (Mininni et al., 2024). See Appendix E for an indicative example. There is scope to link this to personal health monitoring through wearable devices, in collaboration with public health providers and thus potentially opening the door to (co-) fund some energy efficiency retrofits through social prescribing (Pescheny et al., 2019; Lawler et al., 2023).

The broader socio-technical M&E approach may not be realistic for every landlord or scheme. Instead, it may be better suited to pilots, deep retrofits, or strategic pathfinder projects. This is particularly the case given variation in capacity across the sector (as per Table 2). However, regardless of the size and location of the housing association, workshop participants recognised benefits to integrating these types of M&E.

> "I was really interested in [….] working on common indicators and linking them with [….] wanting to measure in terms of the health and wellbeing of the people when retrofits taking place."

Although the focus of both the evidence review and workshop were on quantitative data to inform business cases, the value of **qualitative data** on retrofit should not be forgotten. One workshop participant stressed that surveys can be easy to administer and return high quality data, another mentioned that case studies can be helpful. Interviews can also be useful sources of information for understanding the benefits and impacts of retrofit measures.

> "We do interviews with tenants as part of our project completion reports as well to ask them, you know, do they feel the home's warmer than it was before? Are they finding any differences in their energy bills, what they're having to pay? Also, in terms of their satisfaction with the process."

However, at the workshop it was raised that there can be challenges to sharing data on qualitative insights in any public forum.

5. Data availability on costs and benefits of social housing retrofit

There is an established body of academic literature on the role of data collection in strategic business decisions of social landlords (Gibb et al., 2016; Cooper et al., 2020). Understanding the relative costs and benefits of individual energy efficiency measures and clean heating technologies is essential for making the business case for retrofit measures. We conducted a desk review of publicly available data, including the extent to which this data can be disaggregated by location and social housing archetype (see Appendix A; and Table 3) . Appendix F provides data found on costs of roof, loft and wall insulation. Appendix G gives details of costs and benefits data available regarding loft and roof insulation, wall insultation, other types of energy efficiency measures, and heat pumps.

Table 3: Publicly available data

	Relevant publicly available data (not exhaustive)
Costs of measures	Domestic EPCs for Scottish dwellings National Energy Efficiency Data-framework (NEED)* cost evaluations from Energy Saving Trust, Household Energy Efficiency Statistics (HEES)*, Social Housing Net Zero Heat Fund (SHNZHF) Projects* The Net Zero Distributional Model – Methodology Report - Climate Change Committee Social Housing Decarbonisation Fund The Net Zero Distributional Model – Methodology Report - Climate Change Committee
Benefits of measures	Domestic EPCs for Scottish dwellings Household Energy Efficiency Statistics (including ECO and similar programmes) - GOV.UK* Household Energy Efficiency - data.gov.uk* Accessing SERL data - Smart Energy Research Lab* Smart Energy Data Service (SENSE)* Residential Archetypes Dataset (Kamma Climate) - Climate Change Committee

Data on Domestic EPCs for Scottish dwellings is a potentially relevant source for social landlords wishing to make a business case for retrofit1. It contains detailed information on the dwelling structure and EPC rating, in addition to suggested improvements, the cost and benefit associated, and the potential new EPC rating. It can also filter for occupancy type. This could allow social landlords to do bespoke analyses and compare estimations obtained through EPC assessments with external sources. However, it is currently not possible to

[1] The dataset extraction is available at https://statistics.gov.scot/data/domestic-energy-performance-certificates

analyse this data without extensive data cleaning and reorganisation due to the format of the output sheet. Improved access could allow for more precise business planning, including by observing the evolution in cost estimation over time, to understand which interventions are affordable, and derive the greatest benefit to tenants and the environment.

However, the EPC data is not always reliable or standardised. Few et al. (2023) highlight how the energy use of dwellings having an EPC rating equal or below C is overestimated when comparing assumed values and real data from smart meters. Workshop participants expressed strong doubts about the accuracy of EPC data and its future as a data set.

> "[….] we know that **EPCs are historically pretty inaccurate** and to add insult to injury, the Scottish Government are doing EPC reform. And we've also been told that the UK Government are changing the underlying methodology, how that EPCs are going to be produced."

Participants at the workshop highlighted that if data on costs and benefits were available for different housing **archetypes** then this could be particularly helpful. In-depth evaluations of benefits and costs by housing archetype – including housing type, flooring and wall type – would allow landlords to make more informed decisions and financial projects about retrofit projects. It could also be useful in informing which properties should be considered hard to treat. This would be within the stock of a specific housing association, creating efficiency by doing M&E in a sample of houses of a particular archetype rather than every single property. It was also suggested that sharing of data by archetype from M&E of retrofit interventions in other housing associations in Scotland could be incredibly valuable, if organisations were willing to share it.

However, solely relying on archetype data will not be sufficient to give accurate information for any specific property and needs to be combined with other data points.

> "[….] the variance and the difference [….] these kind of the basic data doesn't tell you anything about current ventilation rates. It doesn't tell you anything about occupant behaviour or, you know, occupancy levels or any of this stuff."

Given the scarcity of reliable, relevant publicly available data, some participants at the workshop discussed how they have approached combining different sources to build an evidence case.

> "If we're looking at a project, we might look at something like an EPC score, and then we might try to triangulate that with a retrofit assessment, and then we might also try to feed in a stock condition survey. We often have multiple different sources of data that tell us fragmented pieces of information, none of which is completely holistic."

5.1 Costs data

Based on the data reviewed (Appendix F and Appendix G) our analysis shows high costs for social housing retrofit, recent increases in costs, disruption-related costs, the potential for economies of scale, and varying costs depending on location. These points are addressed in turn below.

First, costs for **retrofitting Social Housing tend to be more expensive than private dwellings**. The average retrofit costs for solid external wall insulation, roof and loft insulation appear to be higher for social housing than private residences (MHCLG, 2025; DESNZ, 2026; Energy Saving Trust, N.D.)[2]. This may indicate inefficiency, perhaps due to the greater burden on social landlords to adhere to standards. Social landlords often face additional costs related to planning permission requirements (e.g., acoustic enclosures for heat pumps), gas meter removal costs, electricity grid infrastructure upgrades for solar PV, pipework modifications in multi-storey blocks, and additional costs for space-constrained properties requiring custom solutions (Berner et al., 2024). Berner et al.'s (2024) case study research also shows that social landlords do not tend to quantify internal staff costs for tenant engagement, project management, and application writing, making full project cost assessment difficult.

Second, prices appear to **have increased in recent years**, both for insulation and on the running costs of heat pumps. High insulation costs have implications on the number of interventions that can be undertaken and the rising cost of running heat pumps means financial benefits of heat pumps are more marginal.

Third, **hidden costs around disruption** must also be considered such as in the temporary rehousing of tenants or longer void periods whilst works are carried out. Morgan et al. (2024) through interviewing both tenants and professionals, highlight how disruption associated with retrofitting activities resulted in complications from both the inhabitants and the workers point of view. The Great British Insulation Scheme Government report (DESNZ, 2023) shows that retrofitting activities have a significant amount of variance in terms of disruptiveness, ranging between minimal disruptiveness for interventions such as cavity wall and loft insulation, to significant disruptiveness in the case of underfloor insulation. As a result, active and exhaustive communication is needed to minimise the potential impact of works carried out within properties. Engaging with tenants during the entire process reduces the impact of disruptions, but is likely to carry hidden costs for the landlord.

> "And the whole thing about that was in an empty block, so it's also what do you do when you've got occupied stock and when we're obviously in the midst of an increasing housing crisis that isn't spare homes to be able to move people out of to do work in their homes. So it's not just the cost,

[2] Averages for insulation interventions can be found in the English Housing Survey Technical Report, annex table 5.6.3 ("Indicative costs of the EPC measures") (MHCLG, 2025). Additional average Great British price points for insulation measures are provided by the Energy Saving Trust online at: Energy Saving Trust – Solid Wall Insulation and Energy Saving Trust – Loft Insulation. Cost data on social housing interventions from the Social Housing Decarbonisation Fund (SHDF) - Wave 2.1 (DESNZ, 2026) for England are summarised in Appendix F of this report. These represent our most reliable data currently for the Great Britain. Comparing these data points shows that most types of retrofit are more expensive for social housing compared to the average property. Cavity wall insulation in has a mean cost in social housing of £1900 (DESNZ, 2026), £900 more than the English average (MHCLG, 2025), loft insulation has a mean cost in social housing of £1200 (DESNZ, 2026), between £500 and £0 more than the British average (EST, N.D.), external wall insulation has a mean cost in social housing of £22,800 (DESNZ, 2026), £4,800 more expensive than British average (EST, N.D.), and internal wall insulation has a mean cost in social housing of £8,800 (DESNZ, 2026), £3,200 cheaper than British average (EST, N.D.).

> it's the complications that go around about it that I think impact on the business case. So where would we actually put people if we wanted to do this?"

Fourth, the data analysis on SHNZHF single-intervention projects suggests that **economies of scale** can be gained for projects which address a large number of dwellings. SHNZHF projects delivering over 100 units tended to have lower costs per dwelling than those delivering fewer interventions. The average unit costs for some projects addressing over 100 dwellings were around half of the most expensive schemes for both ASHPs and external (solid) wall insulation. This implies that funders may wish to work at scale to leverage savings.

Fifth, there was some evidence of **varying costs depending on location**. The strongest data in this area was from SHNZHF data on ASHPs. Claimed costs in remote rural regions, usually island communities, were around £1,500 higher than in other rural areas. This may suggest that local availability of labour and skills affect retrofit costs. However, *all* findings from SHNZHF should be treated with caution as the data analysis is based on claimed costs per measure and is for a small number of social housing retrofit projects only.

There can be a disparity between data available on **estimated costs and the real-life costs** to social landlords. Beyond the displacement costs mentioned above, workshop participants highlighted that predicted costs do not include additional project costs. Examples given include those arising from unforeseen operational issues, geographical disparities compared to estimated costs, and from inaccuracies in the baseline stock data leading to higher installation costs.

Additionally, social landlords need data on **whole-life costs** for retrofit measures, including maintenance costs and the cost of replacement in the future compared to alternatives; "It's just about life cycle replacement. What do we have to replace? Can we kill two birds with one stone?" The desk review found very little data available on maintenance costs.

5.2 Benefits data

Our analysis of benefits data (Appendix G) suggests that, while the return on investment for different energy efficiency and clean heat measures varies, all new retrofit interventions by social landlords **saved tenants at least £70 a year in energy bills** (floor insulation) and up to £500/£1,000 a year (solid wall insulation). It should be noted that the review of data focused only on individual retrofit measures, whereas in real-world scenarios multiple energy efficiency and clean heat measures are often installed simultaneously.

Whilst the greatest lump sum benefits may accrue from solid wall insulation, the initial investment can cost over £20,000. This means that several decades will need to pass for tenants to save money on energy bills equal to the social landlord's capital investment. An important metric, then, is the number of years of energy savings from tenants needed to exceed the cost of the initial investment. By this measure, draught prevention has the best ratio: an average investment of £250 may save on average £85 a year. For draught prevention, then, tenant savings cover the initial cost within three years.

In most cases the ratio between energy efficiency installation costs and yearly energy bill savings is similar for both flats and houses. Interventions in flats tend to be much cheaper,

but had more modest savings. In most cases, the average number of years to pay-back installation costs through savings was similar between flats and houses.

Participants at the workshop highlighted that even where modelled energy efficiency savings and, therefore, financial benefits data is available, these may not be realised in the real world, particularly not at the individual property level. One participant commented, "you're going to find pretty at times significant differences between the **modelled performance of a property versus the real-world performance.**"

The financial benefits of retrofit measures have been most often calculated in terms of savings to energy bills of tenants. However, some tenants are resistant to the installation of heat pumps due to fear of increased energy costs. In at least one housing association this has been represented by a tenant at board level.

> "Are we trying to sell a product that the customer does not want? Because of the distrust of heat pumps and the horror stories that you hear about cost of heating. In truth, that's my experience."

5.3 Financial benefits

Information accessed in the desk review was looking at financial pay-back in terms of energy efficiency over time. That is, costs saved on energy bills, which mostly accrue to the tenant and may be of benefit in also addressing fuel poverty. To make a financial business case, however, social landlords are also critically interested in financial benefits to them as an organisation, who have made the capital investment. We did not find any public information in these terms. Any data on costs or benefits needs to be clearly framed in terms of exactly whom the costs and benefits fall to.

> "So not just energy cost savings, reduced void periods, prolonged asset improvement or maintenance cycles, reduced stress of damp and mould."

> "It needs to look at the benefits of changes in your capital investment cycle due to, you know, better quality assets. And so I think when we're thinking of that than being put into, you know, annual budgets, five-year asset strategy, you know, five-year investment plans, 30-year asset management strategies, it's both the cost of the measures in their life cycle plus the kind of whole set of benefits that that investment can derive that we hope would be able to be included at the end of this process."

The Scottish Futures Trust (SFT) report 'Financial and funding the decarbonisation of Scotland's social housing' (2025) identified 12 potential finance models for social landlords seeking an energy efficiency retrofit of their housing stock. Different finance models have different data and knowledge requirements. The SFT report described 'heat with rent' and 'sale of carbon credits' financial models which depend on estimation and assessment of reductions in energy use achieved through the retrofit. Therefore, the energy cost reduction benefits described above may be relevant. However, the SFT report ranking of financial models prioritises speed and scale, and by these metrics, these two financial models rank at the very bottom. This does not mean that these models have no place in Scotland's ongoing housing decarbonisation efforts. These models may, in time, provide locally important and contextually-tailored opportunities for retrofit. Lessons regarding financing models can be

learnt from ongoing pioneering projects in Scotland, for example, in area-based approaches and energy with rent.

5.4 Co-benefits of energy efficiency and clean heat

Any financial benefits to tenants of retrofit through saving money on energy bills can reduce fuel poverty by decreasing the portion of income spent on energy (Gibb et al., 2020). Energy efficiency for vulnerable groups can also free more disposable income and boosts GDP and jobs (Turner et al., 2018).

There is evidence of other co-benefits from the introduction of energy efficiency measures. Estimating co-benefits has been found to be complicated due to a lack of data (Heffner and Campbell, 2011). However, more recently the CCC outlined a number of co-benefits from energy efficiency including reducing the number of people living in homes such as improved air quality, reduced dampness, and improved comfort (2023). Living in homes with low internal temperatures is a threat to health through increased respiratory and cardiovascular illnesses. Improving air quality in homes is also associated with reduced morbidity and mortality, and building resilience. Dampness impacts upon the burden on informal care, morbidity and mortality on vulnerable occupants, medical treatment and productivity. Poor health has a further impact on the NHS and wider society, with contingent costs to the public purse. Comfort is also relevant, since the Scottish House Condition Survey (Scottish Government, 2024a) finds that 31% of the respondents living in a social rented property were only sometimes or never able to reach a satisfactory level of warmth.

A 7-year longitudinal study on the wider health benefits of external wall insulation (EWI) was conducted in South West Scotland in vulnerable neighbourhoods (Kearns et al, 2023). Following wall insulation, the inability to achieve thermal comfort in winter reduced by two thirds, decreasing from 24% to 9%. On air quality and dampness, EWI led to gains in physical health scores, including 33 anecdotal reports of physical health improvements such as in respiratory conditions, seasonal illnesses, reductions in pain, and improved mobility. Relative standardised admissions fell in the treatment areas, remaining lower than the district-wide standardised rate for much of a five-year period, with a greater impact on respiratory conditions.

Although there is evidence of co-benefits, recent Changeworks research, Co-benefits of net zero retrofit and stock investment management: Social landlords in Scotland (2026) finds that there are few clear, practical methods for social landlords to value non-energy benefits in financial terms. Limited regulation, organisational capacity and financial planning constraints are found to be limiting factors in financially valuing the co-benefits of retrofit. In line with our findings, Changeworks' research shows that significant data and monitoring gaps prevent landlords from evidencing the wider health and wellbeing benefits of retrofit. Monitoring and evaluation that takes a socio-technical approach is considered good practice (see Good practice) and development of these methods could help landlords make the case for retrofit. Additionally, there could be challenges around access to and ownership of health data for social landlords.

6. Conclusion

Social landlords face tight budgets, staff pressures and overlapping – sometimes unclear and competing – requirements. Without the anticipated SHNZS, it is difficult for boards to prioritise capital spending on retrofit programmes. This is compounded by a lack of publicly available, reliable data on the costs and benefits of retrofit measures, particularly from Scotland and for social housing. Significant work is needed to ensure data is reliable, reflects real-world, whole-life costs and is shared in an accessible format for analysis. Increased use of technology and sharing of data by housing archetype data may help to address this.

There is a strong case for better alignment and simplification of M&E requirements, especially across Scottish Government policy areas. Standardised indicators, templates, and shared methodologies could all help to build a solid evidence base on costs and benefits. Achieving this requires funding, time and support for M&E itself, including baseline data collection before retrofit interventions, to accurately demonstrate impact. Any investment, financial or otherwise, in improving data collection and sharing will pay dividends in terms of enabling the sector to advance retrofit programmes across Scotland's social housing stock.

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8. Appendices

Appendix A: Methods

For the reviews focused on M&E and social landlord experience, the evidence was gathered through a combination of rapid evidence review (RER) and informal discussion with expert informants. The RER corpus consisted of plans, policies, reports, consultation responses, academic articles and Scottish Government webpages. Due to budget and time limitations, it was not feasible to fully examine a comprehensive set of resources for all relevant organisations. Instead, the desk study adopted a more selective approach, seeking to identify best practice case studies and consistent learnings. Given the diversity of the Scottish social landlord landscape, care was taken to collect evidence from a distinct group of cases, including rural vs urban, large vs small and sustainability 'leaders' (evidenced by grants, awards etc.) vs social landlords with a humbler historical track record in developing innovative projects with an energy efficiency component.

Identified via a keyword search, documents were analysed through a light-touch, non-systematic thematic approach, where authors read for key insights and recurrent ideas. Beyond themes, insights and recurrent ideas, data was recorded on the form evidence on the forms of data that social landlords can collect both pre- and post-upgrade, its consistency, reliability and validity, as well as data gaps.

Informal discussions took place with sector experts and were used to inform the authors' thinking and search scope. Given the time and scope of the work, as well as the absence of ethical approval for primary data collection, these informal discussions did not constitute data collection exercises.

The costs and benefits analysis followed four key stages:

a) Map existing data: a review of existing data sources by research sub-question (see Table 4 below); extraction and review of data from individual schemes such as the Low Carbon Infrastructure Transition Programme, SHNZHF, EESSH1/2, Area Based Schemes (ABS), and Scotland's Heat Network Fund,

b) Data gap analysis: identification of gaps in data. This included: (1) cross-checking with the Scottish Public Finance Manual and the UK Green Book to analyse whether information gaps correspond to information that are essential to conduct appraisals; and (2) sharing output with the team members for the M&E and social landlords experience reviews to understand gaps in understanding social landlords' experiences and for M&E.

c) Comparative quantitative analysis: targeted dataset analysis into a matrix summarising the findings and comparing the cost and benefit ranges by intervention.

d) Synthesis and reporting: data synthesis by sub-question and production of the final tables and report.

Table 4: Specific activities and data by sub-question (An asterisk (*) indicates that data sets with tenure data are known to be available. Direct analysis on social housing data can be developed.

Research question	Research activities	Relevant data/datasets (not exhaustive)
a. Costs of measures	Extracting data on financial costs at household level and disaggregating costs according to different measures and payment/ delivery models	Datasets including the National Energy Efficiency Data-framework (NEED)*, cost evaluations from Energy Saving Trust, Household Energy Efficiency Statistics (HEES)*, data from individual schemes in Scotland such as the Social Housing Net Zero Heat Fund (SHNZHF) Projects* The Net Zero Distributional Model – Methodology Report - Climate Change Committee
b. Benefits of measures	Identifying quantified benefits of individual interventions and schemes, disaggregating combined measures where possible	Household Energy Efficiency Statistics (including ECO and similar programmes) - GOV.UK* Household Energy Efficiency - data.gov.uk* Accessing SERL data - Smart Energy Research Lab* Smart Energy Data Service (SENSE)* Residential Archetypes Dataset (Kamma Climate) - Climate Change Committee
	Identifying direct economic and wider co-benefits of clean heat/energy efficiency measures (pollution, health, wellbeing) in social housing	The-Impact-of-Social-Housing-Report.pdf* supported-housing-costs-and-benefits-full-research-briefing.pdf* Investing in health: is social housing value for money? A cost-utility analysis | Journal of Epidemiology & Community Health* Evaluating the co-benefits of low-income energy-efficiency programmes – Analysis - IEA UK Co-Benefits Atlas Co-benefits and trade-offs of UK climate actions - GOV.UK CCC The-distribution-of-climate-action-co-benefits.pdf
c. Data disaggregation and comparison	Analysis of existing datasets and granularity by social housing types and by location.	Linked to the datasets above
	Comparison of costs/benefits ranges	

The purpose of the review on costs and benefits was to locate and present accessible data, and allow social housing associations in Scotland easy access to data sources that would support their business case retrofit of their housing stock. Given the priority of accessibility, all sources in the table above were consulted and referred to during the review, but only the publicly accessible sources were reproduced within the report. This means that some databases such as SERL were consulted but not presented due to accessibility.

Note on archetypes

Where data allowed, we used Cooper et. Al's (2023) 24 archetypes for the SHNZS in our analysis of costs and benefits on different housing types. In most cases, only two dwelling based dimensions (houses and flats) were possible to analyse due to lack of data disaggregation.

Appendix B: SHNZHF spend

The highest uptake of the SHNZHF was in 2023/2024, when almost 75% of the allocated funding was spent. The latest available SHNZHF data is listed in Table 5. This does not include data for 2025/26.

Table 5: Summary statistics of funded SHNZHF projects, 2021/22 – 2024/25

Number of projects	80
Smallest (£)	52,245.93
Largest (£)	11,100,000.00
Mean (£)	486,327.07
Median (£)	434,214.00
Total (£)	69,700,000

In total, the SHNZHF has funded 80 projects by 29 different social landlords. There have been multiple successful applications by some social landlords (Hebridean Housing partnership has 6 projects; Wheatley group has 5; Cairn Housing has 4). This indicates that for some applicants the fund was highly suitable. The Wheatley Group, Scotland's largest social landlord (96,000 homes) won the largest individual project (£11.1m) as well as the largest overall amount (£22.4m). But other large 'winners' are far smaller in size. For example, Hebridean Housing Partnership (£3.1m in total funding) has only 2,400 homes.

Information on unsuccessful applications would allow us to assess the overall application rate of the scheme and help us to examine the nature and extent of the problems that applicants encountered in building a strong business case.

Appendix C: Requirements from the Heat in Buildings Monitoring and Evaluation Framework

Table 6: Example indicator and data requirements from the Heat in Buildings Monitoring and Evaluation Framework

Indicator	Unit/data format	Data source
Share of domestic properties achieving a good level of energy efficiency (equivalent to Energy Performance Certificate (EPC) C or better)	Share of social rented sector properties (%)	Scottish Housing Condition Survey (SHCS)
Level of private financing that public funding leverages	Ratio	Data from the Scottish Government's heat networks, social housing and public sector delivery schemes
Number of improvement measures supported across all delivery schemes by sector during the last year	Number of measures	Scottish Government delivery scheme data

Appendix D: Summary of SHNZS consultation responses

No analysis was published of the consultation on the proposed SHNZS, though a number of social landlords, membership bodies and other organisations publicly published their responses to the call for views. This consultation yielded some 100 written responses. The Scottish Government's portal provides access to these responses, which are mainly from local councils and social landlords. We conducted a thematic review of the respondents' views relating to M&E. This Appendix summarises the themes expressed by the respondents. No individual respondents are identified, nor is analysis of the type of respondent that expressed any particular view.

The **limits of modelled performance** were discussed, with concern over relying solely on modelled performance via Standard Assessment Procedure (SAP) and Energy Performance Certificate (EPC)-style metrics. Respondents argued they do not accurately reflect how homes perform in reality and may mislead investment decisions. With current modelling tools under review, there is uncertainty about how to measure and evidence compliance over time. Responses emphasised the potential of a fabric-first efficiency rating e.g., the Fabric Energy Efficiency Standard (FEES) (applicable to UK new homes from 2025 onwards) which ensures new homes are highly energy-efficient before relying on renewables) (with recognition that this is more appropriate for some housing types than others (Eyre et al., 2023)).

There were calls for **real-world data and pilot monitoring,** where pilot or "pathfinder" projects could compare modelled performance with actual energy use, indoor air quality, and tenant experience (as per the socio-technical approach mentioned in Figure 2). Proposals include sampling-based performance monitoring, using innovative sensors/technologies, and structured pre-during-post retrofit monitoring to assess impacts

on heat demand, carbon, bills, damp/mould, and comfort with the view that a standardised approach could then be rollout out at scale.

This fed into a related call for **structured monitoring frameworks for retrofit projects** to enable standardisation of practice. Some respondents emphasised phased retrofit with evaluation at each stage (fabric, communal/external works, then deep measures on voids) using modelling tools (e.g. Passive House Planning Package) plus subsequent monitoring to refine future investment decisions.

Multiple respondents stress that monitoring must go beyond energy and include **ventilation, health, and indoor environmental quality,** representing a concern for air quality, condensation, damp, mould and ventilation performance, especially where air-tightness is increased. Respondents saw this as critical when Mechanical Ventilation with Heat Recovery (MVHR) systems are not recovered, and may require periodic checks to prevent unintended health impacts.

Consultation responses spoke to the importance of **tenant experience and behavioural modelling.** This included the merits of engaging tenants early, tracking how they use new systems (especially heat pumps) and monitoring whether residents actually see lower bills, improved comfort, and reduced fuel poverty. This can include behavioural aspects such as understanding controls, switching off systems, and adapting to low-temperature heating, though it is recognised that this data is not always easy to collect.

The over-riding purpose of M&E was recurrently linked to **cost, value for money and household expenditure.** Here, concern was given to the cost-effectiveness of measures, long-term lifecycle costs, and the balance between rent levels, retrofit investment and fuel bills. There was shared concern that without robust evaluation of costs versus benefits, retrofit could raise rents or energy bills and worsen fuel poverty, undermining the “just transition” narrative. Further inequality concerns emerged around challenges in **mixed-tenure building stock** M&E, including those related to coordination, consent, legal and funding barriers, which can delay or dilute outcomes for social tenants.

Expert responses called repeatedly for clear Scottish Government guidance in a range of areas, including how to calculate and report fabric ratings, how to design ventilation/monitoring strategies, and how exemptions and discretion should be overseen. This was related to a strong interest in the need for consistent, landlord-aligned metrics so progress can be monitored fairly across landlords.

Appendix E: Sociotechnical approach to evaluation

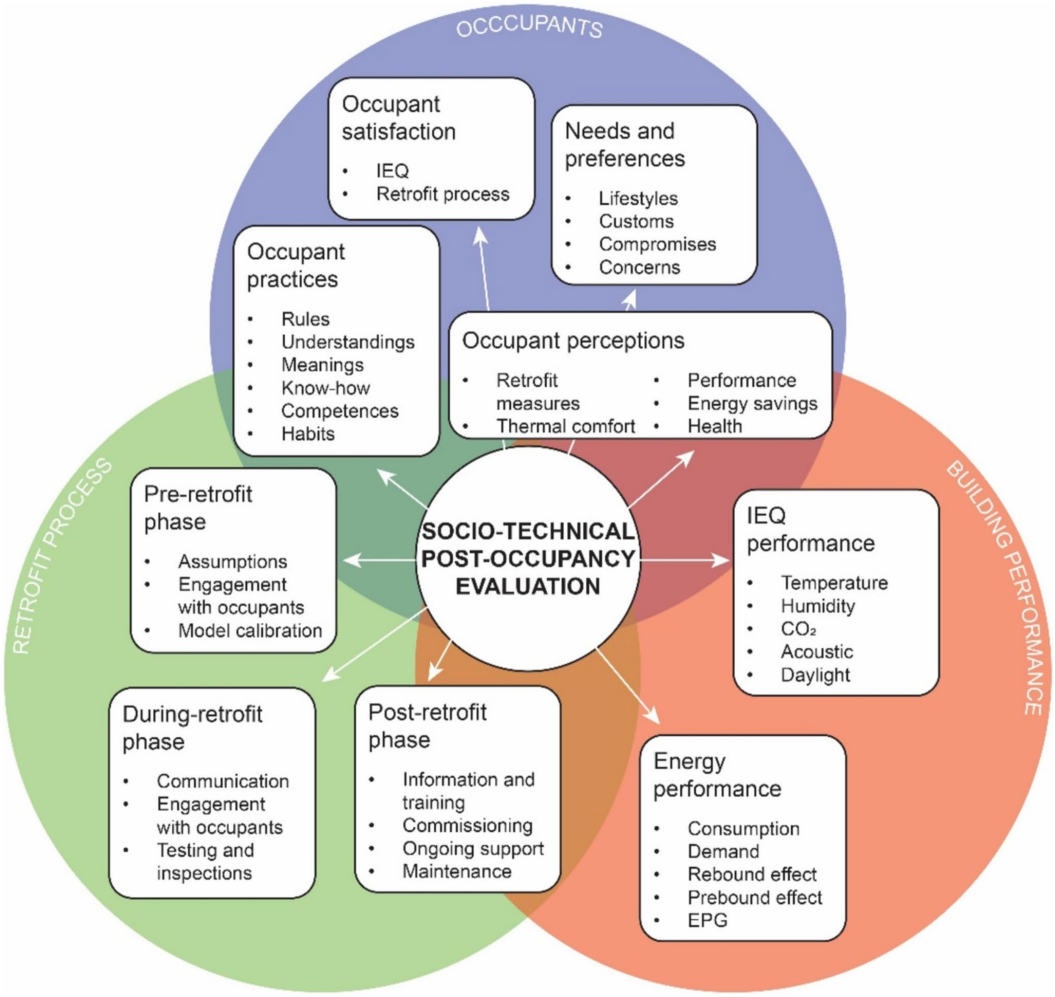

Figure 1: Socio-technical approaches to Post-Occupancy Evaluations (IEA stands for Indoor Environmental Quality and EPG for Evidence of Performance) (Source: Medrano-Gómez et al., 2025).

Appendix F: Data tables on costs of roof, loft and wall insulation

Table 7: Policy-related individual costs of loft and roof insulation

Policy	Year	Location	Average total cost	Cost by housing type (archetype)
Local Authority Delivery (LAD) - Phase 1	2020	England	1,300 £ - Loft insulation 11,900 £ - Flat roof insulation	Average - all housing
Local Authority Delivery (LAD) - Phase 2	2021-22	England	2,200 £ - Loft insulation 7,100 £ - Flat roof insulation	Average - all housing
Local Authority Delivery (LAD) - Phase 3	2022-23	England	2,400 £ - Loft insulation 8,500 £ - Flat roof insulation	Average - all housing
Home Upgrade Grant (HUG) - Phase 1	2022-23	England	2,600 £ - Loft insulation 9,500 £ - Flat roof insulation	Average - all housing
Social Housing Decarbonisation Fund (SHDF) - Wave 1	2022-23	England	2,300 - 2,600 £ - Loft insulation 4,500 £ - Flat roof insulation	Average - social housing
Social Housing Decarbonisation Fund (SHDF) - Wave 2.1	2023-26	England	1,200 £ - Loft insulation 2,700 £ - Pitched roof insulation 8,400 £ - Flat roof insulation 8,600 £ - Room in Roof insulation	Average - social housing

Table 8: Policy-related individual costs of cavity wall insulation

Policy	Year	Location	Average total cost	Cost by housing type (archetype)
Local Authority Delivery (LAD) - Phase 1	2020	England	£2,600	Average - all housing
Local Authority Delivery (LAD) - Phase 2	2021-22	England	£2,800	Average - all housing
Local Authority Delivery (LAD) - Phase 3	2022-23	England	£2,800	Average - all housing
Home Upgrade Grant (HUG) - Phase 1	2022-23	England	£2,700	Average - all housing
Social Housing Decarbonisation Fund (SHDF) - Wave 1	2022-23	England	£2,700	Average - social housing
Social Housing Decarbonisation Fund (SHDF) - Wave 2.1	2023-26	England	£1,900	Average - social housing

Table 9: Estimated individual costs of cavity wall insulation

Data source	Average estimated cost	Location costs	Benefits	Years to pay back costs through savings	Accessibility
Energy Saving Trust (2025)	£1,100 (flats) – 4,300 (detached houses) Installation costs only	UK average	120 £/y - 470£/y savings on energy bills - (based on July 2025 prices) Houses: £140-420 /y Flats: £120 /y CO_2 reductions of 380-1100 kg/y (houses), 310 /y (flats)	Detached houses: 9 years Flats: 9 years	Easily accessible

Table 10: Policy-related individual costs of solid wall insulation

Policy	Year	Location	Average total cost	Cost by housing type (archetype)
Local Authority Delivery (LAD) - Phase 1	2020	England	13,200 £ - External solid wall insulation 7,900 £ - Internal solid wall insulation	Average - all housing
Local Authority Delivery (LAD) - Phase 2	2021-22	England	17,400 £ - External solid wall insulation 9,800 £ - Internal solid wall insulation	Average - all housing
Local Authority Delivery (LAD) - Phase 3	2022-23	England	19,700 £ - External solid wall insulation 11,300 £ - Internal solid wall insulation	Average - all housing
Home Upgrade Grant (HUG) - Phase 1	2022-23	England	19,600 £ - External solid wall insulation 11,300 £ - Internal solid wall insulation	Average - all housing
Social Housing Decarbonisation Fund (SHDF) - Wave 1	2022-23	England	19,200 £ - External solid wall insulation 7,500 £ - Internal solid wall insulation	Average - social housing
Social Housing Decarbonisation Fund (SHDF) - Wave 2.1	2023-26	England	22,800 £ - External solid wall insulation 8,800 £ - Internal solid wall insulation	Average - social housing

For Table 14, the data is publicly available and consists of an average of the costs per measure, when provided. Data is available from:

- The Household Energy Efficiency statistics (Detailed reports, table 5.6), available at https://www.gov.uk/government/collections/household-energy-efficiency-national-statistics
- The SHDF statistics, available at https://www.gov.uk/government/statistics/social-housing-decarbonisation-fund-statistics-january-2026
- The Green Homes Grant and Home Upgrade Grant statistics, available at https://www.gov.uk/government/collections/green-home-grant-statistics

Appendix G: Costs and benefits of specific measures

We looked at the costs and benefits of each type of energy efficiency/clean heat intervention individually, to interrogate the quality and relevance of data currently publicly available. In each case, the most relevant and reliable data is presented in tables, showing Scotland-specific data and wider data from the rest of Britain.

a. Loft and roof insulation

Loft and roof insulation is an area where, after concerted effort over 20 years, the social housing sector has made excellent progress and the remaining gains to be made may be more marginal. In 2023, in the social sector in Scotland, 99% of dwellings had lofts insulated to 100 mm or more, and 77% had 200 mm or more of loft insulation (compared to private housing where 96% were insulated to 100mm and 65% to 200mm). Further, 34% of dwellings had a high standard (300 mm or more) of loft insulation in the social sector, compared to 28% of private sector dwellings in Scotland. This difference in large part is due to the Scottish Housing Quality Standard (SHQS) loft insulation requirement.

Whilst data on costs of loft/roof insulation in Scotland is not currently accessible, some comparable figures are available for England (all housing and social housing) as shown in Table 11 (Appendix E). This data shows notable year-on-year variation: prices for loft and roof insulation have clearly increased in recent years, though the data shows some fluctuation. This may be evidence of market forces and grant funds not sharing standardised costs, meaning that opportunities to retrofit may depend on prices in a given year. In all cases, flat roof insulation is relatively expensive, requiring an investment of around £10,000.

As regards benefits vs costs, the Energy Saving Trust data provides some insight as shown in Table 4. Energy Saving Trust data is for all dwellings in Great Britain (not only social housing) so the data may have less relevance. The data does show that loft insulation has an excellent cost-benefit ratio when starting from 0mm insulation, where costs will be recouped after 3-3.5 years, but more modest savings when adding further insulation, where costs will only be recouped after 25-35 years.

Table 11: Data table summarising costs and benefits – Loft insulation data

Data source	Estimated cost	Location	Estimated benefits	Years to pay-back costs through savings	Data accessibility
Energy Saving Trust (2025) Loft insulation: from 0mm to 270mm	£850 (mid-terrace) – £1,200 (detached bungalows)	UK average	Mid-terraced houses: £210/y Detached bungalows: £380/y (July 2025 prices)	Detached bungalows: 3 years Mid-terraced houses: 3.5 years	Easily accessible
Energy Saving Trust (2025) Loft insulation: from 120mm to 270mm	£700 (mid-terrace) - £900 (detached bungalows)	UK average	Mid-terraced houses: £20/y Detached bungalows: £35/y (July 2025 prices)	Detached bungalows: 25 years Mid-terraced houses: 35 years	Easily accessible

b. Wall insulation

Scottish Government statistics show that many dwellings in the social housing sector do not have any form of wall insulation. In 2023, 71% of social housing in Scotland had a form of cavity wall insulation and 52% had a form of solid wall insulation. However, whilst levels of cavity wall insulation are similar to the private sector where 70% of homes are insulated, levels of solid wall insulation are much higher in the social sector, since only 15% of private dwellings in Scotland had solid wall insulation in 2023.

Cavity wall insulation

The most complete data on the costs of cavity wall insulation again comes from England. Table 12 (Appendix E) summarises the costs. As with loft insulation, the costs of cavity wall insulation are not necessarily rising year-on-year, with the cost of cavity wall insulation decreasing in the most recent data series. English social housing data show a decrease in costs from an average of £2,700 in 2022-23 to £1,900 per unit in 2023-26.

The data in Table 13 (Appendix E) from the Energy Saving Trust presents both costs and benefits. Whilst the ranges do not allow for granular analysis for the costs per location, cost and benefit ranges are available for dwelling type. In general, the cost-benefit ratio holds, with greater investment leading to greater savings on energy bills and CO_2 emissions. Cavity wall installation for a detached house has an average cost of £4,300, leading to £470 saved per year, and 1,100kg less CO_2 emitted, whilst cavity wall insulation is cheaper in flats (£1,100 average), with more modest savings (£120 per year, 310 less CO_2 emitted).

Solid wall insulation

As noted above, whilst solid wall insulation is more common in social housing than the private sector, solid wall insulation is more expensive to install and difficult to fund.[3] However, energy efficiency benefits tend to be longer-lasting than for cavity wall insulation. Table 14 in Appendix E uses LAD, HUG and SHDF data from England to show that the average costs (in England) have steeply increased in the past five years, for both external solid wall insulation and internal solid walls. Costs between 2020 and 2023 for LAD increased by more than £6,000 per dwelling for external walls, and more than £3,000 for internal walls, whilst for the SGDF costs were over £3,000 higher for external walls and £1,300 higher for internal wall insulation installation. Table 14 shows that installations of internal solid wall insulation were around £2,500 cheaper than the national average and £3,000 more expensive for external wall insulation.

Analysis of Scottish costs and benefits data is shown Table 5. In the SHNZHF data, six projects were funded which only had measures for external (solid) wall insulation. The costs can only be inferred from the grant given, but this data shows roughly comparable costs with English data, with an average cost per dwelling of £19,000.[4] Significantly, the costs ranged from a high of £29,000 per unit (23 dwellings) to a low of £15,500 (141 dwellings). Both projects were delivered to island communities. This data suggests the importance of housing archetype since the most expensive unit costs were delivered for timber-framed dwellings and were considered hard to treat, whilst the cheapest costs were delivered in post-1,950 buildings. The data also imply economies of scale may be gained when intervening in over 100 dwellings for solid wall insulation costs.

Changeworks's evaluation of an ABS project in Aberdeen recorded several benefits of solid wall insulation. These included an average £1,000 reduction in fuel costs per dwelling, per year, more thermal comfort, and an EPC rise of four points on average. Energy Saving Trust data is less granular but shows a similar average cost to SHNZHF data, with external wall insulation costing £18,000 (internal walls average £12,000) for the average three-bedroom, semi-detached house. Cost savings are substantial but more modest than the Aberdeen ABS project, with average savings ranging between £160 (flats) and £550 (detached houses). However, according to our initial analysis of the data accessed, cost-benefit ratios for solid wall insulation are poorer than for cavity wall insulation, taking 45 years to cover installation costs through energy savings.

[3] The Scottish Government has proposed a cost-cap of £10,000 for properties complying with the proposed MEES. In a recent confidential report from Changeworks exploring potential costs of the Heat in Buildings Bill, cost estimates for EWI were not included as a measure given that typical installation costs will usually be more than the proposed £10,000 cost-cap. However, solid wall insulation is still included here due to its long-lasting efficiency gains.

[4] Costs inferred from grants, where 50% of costs are funded for energy efficiency and 60% of costs funded for clean heat under the SHNZHF.

Table 12: Data table summarising costs and benefits of solid wall insulation

Data source	Estimated cost	Cost by location	Benefits	Years to pay-back costs through savings	Accessibility
Social Housing Net Zero Heat Fund (SHNZHF) (2023-25)	£19,000 (mixed archetypes)	Scotland (mostly remote/ rural)	None measured	Insufficient data	Public PDF (link)
Changeworks evaluation of Aberdeen City Council's External Wall Insulation ABS project (2022-23)	None	Single location (Aberdeen city)	£1,000 average reduction fuel costs Reduced fuel poverty Over 50% more thermal comfort EPC lifted aver 4 pts 72%: home stays warmer for longer	Insufficient data	Summary report only, available here: link
Energy Saving Trust (2025)	£18,000 (external wall), £12,000 (internal wall), for 3-bedroom, semi-detached house in Great Britain	Great Britain average	£250-£550/y (houses), £160/y (flats) - (based on July 2025 prices) CO_2 emission reduction 650-1,500kg /y (houses), 410kg /y (flats)	Semi-detached house: 55 years	Easily accessible

c. Other types of efficiency

Data is sparser on other categories of energy efficiency such as windows and draught-proofing (Table 6). Data available through the Energy Saving Trust and DESNZ suggests that the costs of high-level (A-rated) double glazing are relatively high for the benefit derived. Savings from floor insulation are significant (average £70 per year). Draught prevention has a low cost and significant savings, with a 3-years investment payback period on average.

Table 13: Data table summarising costs and benefits of glazing, draught and floor insulation

Intervention type	Data source	Estimated cost	Cost by location	Benefits	Years to pay-back costs through savings	Accessibility
A-rated double glazing	Energy Saving Trust (2025)	£12,000 (semi-detached house)	Great Britain average	Annual energy savings of £140/y CO_2 emissions reduction 380kg/y	85 years	Accessible
Draught prevention	Energy Saving Trust (2025)	£250 (archetype not mentioned)	Great Britain average	Annual energy savings of £85/y [further gains possible as thermostat can be set lower]	3 years	Accessible
Floor insulation	DESNZ analysis (2023)	£2,700 (semi-det or end-terrace home)	Great Britain average	Annual energy savings of £70/y	38 years	Accessible

d. Heat pumps

Scottish Government data from 2023 suggests that 89% of dwellings in Scotland use boilers (of any type) whilst Heat Pumps (all types) are only present in 2% of dwellings, only 44,000. Data is not broken down for tenure, but it is worth noting that schemes such as SHNZHF, ABS and the Low Carbon Infrastructure Transition Programme have added a significant number of dwellings with heat pumps. The 2023 ASHP data is therefore likely to be out of date.

Cost and benefit data on clean heat differs from energy efficiency data in two main aspects. First, heat pumps are effective in reducing energy costs only in specific circumstances, compared to energy efficiency measures because their running costs are particularly sensitive to electricity prices. Energy bill savings depend on the level of insulation in the home.[5]

Analysis of SHNZHF data on ASHP shows an average cost per installation of £15,000, which is in line with the Scottish Government's estimated average cost of £14,000 (Table 7). All ASHP-only projects by SHNZHF were commissioned in rural and/or remote areas which may

[5] The Better Home, Cooler Planet report (2023), compared costs for three heat sources (ASHPs, old gas boilers, and modern gas boilers) in dwellings with different levels of insulation. Compared to old gas boilers, heat pumps (37.5% reduction in energy costs) are only comparable in cost savings with modern gas boilers (40% reduction in energy costs) in well-insulated properties. In poorly insulated properties, heat pumps are often poor value for money, with running costs are similar to old gas boilers. The updated report suggests, due to the increase in electricity prices, cost savings will only occur when upgrading to a heat pump from an old boiler, not from a modern boiler, implying that dwellings with modern gas boilers wouldn't financially benefit from switching to a ASHP.

have increased costs. We performed some preliminary location analysis from the SHNZHF reports, which suggests that ASHPs are roughly £1,500 more expensive to social housing providers in remote rural areas of Scotland. Benefits are not outlined in SHNZHF reports.

Table 14: Data table summarising costs and benefits of air source heat pumps

Data source	Estimated cost per ASHP	Location related cost	Benefits	Accessibility
Social Housing Net Zero Heat Fund (SHNZHF) (2023-25)	£15,000 (average for all archetypes)	Location is specified; some cost analysis possible (average Rural Scotland: £14,000 Remote Rural Scotland: £15,500)	Insufficient data	Public PDF (link)
Consultation on new Net Zero Social Housing Standard (2023)	£14,000 (average for all archetypes)	Scotland average	Insufficient data	Section 6.1.4 in report

As with external (solid) wall insulation data from SHNZHF, it appears that social housing landlords are able to leverage economies of scale with ASHPs. The Hebridean Housing Partnership were able to install ASHPs in 192 dwellings at a cost of just over £9,000 per unit. The three most expensive unit costs for ASHPs were projects delivering 32 units (£27,000 per unit), 16 units (£23,000) and 30 units (£22,000). The lower costs were mostly delivered between 2023 and 2024 which may indicate a recent increase in unit costs.

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