

Research Project Design – Research Proposal

RESEARCH PROJECT DESIGN (ACBA5024)
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Introduction

1.1 Background of the Study

The construction and built environment sector plays a significant role in global energy consumption and carbon emissions, making it a critical focus in efforts to address climate change and improve sustainability. In the United Kingdom, buildings account for a substantial proportion of total energy use, largely due to the high volume of ageing building stock that was constructed before the introduction of modern energy efficiency regulations. Many of these buildings perform poorly in terms of thermal efficiency, resulting in high operational energy demands, increased costs for occupants, and elevated carbon emissions. *(UK Energy Research Centre, 2025)*

As governments and industry bodies continue to introduce more ambitious environmental targets, including commitments to net-zero carbon, the need to improve the performance of existing buildings has become increasingly urgent. Two principal strategies are commonly adopted to address this challenge: retrofitting existing buildings to improve their energy performance, and demolishing older structures to replace them with new, energy-efficient buildings. Both approaches present potential advantages and limitations, and the decision between them has become a key consideration within the construction industry. *(UCL Bartlett Faculty of the Built Environment, 2024), (Department for Levelling Up, Housing and Communities, 2025)*

Retrofitting typically involves upgrading the fabric and services of an existing building, such as improving insulation, replacing glazing, or installing more efficient heating and ventilation systems. This approach is often promoted as a sustainable solution because it extends the life of existing structures, reduces demolition waste, and limits the embodied carbon associated with producing new construction materials. In contrast, new-build construction allows for energy efficiency to be embedded into the design from the outset, enabling buildings to meet high performance standards and regulatory requirements. However, new construction is often associated with high initial capital costs and significant environmental impacts during the construction phase. *(Historic England, 2024)*

1.2 Research Problem

Despite the growing emphasis on sustainability within the built environment, there remains considerable debate regarding whether retrofitting existing buildings can achieve comparable outcomes to new-build developments in terms of both energy efficiency and cost-effectiveness. While retrofit projects may offer environmental benefits by reducing waste and embodied carbon, their effectiveness can be constrained by the physical limitations of existing structures, outdated layouts, and variations in construction quality. Conversely, although new-build developments can deliver high levels of energy performance, they may not always represent the most economically or environmentally responsible option when lifecycle costs and impacts are considered. *(UK Energy Research Centre, 2025), (Robinson, 2020)*

The existing literature presents mixed findings, with some studies suggesting that retrofit solutions can deliver significant improvements in energy performance at a lower overall cost, while others argue that new builds offer superior long-term efficiency and value. These inconsistencies create uncertainty for construction professionals, policymakers, and building

owners who must make informed decisions regarding investment in the built environment. As a result, there is a clear need for comparative research that evaluates both approaches using consistent criteria, particularly within a UK context. (Papangelopoulou, Alexakis and Askounis, 2025) / (UCL Bartlett Faculty of the Built Environment, 2024)

1.3 Research Question

This research proposal seeks to address the identified gap by exploring the following primary research question:

Is retrofitting an existing building as energy-efficient and cost-effective as constructing a new build?

To support this investigation, the study will also consider the following sub-questions:

- How does the operational energy performance of retrofitted buildings compare to that of newly constructed buildings?
- How do initial construction costs and long-term lifecycle costs differ between retrofit and new-build projects?
- Under what circumstances may retrofitting existing buildings provide greater overall value than new-build construction?

1.4 Aim and Objectives of the Study

Aim:

The aim of this research is to compare the energy efficiency and cost-effectiveness of retrofitting existing buildings with constructing new-build developments.

Objectives:

To achieve this aim, the study will pursue the following objectives:

- To review existing academic and industry literature relating to energy performance in retrofit and new-build construction projects. (UK Energy Research Centre, 2025)
- To examine lifecycle costing approaches used to assess the economic performance of buildings. (RICS, 2025)
- To analyse secondary data from selected case studies to compare energy use and costs between refurbishments and new builds
- To identify key factors influencing whether retrofitting or new construction represents the more sustainable and cost-effective option

Literature Review

2.1 Introduction to the Literature Review

The purpose of this literature review is to critically examine existing research relating to the energy efficiency and cost-effectiveness of retrofitting existing buildings compared with constructing new-build developments. The review explores key themes within the current body of knowledge, including energy performance outcomes, lifecycle costing approaches, and broader sustainability considerations. By evaluating and synthesising findings from academic and industry sources, this section aims to identify inconsistencies and gaps in the literature that justify the need for further research on this topic.

2.2 Energy Performance of Retrofitted Buildings

A substantial body of research has explored the potential for retrofitting existing buildings to improve energy efficiency. Common retrofit measures include upgrades to insulation, replacement glazing, airtightness improvements, and installation of more efficient heating and ventilation systems. Many studies suggest that such interventions can lead to significant reductions in operational energy use, particularly in older buildings that were constructed prior to modern energy standards. (*UK Energy Research Centre, 2025*), (*Ardron and Allwood, 2025*)

However, the effectiveness of retrofit measures is often constrained by the physical characteristics of the existing building. Structural limitations, heritage considerations, and outdated layouts may restrict the extent to which energy performance can be optimised. Furthermore, several studies highlight the existence of a performance gap, where actual energy use following retrofit does not fully align with predicted outcomes. This discrepancy is frequently attributed to factors such as occupant behaviour, workmanship quality, and limitations in modelling assumptions. (*Robinson, 2020*)

While retrofitting has the potential to substantially improve energy efficiency, the literature indicates that results vary considerably depending on building type, retrofit depth, and implementation strategy. This variability presents challenges when attempting to generalise findings across the wider building stock, particularly when comparing retrofitted buildings with purpose-designed new builds.

2.3 Energy Efficiency in New-Build Construction

New-build construction is often regarded as the most effective means of achieving high levels of energy efficiency, as performance considerations can be integrated into the design from the outset. Modern building regulations, along with voluntary standards and certification schemes, encourage or require new developments to meet increasingly stringent energy performance criteria. As a result, new buildings typically benefit from optimised building fabric, efficient building services, and improved airtightness.

The literature consistently reports that new-build projects can achieve lower operational energy use than both unrefurbished and retrofitted buildings. However, some studies question whether these performance advantages always translate into long-term benefits. Similar to retrofit projects, new-build developments are also subject to performance gaps, where actual

energy consumption exceeds design expectations. This suggests that high theoretical efficiency does not always guarantee superior real-world outcomes.

In addition, the construction of new buildings is associated with significant embodied energy and carbon impacts arising from material production, transportation, and construction processes. Although new-build energy performance is generally strong, the literature highlights that operational efficiency alone may not provide a complete basis for evaluating overall sustainability. (*Department for Levelling Up, Housing and Communities, 2025*)

2.4 Cost-Effectiveness and Lifecycle Costing

Cost-effectiveness is a critical factor influencing decisions between retrofitting and new construction. Many studies adopt lifecycle costing approaches to evaluate building performance, recognising that initial capital expenditure represents only one component of total cost. Lifecycle costing typically considers construction costs, operational energy costs, maintenance, and, in some cases, end-of-life disposal. (*RICS, 2025*)

Retrofitting is often presented as a cost-effective alternative to new-build construction due to lower upfront costs and the avoidance of demolition expenses. However, deeper energy retrofits may require substantial investment, potentially reducing financial viability in certain scenarios. Conversely, while new-build developments incur higher initial costs, proponents argue that improved energy performance and reduced maintenance requirements can offset these costs over time.

The literature reveals significant variation in cost-effectiveness findings, largely driven by differences in methodological assumptions, time horizons, discount rates, and scope of analysis. These inconsistencies hinder direct comparison between studies and limit the ability of stakeholders to make fully informed decisions. As a result, there is growing recognition of the need for more consistent and transparent lifecycle cost assessments. (*Papangelopoulou, Alexakis and Askounis, 2025*)

2.5 Embodied Carbon and Sustainability Considerations

In recent years, consideration of embodied carbon has become increasingly prominent within construction research. Embodied carbon refers to the emissions associated with the extraction, manufacture, transportation, and installation of building materials. Studies suggest that demolition and new-build construction can generate substantial embodied emissions, particularly in the early stages of a building's lifecycle. (*London Assembly Planning and Regeneration Committee, 2024*)

Retrofitting existing buildings is often promoted as a more sustainable approach because it retains much of the original structure, thereby avoiding the carbon impacts associated with new material production. Several researchers argue that, when embodied carbon is considered alongside operational energy use, retrofitting can outperform new-build construction over the full lifecycle. (*Historic England, 2024*)

However, the literature also acknowledges that the sustainability benefits of retrofitting depend on the effectiveness and longevity of retrofit measures. Poorly designed or inadequately executed retrofits may fail to deliver meaningful reductions in energy use, undermining their

environmental advantages. This highlights the importance of evaluating retrofit quality and long-term performance alongside initial sustainability claims.

2.6 Identification of Research Gaps

Although existing literature provides valuable insights into the energy and cost performance of retrofit and new-build projects, several gaps remain. A significant proportion of studies focus exclusively on either energy efficiency or cost analysis, with relatively few adopting an integrated approach that evaluates both aspects simultaneously. Additionally, variations in assessment methods and performance metrics limit the comparability of findings across different studies. *(Papangelopoulou, Alexakis and Askounis, 2025)*

Furthermore, there is limited research directly comparing retrofitted and newly constructed buildings using consistent criteria within a UK context. This lack of cohesive comparative analysis creates uncertainty for construction professionals tasked with determining the most appropriate strategy for upgrading or replacing existing building stock.

2.7 Summary and Relevance to the Proposed Research

This literature review demonstrates that while both retrofitting and new-build construction can deliver improved energy performance, their relative cost-effectiveness and sustainability outcomes are highly context dependent. The identified gaps highlight the need for comparative research that evaluates energy efficiency and cost-effectiveness using consistent methodologies. The proposed study aims to address these gaps by systematically comparing retrofit and new-build case studies, thereby contributing to improved decision-making within the construction industry.

Research Design and Methodology

3.1 Research Design

The proposed research will adopt a comparative research design to examine whether retrofitting existing buildings can achieve levels of energy efficiency and cost-effectiveness comparable to those of new-build construction. A comparative approach is considered appropriate as the study aims to directly evaluate two alternative strategies commonly used to improve building performance within the construction industry.

The research will primarily employ a quantitative methodology, focusing on the analysis of measurable data such as energy consumption figures and cost information. Quantitative methods are well suited to this study as they allow objective comparison between retrofit and new-build projects using consistent performance indicators. However, the research may also incorporate limited qualitative insights drawn from existing case study commentary to provide additional context where appropriate, resulting in a predominantly quantitative but partially mixed-methods approach.

As this is a research proposal, the study is designed as a desk-based investigation using secondary data rather than primary data collection. This approach is considered feasible within

the scope and timeframe of the project and allows access to a broader range of established case studies and datasets than would otherwise be possible. (*Papangelopoulou, Alexakis and Askounis, 2025*)

3.2 Data Collection Methods

Data for the proposed study will be collected from secondary sources, including academic journal articles, industry reports, government publications, and published case studies relating to retrofit and new-build construction projects. These sources commonly provide information on building energy performance, capital costs, operational energy use, and lifecycle assessments. (*UK Energy Research Centre, 2025*)

Energy efficiency data may be obtained from sources such as Energy Performance Certificates (EPCs), monitored energy use records, or performance evaluations reported within published studies. Cost data is expected to include initial construction or retrofit costs, as well as operational and maintenance costs where available. Using secondary data enables the study to draw upon previously validated datasets, improving reliability while avoiding the time and resource constraints associated with original data collection.

To ensure relevance and comparability, particular emphasis will be placed on studies based within the UK or in regions with similar regulatory and climatic conditions. This will support the applicability of findings to contemporary construction practice in the UK context.

3.3 Sampling Strategy

The sample for this research will consist of a selected range of case studies representing both retrofitted buildings and new-build developments. A purposive sampling strategy will be adopted, whereby cases are chosen based on their relevance to the research question rather than random selection.

The study will aim to compare buildings of similar type and function, such as residential or commercial properties, in order to reduce variability and enhance comparability. Where possible, case studies will be selected to ensure similarities in size, usage, and occupancy patterns. This approach is intended to minimise external influences and allow a more meaningful comparison of energy and cost performance.

The sample size is expected to be limited but sufficient to identify patterns and trends within the data.

3.4 Data Analysis Plan

The collected data will be analysed using comparative analytical techniques. Energy performance will be assessed using indicators such as energy use intensity, typically expressed in kilowatt-hours per square metre per year (kWh/m²/year). This metric enables direct comparison between retrofitted and new-build buildings regardless of scale.

Cost-effectiveness will be evaluated through lifecycle cost analysis, incorporating initial capital costs, estimated operational energy costs, and maintenance expenses over a defined period.

By considering costs over the full building lifecycle, the analysis aims to provide a more comprehensive assessment than comparisons based solely on upfront expenditure.

Data will be organised into tables to facilitate comparison across case studies, and findings will be interpreted in relation to the research objectives. The analysis will focus on identifying conditions under which one approach may demonstrate advantages over the other, rather than seeking to produce definitive universal conclusions. (*RICS, 2025*)

3.5 Ethical Considerations

Although the proposed research does not involve human participants or primary data collection, ethical considerations remain relevant. All data used in the study will be sourced from publicly available and reputable publications, ensuring transparency and academic integrity.

Care will be taken to accurately represent findings from existing studies without selective reporting or misinterpretation. Any limitations or uncertainties within the data will be acknowledged in the analysis, and all sources will be appropriately referenced in accordance with academic conventions. By adhering to these principles, the research aims to maintain ethical responsibility and credibility throughout the study.

3.6 Limitations of the proposal Research

While the proposed research seeks to provide a structured comparison of retrofitting existing buildings and new-build construction in terms of energy efficiency and cost-effectiveness, several limitations must be acknowledged in order to contextualise the findings and maintain analytical transparency (Papangelopoulou, Alexakis and Askounis, 2025).

A primary limitation of the study is its reliance on secondary data sources. Although using academic literature, industry reports, and published case studies allows access to a wide range of established datasets, the researcher has limited control over the original data collection methods. Variations in data quality, modelling techniques, and reporting standards across different sources may affect the accuracy and comparability of results. For example, some studies report predicted energy performance derived from simulation models, while others present monitored energy consumption, which may lead to inconsistencies when drawing comparisons (Papangelopoulou, Alexakis and Askounis, 2025).

Another limitation arises from the inherent variability of buildings included in comparative studies. Buildings differ considerably in age, construction type, size, occupancy patterns, and geographic location, all of which influence both energy consumption and operational costs. Although purposive sampling will be used to select broadly comparable retrofit and new-build case studies, it may not be possible to isolate all external variables influencing performance. Previous UK-based research highlights that such variability can significantly affect retrofit outcomes, limiting the extent to which findings can be generalised across the wider building stock (Ardron and Allwood, 2025).

The application of lifecycle costing (LCC) also presents certain challenges. Lifecycle cost analysis depends on assumptions related to building lifespan, discount rates, maintenance regimes, and future energy prices. Professional guidance recognises that differences in these

assumptions can lead to variations in cost-effectiveness outcomes, particularly when comparing refurbishment and new-build options (Royal Institution of Chartered Surveyors, 2025). While this study will interpret cost data in line with established guidance, uncertainty associated with long-term forecasting cannot be entirely eliminated.

Time and scope constraints represent an additional limitation. The number of case studies included in the research will be restricted in order to ensure feasibility and depth of analysis. As a result, the study does not seek to produce statistically representative conclusions but instead aims to identify indicative trends and comparative insights relevant to decision-making.

Finally, the research is limited in its ability to capture social and behavioural factors, such as occupant behaviour and user interaction with building systems. These factors are widely recognised as contributing to the performance gap between predicted and actual energy use but are often insufficiently addressed within secondary datasets (Robinson, 2020). Consequently, the analysis will focus primarily on technical and financial performance while acknowledging behavioural influences as a contextual limitation.

By clearly identifying these limitations, the study adopts a cautious and balanced approach to interpretation, ensuring that conclusions drawn from the analysis remain proportionate to the scope and quality of the available data.

Timeline

The proposed research will be undertaken over a structured timeframe designed to ensure the systematic completion of all stages of the research process. Developing a clear timeline is considered essential for managing the scope of the study and demonstrating feasibility. The research will be organised into six key phases, progressing logically from literature review through to final analysis and report writing.

The initial phase will focus on refining the research question and conducting a comprehensive review of existing academic and industry literature relating to building retrofit, new-build energy efficiency, lifecycle costing, and embodied carbon. This stage is critical for establishing the theoretical and contextual foundation of the research and identifying appropriate case studies for analysis. (*Papangelopoulou, Alexakis and Askounis, 2025*)

Following the literature review, relevant retrofit and new-build case studies will be identified using purposive sampling. Selection will prioritise UK-based projects to ensure alignment with regulatory, climatic, and market conditions. Once selected, secondary data relating to energy performance and cost metrics will be extracted from published sources, including Energy Performance Certificates, government reports, and peer-reviewed case studies. (*UK Energy Research Centre, 2025*)

The data analysis phase will involve comparative assessment of energy use intensity and lifecycle costing. Lifecycle cost analysis will be applied following principles outlined in professional guidance, allowing both capital and operational costs to be considered over a defined building lifespan. The findings will then be interpreted in relation to the research objectives, identifying trends and contextual factors influencing retrofit and new-build performance. (*RICS, 2025*)

The final stages will involve drafting, reviewing, and refining the research report. This will include assessing the limitations of the study and ensuring clarity, coherence, and consistency throughout.

Indicative timeline structure:

- Weeks 1–3: Literature review and theoretical framework development
- Weeks 4–5: Case study selection and data sourcing
- Weeks 6–7: Data analysis and comparison
- Weeks 8–9: Drafting findings and discussion
- Weeks 10–11: Review, refinement, and final submission

Expected Outcomes

The proposed research is expected to provide comparative insight into the relative energy efficiency and cost-effectiveness of retrofitting existing buildings versus constructing new-build developments. While the study does not seek to produce definitive or universally applicable conclusions, it aims to identify patterns and conditions under which each approach may offer advantages.

One anticipated outcome is the identification of scenarios in which retrofit solutions deliver substantial improvements in energy performance, particularly when applied to older buildings with low baseline efficiency. Existing research suggests that targeted upgrades can significantly reduce operational energy demand, although outcomes vary depending on building type, retrofit depth, and quality of implementation. The study is expected to highlight these contextual influences and demonstrate why retrofit performance cannot be assessed using a one-size-fits-all approach. (*Ardron and Allwood, 2025*)

In terms of cost-effectiveness, the research is likely to show that retrofitting often involves lower initial capital expenditure compared with new-build construction, particularly when demolition and redevelopment costs are avoided. However, lifecycle analysis may reveal circumstances where higher upfront investment in new-build projects results in lower long-term operational costs. Applying lifecycle costing principles is therefore expected to provide a more balanced evaluation of financial performance than initial cost comparisons alone. (*RICS, 2025*)

The research is also expected to confirm the importance of embodied carbon considerations in decisions between retrofit and new construction. Several studies indicate that new-build developments generate significantly higher embodied carbon emissions than retrofit alternatives, potentially undermining their sustainability benefits despite lower operational energy use. The study is therefore expected to reinforce the growing argument for prioritising retrofit where feasible within broader sustainability strategies. (*Historic England, 2024*), (*London Assembly Planning and Regeneration Committee, 2024*)

Overall, the findings of this research are expected to contribute to improved decision-making within the construction industry by providing evidence-based insight into the energy, cost, and sustainability implications of retrofit and new-build options. This contribution aligns with

current industry and policy priorities aimed at reducing the environmental impact of the built environment while delivering long-term value.

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