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Retrofitting Scotland's private rented sector: Challenges and landlord attitudes

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ABSTRACT

Retrofitting Scotland's private rented sector to achieve energy efficiency standards presents significant challenges, not only because of the high proportion of flats (67%) and older properties (42%), but also due to wider technical, socio-economic, and regulatory constraints that demand further research. This study aims to deepen understanding of these challenges and to provide insights into private landlords' attitudes towards retrofitting. Using a mixed-methods online survey, ten interconnected challenges are identified, explaining their root causes and how they influence landlords' decisions and retrofit strategies. The integration of energy compliance data and cost-based retrofit scenarios into the methodology expands current perspectives on the retrofit challenges faced by private landlords. The findings provide valuable evidence to support targeted improvements in the private rented dwellings sector by addressing the key retrofit challenges, including difficulties associated with hard-to-treat dwellings, high retrofit costs, flaws in the compliance energy assessment, and complications with mixed tenure retrofit. These challenges shape private landlords' attitudes towards retrofit approaches, reflected in two main patterns: 1) hesitation to undertake retrofits due to policy uncertainty and perceived post-retrofit property risks; and 2) a low preference to adopt key energy efficiency and carbon-reduction measures such as fabric upgrades and heat pumps. This study highlights the need for robust policy design, financial incentives, and tailored support to enable effective retrofitting across the sector.

1. Introduction

One in five homes in Scotland are built before 1919 using traditional construction methods and materials [1] that are considered difficult to retrofit. The challenges could also be greater in Scotland than the rest of the UK due to a higher proportion of flatted properties, which account for 36% of Scotland's housing stock [1], compared to 21.5% in England, 13.5% in Wales [2] and 10% Northern Ireland [3]. The Scottish Government is focusing on improving energy efficiency across all housing tenures to meet its 2045 net-zero emissions target. The social housing sector leads in performance ratings, with higher energy performance certificate (EPC) scores. This is due to Energy Efficiency Standard for Social Housing (EESSH) and EESSH2 policies. However, regulatory gaps remain for the owner-occupier and private rented sectors (PRS). The PRS is the worst-performing, with nearly 14% of homes rated in the lowest EPC bands, compared with owner-occupied (11%) and social housing (5%) [1]. In addition, the PRS sector has grown substantially over the past two decades, despite a slight decline since 2016, and remains in high demand, with levels around 2.5 times higher than the UK average [4]. This highlights the urgency of targeted action and justifies the focus of this study on Scotland's PRS.

Scotland's evolving policy landscape on domestic energy efficiency for the private rented sector has significant implications for landlords, tenants, and the wider housing market [5]. As the government moves towards developing regulations that will require improved performance across the sector, important questions arise: How will private landlords

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respond? Are the proposed standards achievable? What challenges do landlords face in retrofitting their properties? These uncertainties highlight the urgency and complexity of the issue, prompting a more comprehensive assessment. While some studies have explored aspects of retrofit in the sector, the depth and breadth of understanding remain insufficient. Responding to this need, this research aims to deepen understanding of the retrofit challenges in Scotland's private rented properties by examining the challenges faced by private landlords in meeting minimum energy efficiency standards.

2. Literature review and background study

2.1. Scotland's PRS, energy efficiency and the policy context

Around 84% of private landlords in Scotland are individuals, while the remaining 16% are institutional landlords [6]. Majority of the registered individual landlords own a single property, 94% or around 238,094, while only 1% manage three or more [6–8]. Building on the current understanding of retrofitting challenges in the rental sector, this study focuses specifically on individual landlords as delivering energy efficiency upgrades to their stock is more challenging on account of a lack of capital investment and inexperience [9,10], and to explore their challenges in greater depth.

The PRS has the smallest share of Scotland's housing stock, with just over 344,000 properties in October 2023 (14% of total), compared to 59% owner-occupied and 27% social housing [11]. Despite its smaller size, it contains the highest proportion of energy-inefficient homes, with three times (14%) of the share in EPC bands E to G compared to the social sector [12]. The rental sector in England and Wales shows similar patterns [13], making Scotland's case nationally relevant.

The Scottish Government has recognised the sector's poor performance and has developed various regulatory proposals since 2013, when the Regulation of Energy Efficiency in Private Sector Homes (REEPS) group was established. However, as of January 2026, no regulation has been fully implemented. This research refers to the *Heat in Buildings Strategy* (HiBS, 2021) as its main regulatory context [14]. HiBS replaced the withdrawn 2019 draft regulation, *The Energy Efficiency* (*Private Rented Property*) (*Scotland*) *Regulations 2020* (*Draft Energy Efficiency 2020*) [15] which had proposed achieving progressively higher EPC bands, beginning with EPC D for new tenancies by 2022. This regulation was postponed in March 2020 due to the impacts of COVID-19. Published in October 2021, HiBS set a target for all PRS homes to achieve EPC C by 2028 (where feasible), with owner-occupied homes by 2033, and social housing to meet EPC B by 2032. In delivering HiBS targets, concerns arose around technology implementation, including measures such as heat pump capacity for scaling up, addressing different building types, and the importance of financial support [15–17].

The regulatory context continues to evolve, notably through the *Heat in Buildings Bill* (HBB) consultation in November 2023 [18], which proposed deadlines for energy efficiency upgrades and the installation of low-carbon heating, with polluting systems banned after 2045. The PRS was expected to meet minimum standards by 2028, but the proposal was withdrawn due to concerns over fuel poverty and the financial burden on homeowners. In a more recent development, a draft minimum energy efficiency standard for Scotland's private rented sector was consulted on from June to August 2025 [19], introducing a new way of assessing and rating energy efficiency, based on the reformed EPC. Under this draft, all private rented dwellings must achieve a minimum Heat Retention Rating (HRR) of C by 2033.

2.2. The challenges of improving PRS energy efficiency

The PRS underperformance is largely attributed to its ageing, energy-underperforming traditional building stock. 67% of dwellings are flats, many in tenement[2] buildings, and 42% were built before 1919 using thick solid stone walls, original sash-and-case windows, with permeable construction materials such as solid stone and lime materials (mortars and renders) [20]. These features present significant technical and regulatory barriers to retrofitting, particularly where listed building status or conservation area protections apply. Measures such as external wall insulation, altering or replacing windows, installing secondary glazing, or adding renewable technologies like solar panels and wind turbines may be prohibited or require planning permission [21]. These restrictions are for historic preservation and, at the same time, can severely limit the feasibility of energy-saving interventions and frequently increase the cost and complexity of works [22].

Technical studies show that internal and external wall insulation can improve thermal performance and reduce U-values [23,24], but these gains are not adequately captured by the Standard Assessment Procedure (SAP), which underpins EPC ratings. This reveals an ongoing misalignment between actual retrofit outcomes and official compliance metrics [25]. Furthermore, application of unsuitable retrofit materials, especially those that do not consider the breathability of traditional construction, can cause long-term damage to the building fabric, including condensation and mould [26].

Further complications arise in multi-storey buildings where properties are of mixed-tenures, and retrofitting requires collective decision-making and coordinated effort. Legal and logistical issues such as fragmented ownership, unclear responsibilities for communal areas, and the need for consensus among multiple stakeholders often delay or obstruct improvements [27]. Even where funding is available, projects have progressed slowly due to prolonged engagement processes and SAP limitations in recommending upgrades in shared spaces [28]. Property law in Scotland also adds to the complexity, making it difficult to execute upgrades in a timely or cohesive manner [29].

2.3. Private landlords' attitudes to energy efficiency improvements

The uptake of energy efficiency improvements in response to proposed regulations will depend heavily on private landlords, who are the key actors. Existing studies on landlord attitudes, shaped by their motivations and retrofitting challenges, help to understand the factors influencing retrofit uptake in the sector. Private landlords' motivations to retrofit are attributed to financial, regulatory, and tenant-related factors. Financial incentives, such as subsidies and tax breaks, are consistently cited as key motivators in the UK and internationally [30,31].

Despite these drivers, multiple studies report persistent challenges, with high upfront costs and limited knowledge of available funding reported as the main challenges [9,30,32]. This is contributed by the "split incentive" problem, where landlords bear the cost while tenants benefit through reduced energy cost [33,34]. Rental market conditions also play an important role in shaping landlord investment decisions. The landlord–tenant energy efficiency gap is more pronounced in supply-constrained rental markets, where high demand limits tenants' choices and reduces landlords' incentives to improve energy performance [35]. Consequently, conventional payback models based on tenant energy bill savings are of limited relevance to landlords, whose investment decisions are driven more by rental income, compliance requirements, and market risk than by potential reductions in energy costs [36].

[2] Tenement is defined as "two or more related but separate flats divided from each other horizontally, and also framed broadly to include not only traditional tenement properties but also four-in-a-block houses and larger houses which have been subdivided" - Section 26 of the Tenements (Scotland) Act 2004 [57].

Landlords also hesitate to undertake energy efficiency retrofits due to misinformation, limited awareness of retrofit options and available support [9,32]. While physical building constraints such as heritage protections and traditional construction methods make retrofitting technically difficult, landlord concerns about costs, and limited awareness and retrofit knowledge further complicate progress.

Limited research on private landlords retrofitting challenges in the Scottish context has led to a review and rapid analysis of Scotland's private landlords' response to the *Draft Energy Efficiency 2020* [37]. The review identified four main challenges: high retrofit costs, difficulties in retrofitting the traditionally built properties (hard-to-treat), complexities related to properties in mixed-tenures and communal retrofit, and SAP flaws. These findings provide the foundation for this research, which aims to deepen understanding of the challenges private landlords face in retrofitting to meet minimum standards and to gain insights into their attitudes. Energy compliance data and cost-based retrofit scenarios are integrated into the assessment of private landlord challenges, responding to the findings of background studies. This integrated approach remains underexplored and largely absent from the existing literature.

3. Methodology

This research employed a mixed-methods online survey, combining quantitative and qualitative approaches to explore retrofit challenges. An online survey was adopted due to its convenience, speed, flexibility, and broad reach, as demonstrated by prior studies [38]. The survey was opened for ten weeks from 6th June 2022 to 15th August 2022, facilitated by the Scottish Association of Landlords (SAL) through distribution to its member list, which potentially enhanced participation.

Retrofit challenges informed by findings from a literature review [9,10,30,33] and a background study of consultancy responses to the *Draft Energy Efficiency 2020* [39] became the basis for forming questions for the mixed approach online survey. The survey consisted of three sections (see Fig. 1). Section 1 contained questions to understand awareness of the proposed policy, background information about participants' property (type, age, EPC) and energy efficiency measures applied. Section 2 was designed to seek further understanding of the main retrofit challenges found through literature review and background studies and to explore other challenges private landlords face. Mixed approaches were utilised in evaluating the challenges. Ordinal scale questions were used to assess how respondents were affected by the challenges. They were further asked to explain the challenges in detail and describe if they faced other associated challenges through an open-ended question.

The final set of questions of section 2 (C4) was only for landlords of pre-1919 rental properties, focusing on the challenges of retrofitting traditional solid stonewall tenements. Section 3 was expanded to investigate landlords' retrofit plan and preferences. A set of ten scenario-based questions was integrated to explore landlords' preferences when selecting retrofit measures to support assessment of their retrofit challenges and gain insights into their attitudes. Each scenario compared retrofit measures with predicted SAP improvements and costs, extracted from a case study of energy calculations and energy compliance research [39]. The energy performance assessment utilised SAP and Passive House calculations to predict measures that can achieve the minimum energy efficiency standard of EPC band C in case studies of pre-1919 poor-performing Scotland's rental properties.

The analysis combined thematic analysis of retrofit challenges emerging from Section 2 with an evaluation of the preferred retrofit scenarios, obtained from Section 3, supported by information from Section 1 to form the foreground understanding of the overall assessment. Using thematic analysis, data were categorised according to main challenges or meaningful themes and their emerging issues [40,41]. The evaluation of retrofit scenarios identified relationships between landlord plans and preferences and their challenges in retrofitting to achieve energy efficiency standards.

4. Results and analysis

A total of 64 responses were received, including 41 from landlords of pre-1919 properties who completed additional questions in Section 3.

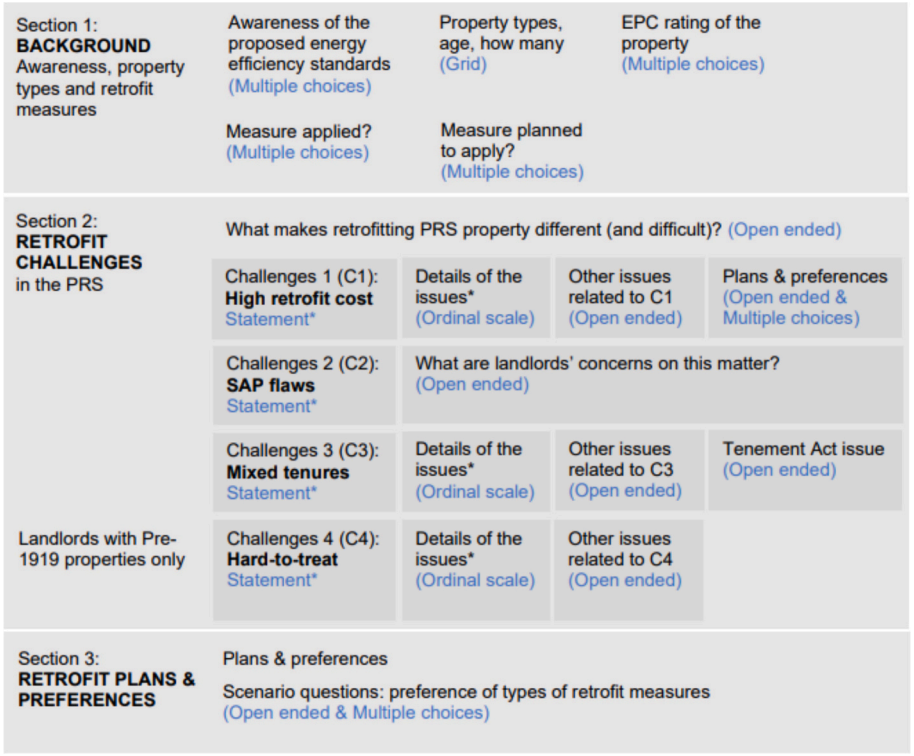

Fig. 1. Structure of the survey questions.

The richness of responses received through the mixed-method online survey has enhanced this research credibility and validity, as referenced by other research [42]. Results are presented in three areas: 1) Respondents' awareness and existing energy efficiency improvements, mainly from Section 1 of the survey, 2) Challenges to retrofitting the PRS, derived from Section 2 and also combining interpretation of findings from all sections and 3) Assessment of private landlords' attitudes, interpreted from all sections, supported primarily by Section 3. Landlords' responses cited here are drawn from the full sample of 64 respondents, rather than from a single landlord.

4.1. Respondents' awareness and energy efficiency improvement

Most respondents (72%) were fully aware of the proposed EPC Band C target for 2028, though some had limited awareness or none at all (Table 1). A majority had undertaken basic fabric improvements, particularly loft insulation and window upgrades (61%), while more complex and costly measures, such as external wall (25%) and floor insulation (8%) were less common. Heating upgrades applied were mainly focused on replacing older systems with condensing boilers (50%) and improved controls (47%), while heat pumps had not been adopted. Uptake of low-carbon and renewable technologies was negligible, with only 3% reporting the installation of solar PV.

4.2. Assessment of challenges to retrofitting private rented properties

Qualitative analysis using thematic methods identified and expand the four primary challenges initially explored (C1 to C4). Six additional challenges raised by landlords were identified (C5 to C10), as discussed below.

4.2.1. C1: high retrofit investment cost and limited returns on rental incomes

Based on ordinal-scale responses, a majority were strongly affected by the high upfront cost of retrofitting traditionally constructed buildings (89%), long investment payback period (83%), and the expense and complexity of achieving higher energy ratings (86%). Furthermore, 67% reported being strongly affected by the limited benefits landlords will gain, while 69% were concerned about the numerous improvements required to meet EPC C standards (refer to Table 2).

Four key issues emerged from landlord responses within this challenge:

i. High upfront costs and long payback periods: This concern was particularly strong among those with low rental income, as shown in comments like, "*The costs will be too high to be recovered from rental income, no matter what notional return of investment period is envisaged*," and "*Paybacks are in the 20 year range—who would invest for a 20 year payback?*" For private landlords, the payback period refers to the recovery of capital investment rather than energy savings alone. Experiences of costly works such as replacing sash windows or installing internal wall insulation were common; "*We have made improvements in two properties at a cost of over £40,000 each*," and "*Replacing ancient double glazing for 2022 ST will require a long payback on heating savings*".
ii. Limitations to rural properties incurred retrofit cost: Landlords with rural properties highlighted further limitations in retrofit feasibility due to off-grid locations and a lack of suitable heating alternatives. These challenges were captured in comments such as, "*No clear cost-effective* [*alternative*] *to oil or wood burners*," Many called for more appropriate and equitable support for privately rented properties across all areas in Scotland.
iii. Landlords-tenants dilemma and small profits margin: Landlords also expressed a dilemma in which tenants benefit from lower energy bills, while landlords receive no direct gain, despite making significant financial investments; "*The landlord can pay huge sums to install measures but sees no direct financial benefit*," and, "*There is not much 'spare' income from rent income to go towards energy improvement measures.*" Limited rent increases, small profit margins, and other maintenance obligations were also seen as significant barriers to undertaking retrofit work.
iv. Financial strain during void or in-tenancy periods: While landlords recognised that retrofitting is easier in unoccupied properties, the financial losses such as missed rental income, alongside

Table 1
Respondents' awareness and energy efficiency improvement applied.

Online questions (multiple choices & ordinal scale) /	Resonses (%)
i. Awareness of EPC Band C Target by 2028	
Fully aware	72%
Aware with minimum knowledge	22%
Not aware	6%
ii. Fabric improvements undertaken *(multiple answers)*	
Window improvement	61%
Loft insulation	61%
Draught-proofing	30%
Wall insulation of external walls	25%
No improvement	22%
Door insulation	17%
Ground floor insulation	8%
Intermediate floor insualtion	2%
Party wall insulation	0%
Rafter insulation	0%
iii. Heating improvements undertaken *(multiple answers)*	
Replace with efficient condensing boiler	50%
Programmer and room thermostat	47%
No improvement	34%
CPSU boiler	2%
Heat pump	0%
iv. Zero Carbon & Renewables applied *(multiple answers)*	
No improvement/ no installation	97%
Photovoltaic	3%
Solar thermal for hot water heating	0%
Domestic wind turbine	0%
Others	0%

Table 2
How landlords are affected by challenges related to high retrofit investment cost.

Online questions (ordinal scale) /	Resonses (%)
i. High retrofit cost for traditionally constructed building (hard to treat)	
Strongly affected	89%
Slightly affected	8%
Not affected	3%
ii. Long payback period for some improvement measures	
Strongly affected	83%
Slightly affected	14%
Not affected	3%
iii. Achieving higher energy efficiency rating means expensive and difficult	
Strongly affected	86%
Slightly affected	15%
Not affected	0%
iv. Limited benefit for landlords	
Strongly affected	67%
Slightly affected	26%
Not affected	7%
v. A lot measures required to achieve minimum standard of EPC C	
Strongly affected	69%
Slightly affected	21%
Not affected	10%

ongoing loan repayment and council tax liabilities posed challenges. Retrofitting during an active tenancy was also found to incure additional costs related to temporary rehousing as illustrated by this comment; "*Tenant had to be rehoused, flat cleaned and redecorated afterwards*," and, "*Finding replacement accommodation will be very difficult and costly*".

4.2.2. C2: flaws of energy performance assessment methodology (SAP and RdSAP)

Only open-ended questions were designed for this challenge and thematic analysis collected four main issues:

i. Inconsistent and insufficient details: Many landlords expressed their disappointment over SAP methodology, claiming that the system is inconsistent, outdated, and has insufficient details; "*The system is technically flawed and has no bearing on the actual energy use of various properties, where many lower band properties use less energy*". They also questioned the assumptions made during the property assessment: "*Audit process means that even if there is wall, floor or attic insulation, but this cannot be properly evidenced by photography or certificate, then the assessor must assume its absence, thus being forced to provide inaccurate EPCs.*"
ii. Not reflecting occupancy needs and practicality: The system was further criticised for inadequately reflecting real occupancy conditions and practical constraints of use; "*Tenants do not like storage heaters in our small studio/1-bed flats. They lose control and flat is heated even when they don't want/need it to be. They prefer thermostatically controlled, timer-programmed Smart electric heaters and have reported savings. EPC does not reflect this*". In addition, some measures that are recommended to be applied in traditional properties by Historic Environment Scotland, such as shutters and thermally lined curtains, are also not recognised in the SAP methodology, and this has discouraged landlords.
iii. Limited criteria for achieving higher scores: Landlords questioned the limited gains in EPC scores under SAP, even after implementing multiple interventions; "*It seems to vary and not clear how the calculation is made. I fully insulated with underfloor heating not recognised and still very low EPC*", "*Band C is simply unachievable for certain tenement flats.*"
iv. Limited awareness of SAP and EPC: Some landlords do not have information about EPC and how it works; "*Don't know enough about the SAP system to comment*", "*No idea!*", "*Sorry I don't know*", "*never heard of it*". Other landlords showed limited awareness of how the EPC certification process works, such as being unaware that EPC can be estimated before retrofit investment; "*We have no way of assessing what our proposed improvements will affect the score until an EPC is done AFTER the investment. It says insulate walls… but it doesn't say to what standard, thickness, area and so on. It is too vague, generic…*"

4.2.3. C3: challenges to mixed tenures and communal retrofit

Ordinal-scale responses indicate that landlords face notable difficulties when retrofitting in mixed-tenure or communal properties (Table 3). The majority reported challenges in securing permissions from other homeowners (80%*), and in managing the retrofit process (80%*). Cost concerns were also evident, particularly for shared wall insulation (81%*), while a huge proportion (76%*) felt uncertain about how to initiate retrofit works on shared building elements, (*combined agreement and likelihood).

Open-ended responses were analysed using thematic analysis, revealing four emerging issues related to this challenge:

i. Difficulty in securing joint agreements, financial and work distribution: Many landlords highlighted that securing unanimous agreement for communal retrofit works such as replacing common windows and doors, adding insulation, or repairing roofs, were often blocked by disinterested or uncontactable owners; "*Tenement – external cladding – needs cooperation of other landlords who are not interested… doesn't actually improve EPCs*," while another stated, "*Impossible in most cases to achieve unanimous 100% agreement. Easier to sell the property.*" Differing tenures, policies, and deadlines further complicated decision-making, with one respondent observing, "*Different tenures exist in flats… extremely difficult with no clear solution.*"

Cost sharing and work distribution posed further obstacles. "*What if some owners cannot afford their portion and list the flat for sale?!*" reflected one landlord's concern, while others recounted difficulties in reclaiming communal maintenance costs. Grants such as "missing shares" occasionally resolved disputes but were one-off and inconsistently accessible. Uncertainty over shared property law also deterred action, as highlighted in "*I need clarity on whether loft insulation can be treated as a joint improvement*," and "*Who benefits from PV panels if there's only one roof and multiple flats… how is the benefit split?*"
ii. Time-consuming: Landlords cited limited time frames, complex regulations, and delays in securing funding as a challenge; "*Concerns that there will be enough time to find funding before the deadline*", "*Improvements can take a while to undertake and can often leave a mess in the property*".
iii. Prioritisation of maintenance works: Many landlords stated they were already struggling with critical maintenance issues, making it difficult to justify further investment in energy efficiency upgrades. This led to a sense of hopelessness or futility regarding retrofit: "*Challenge enough carrying out critical maintenance tasks, never mind upgrades of this sort*", "*These buildings are in some cases not fit for use and difficult to maintain, never mind improve.*"
iv. Concern about building appearance: One landlord feared that retrofit might negatively alter the external aesthetic of the property, leading to conflict or deteriorating relationships among co-owners: "*Look of building will be negatively impacted, unlikely that everyone will agree and if they do, may be repercussions in relationships after the event.*"

Table 3
How landlords are affected by difficulties related to mixed-tenure and communal retrofits.

Online questions (ordinal scale) /	Resonses (%)
i. Difficulty in securing other homeowners' retrofit permissions	
Yes/ Most likely	64%
Yes/ Likely	16%
No/ Unlikely	6%
No/very unlikely	14
ii. Standard is high for old and traditionally constructed property	
Yes/ Most likely	61%
Yes/ Likely	19%
No/ Unlikely	9%
No/very unlikely	11%
iii. Adding insulation to a shared wall will be expensive	
Yes/ Most likely	93%
Yes/ Likely	7%
No/ Unlikely	0%
No/very unlikely	
iv. Do not know suitable retrofit to achieve EPC C	
Yes/ Most likely	61%
Yes/ Likely	20%
No/ Unlikely	6%
No/very unlikely	13%
v. Do not know how to start retrofit for the shared elements	
Yes/ Most likely	53%
Yes/ Likely	23%
No/ Unlikely	13%
No/very unlikely	11%

4.2.4. C4: challenges to retrofit traditional built properties

Only landlords owning a pre-1919 traditionally built flat were invited to respond to Section 3 of the survey. From the 64 landlords who completed Sections 1 and 2, 41 proceeded to complete Section 3. Ordinal-scale results show that most landlords felt strongly impacted by the need to improve the energy efficiency of their properties (98%) and agreed that standards are high for traditional properties (88%), with limited measures available (93%). Over half (61%) were uncertain about suitable solutions, and 68% worried about unintended consequences such as condensation, refer to Table 4.

Open-ended responses were analysed using thematic analysis, revealing four main emerging issues within this challenge:

i. Construction-related limitations: Landlords reported the impracticality of retrofitting traditional properties, particularly insulating solid masonry walls and suspended timber floors, reflected in comments such as; "*Cavity wall insulation not feasible. Under floor insulation is not feasible without wrecking the floor*", "*Not practical to insulate the inside of the external walls due to cost and loosing floor space*", "*Ground floor insulation sounds great but it's actually very difficult to retrofit*".
ii. Concerns about condensation: This was linked to poor ventilation behaviour and the effects of insulation upgrades from adjacent properties: "*Health issues, because of tenants not opening windows or vents, made worse by insulation*", "*We have experienced condensation issues in a property where adjacent buildings were retrofitted with external wall cladding*" and "*Have installed thicker loft insulation. Have come to the conclusion that any insulation (external or internal) will result in rising damp issues*". Besides sharing their experiences, there are also situations where landlords express their fear of undertaking retrofit, to avoid condensation risk; "*It is prone to condensation damp…I worry that external cladding will make the building sweat*", and "*potential problem it may cause.*"
iii. Disruption and loss of original features: The intervention risks losing traditional internal features like ceiling cornices, skirtings, and architraves. Landlords emphasised that these features add value and should be preserved. Moreover, there are repeated concerns about losing floor space or reducing room size if internal wall insulation is adopted as retrofit measure; "*Internal insulation means the flat would effectively be smaller. Corridors etc. would be too tight. Disruption to internal doors, decorations etc. too disruptive*"
iv. Perceptions of unachievable standards: Respondents commonly believed that achieving high-standard energy efficiency retrofits in traditional buildings is impossible, expressed through the use of phrases such as "*impossibility of effective improvement to older, traditional and non-standard*", "*external wall/cavity wall not possible in traditional tenements*", "*There are no obvious measures that can be taken so far*" and "*There will be properties for which no viable solution exists*".

Table 4
How landlords are affected by challenges in retrofitting traditionally built properties.

Online questions (ordinal scale) /	Resonses (%)
i. Significant investment is required to retrofit older property	
Strongly affected	98%
Slightly affected	2%
Not affected	0%
ii. Standard is high for old and traditionally constructed property	
Strongly affected	88%
Slightly affected	12%
Not affected	0%
iii. Limited measures to achieve EPC C standard	
Strongly affected	93%
Slightly affected	7%
Not affected	0%
iv. Do not know suitable retrofit to achieve EPC C	
Strongly affected	61%
Slightly affected	19.5%
Not affected	19.5%
v. Unintended consequences of retrofit, i.e condensation	
Strongly affected	68%
Slightly affected	27%
Not affected	5%

4.2.5. C5: limitations of financial support

Four key issues emerged from landlords' responses:

i. Lack of available financial support: A significant proportion of the landlords surveyed (74%) expressed frustration over the limited financial support, emphasising that grant funding is essential to carrying out energy efficiency improvements and warning of potential property sales in the absence of such aid; "*Unless heavily grant aided, complete agreement will never happen,*" and "*I can't see it being done unless it is grant funded*".
ii. Burdensome and unpredictable application processes: Landlords also criticised the complexity and administrative burden of accessing support, describing the process as "*laboursome,*" "*farcical,*", "*time consuming, unpredictable, outcome uncertain and unclear.*" These frustrations were often linked to delays, poor communication, and inconsistent procedures.
iii. Absence of tax incentives: Landlords reported that the absence of tax incentives discourages energy efficiency upgrades. Retrofitting projects in the UK are subject to a 20% Value Added Tax (VAT) which increases landlords' investment costs. One noted, "*No tax incentive for making improvement (i.e. all improvements paid for out of taxed income)*". Others urged "*a carrot as well as a stick – e.g. interest free loans, grants, complete lack of VAT*", adding that "*tax implications mean less yield so less funding for improvement*".
iv. Restrictive funding criteria: The eligibility restrictions of available funding, such as limiting support to landlords with fewer than four properties, or to specific measures, created additional barriers. Landlords noted that some schemes were short-lived or only applicable under certain conditions; "*The funding we have been aware of is far too transitory to base major financial decisions on.*" Together, these limitations illustrate a financial support system that is difficult to access, poorly aligned with landlord needs, and insufficiently motivating to drive widespread retrofit uptake in Scotland's PRS.

4.2.6. C6: difficulties in managing tenants for retrofit

Three key issues emerged from landlords' responses:

i. High-intervention measures disrupt tenants: Invasive interventions like internal wall or underfloor insulation caused disruption to tenants. Common approaches include rehoming tenants or completing works between tenancies, which cause potential losses to landlords; the relocation process requires extra cost, while a void period will prohibit landlords from getting funding assistance: "For invasive procedures, the tenant would need to be rehomed". Concerns were greater for vulnerable tenants, including families with young children, the elderly, or those with health issues.
ii. Tenant resistance to improvements: Some tenants resisted improvements, citing dissatisfaction with workmanship or unwillingness to accept changes. One landlord reported, "*The mess… was unacceptable for the tenant and we had to redo most,*" while another described "*tenants uncooperative or unwilling to have changes carried out.*"
iii. Tenant misuse or damage of upgrades: Landlords also reported retrofit measures being damaged or compromised by tenant behaviour, such as "*…tenants don't air building so damp builds up…*

new windows/doors… depreciate in value." A perceived lack of maintenance knowledge raised concerns over sustaining the performance of energy efficiency improvements.

4.2.7. C7: restrictions to listed buildings and buildings in conservation areas

Two key issues emerged from landlords' responses:

i. Limited applicable and practical measures: Landlords reported that retrofit options for listed and conservation-area properties are highly restricted, limiting energy efficiency improvements resulting and in lower EPC bands; "*We have already upgraded boilers and use LED lighting throughout, but the main heat loss is from single-glazed period sash windows. Although we have them fitted for draught brushes and have working shutters, we are not permitted to install double glazing, yet we have to meet a C rating!*
ii. Multiple owners - mixed tenure difficulties: Moreover, when properties in conservation areas have multiple owners or are part of mixed tenures, the retrofitting process becomes even more complicated. Coordinating with different owners to make improvements like insulation or energy-efficient heating is particularly challenging in these settings. As one landlord explained, "*Many rented properties are stone-built tenements where wall or loft insulation is difficult or impossible, particularly in conservation areas with multiple owners responsible.*"

4.2.8. C8: lack of competent builders for energy efficiency technologies

Two key issues emerged from landlords' responses:

i. Difficult to find qualified and reliable contractor: Many landlords have expressed frustration with the limited number of qualified contractors available for retrofit works; "*Timescale to get all the work done given the lack of local contractors to do what is necessary*". Several landlords highlighted concerns over reliability and expertise: "The amount of companies that say one thing only to find out it's lies," and "Having reliable and well-trained contractors to undertake the work required".
ii. Limited availability of tradesmen outside cities: Landlords outside of major cities face even greater challenges in finding competent contractors; "*Lack of suitable competent contractors outside Central Belt*" and "*Struggle to gain quote for insulation upgrades as very few/one in NE Scotland*".

4.2.9. C9: regulatory burdens and policy uncertainty

Two key issues emerged from landlords' responses:

i. Burden of regulations and limited incentives: landlords expressing frustration with what they perceived as excessive regulations and limited incentives, as seen in statements like, "*Becoming too challenging, time-consuming to continue being a landlord, too many regulations and not enough rewards now.*" These perceptions were further compounded by financial concerns, with one landlord noting that, "*Current hostility by gov towards landlords probably means there will be no funding/help.*"
ii. Unclear and changing standards: Landlords reported confusion and hesitation arising from evolving energy efficiency requirements and assessment methods. "*The EPC C thing is very much a moving goal post at the moment…by the time I need a new EPC C, the rules may have changed again,*" and "*It's hard to keep up to date and hard to know what exactly the current requirements because it's quite fluid, it keeps changing.*" These concerns were further intensified by forthcoming changes to the Standard Assessment Procedure (SAP), leaving landlords uncertain about how to plan for and achieve future regulatory compliance.

4.2.10. C10: impractical time scale

i. Unrealistic deadlines: Landlords, particularly those with multiple properties, questioned the feasibility of meeting EPC C by 2028, given the regulation's 2025 start and limited contractor availability; "*Doing all that work in three years, it's just not going to happen. There will not be contractors available even if we have the resources.*" A longer time frame, of up to 10 years, was suggested to allow adequate planning, funding, and training of skilled workers.

4.3. Assessment of private landlords' attitudes in retrofitting

Participating landlords were asked about planned energy efficiency measures, approaches to addressing high retrofitting costs, and their investment and funding preferences in Sections 1 and 2 of the survey. Landlords' responses reflect mixed and cautious attitudes towards retrofitting. While 32% reported having no plans and 28% were unsure, a smaller group intended to improve building fabric (22%) or heating systems (22%), and only 2% considered low-carbon technologies. Faced with high retrofit costs, over half (56%) were open to phasing improvements, although 42% indicated they would be unlikely to proceed. Encouragingly, 75% expressed a willingness to seek advice before deciding, suggesting some openness despite financial concerns (Table 5).

The assessment of private landlords' attitudes towards retrofitting indicates a clear preference for low-cost retrofit measures, with 88% indicating a budget limit of £5000 per upgrade. A majority (47%) expected a return on investment within five years, while 42% were willing to wait up to 10 years. The most preferred funding option was grants, with 86% of respondents opting for this form of financial support, compared to 16% seeking loans and 2% considering mortgages. Notably, 8% of landlords stated that return on investment was not a priority for them, as shown in Table 6.

Participating landlords were also presented with 10 scenario questions in Section 3 to assess their preferred energy efficiency measures based on cost, and the resulting impact on SAP point as key contributing factors. The most striking overall observation from these questions is that more than half of the respondents were not keen on any retrofit measures shown in the comparisons. Most respondents chose '*none of the above*', instead of any fabric, heating and zero carbon and renewable

Table 5
Landlords' planned retrofit measures and potential actions in response to high retrofit cost.

Online questions (multiple choices & ordinal scale) / Resonses (%)	
i. Improvement measures landlords plan to apply (multiple answers)	
None	32%
Not sure	28%
Fabric insulations	22%
Heating system improvements	22%
Zero Carbon & Renewables	2%
ii. Undertake energy efficiency improvements in several phases, if retrofit cost is high	
Yes/ Most likely	17%
Yes/ Likely	39%
No/ Unlikely	27%
No/very unlikely	17%
iii. Do not plan to carry out any energy efficiency improvement, if retrofit cost is high	
Yes/ Most likely	22%
Yes/ Likely	20%
No/ Unlikely	42%
No/very unlikely	16%
iv. Not sure at the moment and will look for advice, if retrofit cost is high	
Yes/ Most likely	47%
Yes/ Likely	28%
No/ Unlikely	6%
No/very unlikely	19%

Table 6
Landlords' preferred retrofit budgets, returns on investment and types of funding.

Online questions (multiple choices) /	Resonses (%)
i. What budget would be acceptable for retrofitting a rented property at a time?	
Maximum £5,000	88%
Maximum £10,000	9%
Maximum £15,000	1.50%
Maximum £20,000	1.50%
Maximum £25,000	0%
ii. What return of investment period is acceptable for energy efficiency improvements?	
Less than 5 years	47%
Less than 10 years	42%
Less than 15 years	3%
Less than 20 years	0%
Return of investment is not a priority	8%
iii. What type of funding are you looking at for the energy efficiency improvement to your rented property?	
Loan	16%
Mortgage	2%
Grant	86%
Financial support is not required	11%
Other	0%

measures (Fig. 2). This finding can be attributed to most landlords (75%) reporting uncertainty about the next steps when faced with high retrofit costs and actively seeking advice (Table 5-iv). This trend was consistent across the majority of scenarios, with the exception of Scenario 3, where a slightly higher proportion of landlords showed more interest in changing to an example of a less intrusive and cheaper measure with higher SAP improvement.

Internal wall insulation, which was reported as an intrusive measure, was consistently the least preferred measure across multiple scenarios - Scenario 1, 3 and 4. In Scenarios 1, landlords showed higher preference for window upgrades, despite these offering lower predicted SAP gains and at a higher cost, reinforcing their lower preference towards internal wall insulation.

Landlords showed mixed preferences when selecting heating systems as energy efficiency improvements. A cheaper heating improvement, combi-condensing boilers are the most preferred option in Scenarios 3 and 7, likely due to their relatively low cost, high SAP point increase, and minimal disruption to tenants and pre-1919 tenement buildings. In contrast, air-source heat pumps received very low interest, as shown in Scenario 2, despite offering higher SAP gains and an estimated cost that is about the same as internal wall insulation.

The results reveal a very low preference for zero carbon and renewable technologies in Scenarios 4, 5, and 6. Among the technologies, photovoltaics are the most favoured, though still less preferred than internal wall insulation, even with four times the SAP gain (24 vs 6 points). A similar trend is seen with solar thermal, which also offers higher EPC gains but receives little interest. Despite comparable or lower costs than solid wall insulation, these measures remain unpopular, suggesting landlords' choices are not primarily driven by SAP gains or investment costs.

The combination of fabric measures significantly increases the cost, and when compared to other options, landlords' preference for lower-cost measures becomes more evident, as reflected in Scenarios 7 to 9.

In the final scenario, 63% of landlords indicated they would be unable to meet the 2028 minimum energy efficiency standards, while 27% were unsure. This pertains to retrofitting pre-1919 flats, where the top and ground floors are more difficult and costly to retrofit, with costs potentially reaching up to £25,000 or more.

5. Challenges to retrofitting private rented properties

Ten retrofit challenges identified in this research are discussed and interpreted in relation to existing research and current developments in the private rented sector in Scotland and the UK, with five key findings discussed below.

5.1. *Lack of accessible detailed technical guidance for hard-to-treat retrofits*

Retrofitting traditional and older properties has emerged as a significant challenge in improving energy efficiency and meeting minimum standards, as highlighted by survey respondents. Landlords report substantial building construction difficulties associated with pre-1919 construction, including limitations with internal and external wall insulation, loss of internal space, and impacts on doors, corridors, and historic features. Concerns over condensation, damp, and related health issues, often linked to poor ventilation behaviour or insulation effects from adjacent properties, further discourage investment. These findings are consistent with previous research indicating that older dwellings present multiple retrofit challenges due to their construction, heritage constraints, and vulnerability to unintended consequences [43,44].

This research further reveals landlords' narratives from two key perspectives: those reflecting direct retrofit experience and those shaped by perceived technical construction difficulties and financial barriers. Expressions such as “impossibility of effective improvement” and “no viable solution exists” illustrate the prevailing belief that traditional dwellings cannot be upgraded without risking building fabric or indoor conditions. This study adds nuance by capturing these lived experiences, showing that perceived risks, such as rising damp or condensation, can sometimes outweigh actual technical limitations. The combination of technical and psychological barriers may not have been fully addressed in prior studies.

While these concerns are supported by evidence that retrofitting pre-1919 properties is technically complex, case studies such as Holyrood Park Lodge, which was upgraded from EPC F to C, illustrate that sympathetic interventions combined with detailed building surveys can enable successful retrofits [45]. The whole-building approach emphasised by Historic England advocates achieving energy savings while maintaining heritage value and indoor comfort, accounting for environmental, cultural, and socio-economic factors [46]. European studies also indicate that pre-1919 dwellings can achieve substantial energy efficiency improvements when retrofitted with appropriate measures and attention to building-specific characteristics [47].

This research suggests a potential gap in delivering or communicating technical knowledge to landlords, which may contribute to psychological barriers or perceived difficulties. In practice, knowledge transfer remains a critical barrier, with retrofit decision-making constrained by uncertainty, perceived costs, and a lack of tailored guidance [48]. Landlords suggested potential remedies, including lowered EPC targets for older properties or exemptions based on costs and location, reflecting ongoing debates in policy literature about balancing ambition with feasibility [49].

These findings indicate that while retrofit expertise exists, its accessibility and translation into actionable guidance for landlords are insufficient. Ensuring effective improvements in hard-to-treat properties requires targeted dissemination of technical guidance, practical case studies, and professional support to reduce perceived risks and encourage adoption.

5.2. *SAP flaws reported in assessment methodology and applications*

SAP, the UK government's main methodology for evaluating the energy performance of dwellings, has faced considerable critique for its shortcomings [50,51]. Focusing on Scotland's private rented sector, this study uncovers two key methodological deficiencies: 1) SAP's framework is simplistic and fails to account for varying occupancy patterns; and 2) assessor practices introduce further inaccuracies. Landlords frequently report that SAP disproportionately disadvantages older

	Fabric improvement			vs	Heating improvement			vs	Renewable energy technologies			vs	None (of the measures)
	Measure	EPC points	Cost		Measure	EPC points	Cost		Measure	EPC points	Cost		
Scenario 1	Internal wall insulation (IWI) **15%** vs Secondary glazing + shutters **34%**	6 EPC / 3 EPC	£7k - £8k / £9.5k									vs	None **51%**
Scenario 2	IWI **22%**	6 EPC	£7k - £8k	vs	Air-sourced heat pump (ASHP) (gas) **5%**	8 EPC	£6k - £8k					vs	None **73%**
Scenario 3	IWI **12%**	6 EPC	£7k - £8k	vs	Combi condensing boiler (CB) (gas) **46%**	18 EPC	£1.8k					vs	None **42%**
Scenario 4	IWI **17%**	6 EPC	£7k - £8k					vs	Photovoltaic (PV) **17%**	23 EPC	£7k - £8k	vs	None **66%**
Scenario 5	IWI **17%**	6 EPC	£7k - £8k					vs	Solar thermal for hot water **10%**	11 EPC	£4.5k	vs	None **73%**
Scenario 6	IWI **20%**	6 EPC	£7k - £8k					vs	Rooftop wind turbine **5%**	2 EPC	£11.03 k	vs	None **76%**
Scenario 7	All fabric insulations, windows, draughtpro of (ALL) **10%**	13-26 EPC	£21k	vs	Combi condensing boiler (CB) (gas) **42%**	18 EPC	£1.8k					vs	None **49%**
Scenario 8	ALL **7%**	13-26 EPC	£21k	vs	ASHP (gas) **10%**	8 EPC	£6k-£8k					vs	None **83%**
Scenario 9	ALL **5%**	13-26 EPC	£21k	vs				vs	PV **27%**	23 EPC	£7k - £8k	vs	None **68%**
Scenario 10	Opinions on achieving 2028 minimum standards given upgrade costs of up to £25,000 for EPC F and E tenement flats (top and ground floors): YES (can achieve) **7%** NO (cannot achieve) **63%** NOT SURE **30%**												

Fig. 2. Scenario-based questions and corresponding results (percentages) used in Section 3 of the survey to assess landlords' plans and preferences.

properties, as it recognises only a narrow range of retrofit measures that suit pre-1919 properties, making minimum standard compliance nearly unattainable.

Moreover, the survey reveals that many landlords either lack an understanding of how SAP operates or, despite familiarity, find it unclear regarding pre-retrofit measures. A recurring complaint is that the EPC rating remains unknown until after retrofit works are completed. While prior research highlights SAP's reliance on standardised inputs (as in RdSAP) and its tendency to conflate cost-effectiveness with true environmental performance [52], our findings are distinct in revealing informational and procedural barriers experienced by landlords in Scotland's private rented sector, providing further understanding to broader studies.

The UK government has updated SAP multiple times since SAP 2012, with SAP 10.2 enforced under revised Building Regulations as of June 2022 and in Scotland from February 2023, incorporating new fuel prices, CO_2 emissions factors, and primary energy data. A comprehensive reform, now referred to as the Home Energy Model (HEM), targeted for implementation in 2026 [53]. This new methodology is planned to specify new calculation methodologies, revise banding, and adopt a Heat Retention Rating for new HEM, and introduce a Heating System Rating within the new domestic EPC. These changes could enable more accurate assessment of fabric efficiency, heating system emissions and efficiency, and energy-cost evaluation.

However, these reforms may not adequately reflect the realities of retrofitting older, traditionally built properties. Landlords call for more adaptable and less intrusive measures, enhanced assessor capability, and, crucially, a clear support framework guiding retrofit planning from the onset. The results suggest that a comprehensive SAP framework that integrates the methodology, retrofit measures, assessor practices, and building conditions could help landlords overcome challenges and meet minimum standards.

5.3. Consent and legal constraints limit mixed-tenure retrofit progress

Retrofitting in the private rented sector is particularly complex in Scotland due to the dominance of flats (67%) [54], many of which are located in tenement buildings comprising mixed tenure and communal features such as stairwells, external walls, and roofs. This study identifies that retrofitting units in multi-storey and mixed-tenure blocks is complex due to several deterrents: 1) difficulty in reaching agreement and work distribution with other owners; 2) legislative constraints and limited understanding; and 3) difficulty securing financial shares between owners. These difficulties are heightened by tenure-specific retrofit deadlines. For many landlords, the existing legislation, Tenements (Scotland) Act 2004 was seen as insufficient and restrictive as unanimous consent from all flat owners is required for measures classified under the 'improvement' category. These findings are consistent with other research highlighting collective action challenges in multi-owner buildings [55,56], while also adding value by emphasising the Scottish-specific legal and tenure context.

Several landlords proposed enabling retrofit works through majority or qualified consent, or through formalised managing associations. This suggestion can be regulated under the Tenements (Scotland) Act 2004, specifically within Schedule 1: Tenement Management Scheme [57], which provides a framework for managing shared responsibilities and maintenance in tenement buildings. Additionally, making retrofit work a mutual responsibility among all owners, supported by grants, can be formalised within the Scheme to promote collective improvements and equitable financial contributions. The PAS 2035 framework, which mandates such coordinators in public schemes [58] also offers a possible model.

This research provides evidence for the need for a special retrofit framework for mixed tenure properties, including revisiting the limitations that exist in the current Tenement Acts (2004) and providing facilitation to assist landlords in coordinating retrofits.

5.4. High retrofit costs driven by perceived low benefits and limited financial support

Upgrading Scotland's private rented sector to meet proposed EPC band C standards will require significant investment, as over 60% of properties fall below this threshold. This research highlights a significant gap between required retrofit costs and landlords' stated spending limits for any single retrofit investment. While basic improvement costs for a flat can reach £44,000 [59], most surveyed landlords reported a maximum budget of £5000 per improvement, with some considering even this amount to be excessive. Reported reasons include low rental income due to limited rent increases, rising mortgage, maintenance and repair costs, a lack of and the effects of the energy crisis and inflation. These findings align with previous research [9,10] which highlights that high capital requirements and long investment payback periods continue to limit retrofit uptake in the private rented sector, while providing added clarity on how actual costs and associated issues contribute to private landlords perceiving these measures as 'high cost'.

Although the £5000 cap is self-declared and private renting remains a business-driven activity, it nevertheless provides meaningful insight into landlords' investment behaviour. The evidence suggests that many landlords are likely to prefer incremental or staged improvements rather than large one-off investments. This indicates that government incentives designed to support phased, long-term retrofit approaches may be more effective in engaging landlords who face similar financial constraints and risk perceptions.

Long investment payback periods, especially for zero-carbon and renewable technologies, further deter retrofitting. Even measures with shorter investment payback, such as internal wall insulation, are often dismissed due to perceived insignificant savings. Many landlords also felt that retrofit investments mainly benefit tenants through reduced energy bills, leaving them with minimal returns, long investment payback, and potential losses from void periods, tenant decanting, and unprofitable returns, leading nearly a third to consider selling their properties.

Access to financial assistance is limited, including the absence of tax incentives. Government schemes are often complex to apply for, narrowly targeted, and restricted in scope. Support is largely provided through loans rather than the grants landlords prefer. Only one scheme is available for private landlords at the moment; the PRS Loan, for which the available funding frequently falls short of actual costs. Moreover, many schemes prioritise rural or fuel-poor households, leaving many rental properties at a disadvantage.

Landlords suggested staged retrofits, expanded grant provision, tax relief for retrofit, and clearer policy timelines to encourage uptake. The UK Government's temporary zero and reduced rate VAT on selected energy-saving materials (2024–2027) may encourage landlords to uptake retrofit, but uncertainty over future regulations could delay decisions.

Ultimately, "high cost" for landlords encompasses not only large upfront expenditure but also perceived low returns, minimal savings, limited support, and the persistent landlord–tenant split incentive. Beyond the technical challenges that cause high retrofit costs, landlords' decisions may be shaped by economic rationality rather than regulatory compliance as also highlighted by UK research on landlord behaviour [60]. Overcoming this challenge will require a consistent strategy that encourages non-financial benefits such as highlighting improved comfort criteria, addresses the split incentive problem, and deliver accessible, equitable financial assistance.

5.5. Limited support for tenant management during retrofit

This study identifies the challenge of managing tenants during energy efficiency upgrades as a notable, yet underexplored challenge to retrofitting in the private rented sector. While previous work has acknowledged tenant disruption as a concern [9,10], this research provides detailed evidence of the situations landlords face. Survey responses revealed issues including: 1) tenant resistance to intrusive measures such as fabric interventions, 2) refusal of property access for planned works, and 3) conflicts arising from perceived or actual damage caused by tenants' living practices, such as inadequate ventilation leading to condensation and mould. Under both the earlier Draft PRS Energy Efficiency Regulations (2020) and the newly consulted Draft Regulations (2025), landlords may claim an exemption where they are unable to obtain a tenant's consent for improvement works, provided that they have made reasonable efforts to secure such consent. If this behavioural barrier remains unaddressed, a significant number of PRS dwellings could become exempt, undermining efforts to improve energy performance and jeopardising progress towards achieving net zero targets. Despite growing support for tenants in accessing quality, affordable homes [61], practical guidance for landlords on managing tenants during retrofits is lacking. There is very little support available for private landlords in managing tenant-related challenges during energy efficiency retrofits. No guidance exists on handling conflicts between tenants' preferences and recommended measures, leaving both parties without clear direction. Supporting landlords in this aspect is critical for successful retrofit implementation, yet limited research and practical resources currently discourage necessary improvements in the private rented sector.

6. Private landlords' attitudes to meeting minimum energy efficiency standards

Private landlords' attitudes towards retrofitting are assessed based on ten key retrofit challenges, the emerging issues identified, and their retrofit plans and preferences, which are reflected in two key attitudinal tendencies discussed below.

6.1. Hesitation and lack of confidence to achieve standards

This research observes that private landlords expressed reservations, hesitations, and a lack of confidence towards improving their rental properties to a minimum standard. These attitudes are attributed to many factors, as discovered through the online surveys. 60% of participating landlords hesitate to carry out any energy efficiency improvements to their rented properties and are indecisive about the potential measures to achieve the proposed standard. Further exploration through qualitative analysis reveals that their hesitations are contributed by the volatile policy scenarios, flaws in the assessment tool, and a lack of financial and informational supports.

i. Volatile policy scenarios and assessment tool flaws discourage retrofitting

The sector experienced changes in the proposed energy efficiency policy when the *Draft Energy Efficiency Regulations 2020* was withdrawn due to Covid-19, subsequently impacting the sector. An adjustment of minimum energy efficiency ratings between 2020 and 2021 replaced the staged target (EPC E to D) with specific deadlines with a single rating target of EPC C, accompanied by an extended duration. The changes have alarmed landlords about possible future changes and given rise to a perception that energy efficiency policy is unclear or regarded as 'a moving goalpost'. The regulatory landscape continued to change several times after the 2020 draft regulations stalled, reflecting the uncertainties highlighted by landlords. Their concerns about changing standards also arise from revisions to SAP, the impact of which on current EPC ratings remains unclear. Distress over the volatile policy scenario and flaws of the assessment tool have influenced their attitudes and decisions regarding the proposed policy. This is reflected in the finding that more than half (60%) of participating landlords had no plan for energy efficiency measures, while most (75%) were uncertain about future actions and sought advice.

ii. Limited financial and informational supports deter retrofitting

Private landlords' resistance and hesitation in achieving the proposed energy efficiency standards are notably shaped by their perceived lack of facilitation, support, and information, which cover various aspects of retrofitting. These include limitations of financial support, which are commented as limited, with laborious and time-consuming processes, the absence of tax incentives for retrofitting expenses, and being limited to specific qualifying criteria. These limitations were overwhelmingly mentioned through the survey, contributing to the perceived high cost of retrofitting. The lack of financial support received by landlords for energy efficiency improvements is evidenced by the Scottish government's response data; only 215 or 0.06% of the total 340,000 private rented dwellings had received funding for retrofitting measures from the Private Rented Sector Landlord Loan Scheme, established in 2020 [62]. The findings of this research suggest the reasons for the deficient uptake of the government's energy efficiency loan scheme; the majority of respondents (86%) indicated a preference for grants over loans. Landlord-tenant dilemma and small profit margin could explain their preferences for grants as funding support.

Private landlords' hesitation and lack of confidence in retrofitting are strongly influenced by insufficient information and guidance on regulations, technical retrofitting measures, and the energy efficiency assessment methodology. This research indicated that landlords' hesitation in retrofitting to prevent potential damages, particularly when insulating traditionally built properties, is caused by limited knowledge and guidance on appropriate methods. Many landlords cited risks such as harming internal details, reducing room space, and causing disruptions. Although sustainable approaches to upgrading traditional building fabric exist [46,63], these concerns persist, driven by gaps in information, guidance, and trust, as noted in recent studies [64]. Insufficient information and guidance are also reported for improving shared areas in tenement flats, which are seen as lacking practical regulations, enforcement, and coordination. Additionally, limited guidance on the SAP methodology affects landlords' attitudes towards meeting energy efficiency standards.

6.2. Low preference for significant energy efficiency and heating measures

Although there were changes and developments in the Scottish PRS building regulations, their core aim remains achieving zero-emission buildings by 2045, in line with the Climate Change Act (2019). HiBS (2021) introduced low and zero-emissions heating prioritising heat pumps and heat networks, while fabric improvements underpin the energy reduction strategy and encourage transition into renewable energy sources such as photovoltaics. Survey results provide insights into private landlords' preferences for energy efficiency measures and how these are shaped by the challenges they face, with generally low uptake of key retrofit measures needed to reduce heat demand and decarbonise heating.

i. Low preference for heat pumps and low, zero-carbon technologies

Findings suggested that improving the heating system by changing to heat pumps is less favoured for several reasons. The most pivotal reason observed was the compatibility of new technology with older properties as quoted by a landlord, "*Air source heat pumps don't work on older buildings, so we had to recently fit a replacement gas boiler*". Landlords questioned the recommendation to install a heat pump through the EPC certificate as the system requires external space, which is unavailable in tenement flats. Moreover, landlords doubted the practicality of heat pumps in colder areas in Scotland, as they may require more energy to maintain the system. These reasons explain the low preference for the uptake of heat pumps when retrofitting energy efficiency, identified in the survey scenario questions.

Although Scotland's climate and building stock are suitable for heat pumps, limited in situ performance data restrict understanding of potential improvements [65]. The Heat Pump Heroes project showcases homeowners' experiences but lacks examples in tenement flats, where installation is constrained by limited external space, multi-storey layouts, and building access. These practical challenges, compounded by high costs, limited guidance, and lack of information, reduce landlords' willingness to adopt heat pumps, potentially slowing progress towards the government's 2045 decarbonisation target.

Similarly, the survey noted a low interest among landlords towards zero carbon and renewable energy measures such as photovoltaics, solar thermal, and wind turbines. The technologies are undesirable even when they are compared with internal wall insulation, a measure that is also avoided by landlords. Among the reasons, the low interest of zero-carbon and renewable measures can be observed through their responses, such as "*Yes, solar on communal roof slopes. Who benefits, who pays, roof repairs, possible roof structure issues due to additional loads, water ingress, cracked tiles and slates etc.*". Landlords' responses suggest four main reasons for their lower preference for the technologies: 1) lack of information about the technologies, 2) high cost of the technologies and perceived less benefit, 3) the measures are impractical for old properties, listed properties, and conservation areas, and 4) fewer incentives offered for the technologies. Landlords' less interest, engagement, and application of low and zero-carbon technologies suggest that the government

transition to green energy sources will be at risk.

ii. Low preference for fabric-first retrofit approach in hard-to-treat properties

Although the government is taking a zero-emission first approach in HiBS (2021), the fabric-first approach continues to be emphasised as it underpins the successful roll-out of heating and low and zero-carbon technologies. Building fabric efficiency is the forefront of all government fuel poverty interventions. Fabric insulation alone, on roofs, floors, walls, and doors is often insufficient to raise the poorest performing private rented homes to the minimum EPC C standards. While insulation can improve thermal efficiency by up to 90%, achieving the target generally requires combining it with heating upgrades or renewable technologies [39]. On the other hand, relying on heating system improvement without improving insulation or draughtproofing can increase energy bills, strain the electricity grid, and require larger systems to maintain indoor comfort [66].

This research observes that the fabric approach is the least preferred measure. Landlords are observed to be apathetic towards adopting fabric insulations due to the challenges of retrofitting, such as the construction difficulties of internal wall insulation, loss of space, and the contribution to major disruption to tenants. Besides, the benefits of fabric insulation, which increase thermal comfort and reduce energy bills, are not perceived as significant by some landlords. Other limitations, such as the landlords-tenant dilemma and restrictions on rent increases, might influence landlords' perceptions and interest in fabric improvements for energy efficiency.

The private landlords' less inclination for uptaking fabric improvements can pose many implications. Achieving EPC C without fabric improvement is possible in some cases, but tenants may face or remain in fuel poverty due to high energy costs in inefficient buildings. Furthermore, a huge proportion of PRS dwellings may not meet the EPC C target due to the landlords' low preference to this significant measure.

7. Conclusion

Retrofitting Scotland's private rented sector presents a more complex challenge than policy narratives often acknowledge. This study demonstrates that the practical implementation of energy efficiency standards is shaped by a complex intertwined set of technical, regulatory, economic, and behavioural challenges, many of which remain insufficiently addressed in the current Scottish scenario. While policy frameworks have gradually evolved and remain under debate as of early 2026, while this research was last updated, the realities faced by private landlords continue to be overlooked.

A key contribution of this research lies in its integration of a policy review with first-hand perspectives from Scottish private landlords. It provides one of the most extensive examinations of retrofit challenges in this sector to date, and through its combination with technical and cost data within the same context. The research also demonstrates the methodological value of integrating quantitative and qualitative approaches within a single instrument, enabling both breadth and depth of insight. This approach allowed the study to identify and develop a deeper understanding of ten interlinked socio-technical challenges while providing insights into how the challenges and shifting regulatory landscape shape landlord behaviours to act on retrofitting.

The research also offers new evidence on the regulatory and building construction difficulties of retrofitting Scotland's pre-1919 tenement flats, an archetype that dominates the PRS and remains among the hardest to treat. The findings contribute directly to the refinement of energy efficiency governance by identifying the root causes of private landlords' challenges and also suggest guidance for future policy design, such as adapting the Tenement (Scotland) Act 2004, enhancing compliance tools such as RdSAP, SAP or the future HEM, and supporting retrofit strategies better suited to landlords and tenants, cost-sensitive hard-to-treat properties. Although based in Scotland, the insights are relevant to other UK and European contexts where older rental stock, shared ownership structures, and market-driven landlord behaviour similarly constrain retrofit uptake. Ultimately, this research provides a grounded evidence base to support a more just, inclusive, and feasible transition towards net-zero in Scotland's rental housing sector.

CRediT authorship contribution statement

Azlizawati Ibrahim: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Kate Carter:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Formal analysis, Conceptualization. **John Brennan:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Conceptualization. **Julio Bros-Williamson:** Writing – review & editing, Validation, Supervision, Resources, Project administration.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Azlizawati Ibrahim reports financial support was provided by Majlis Amanah Rakyat (MARA). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The data that has been used is confidential.

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