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# Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy: Final Report

Authors: Liam Heaphy, Philip Crowe, Ciara Reddy, Rola Abu Hilal, Lysander Reid-Powell, Gloriana Vargas Castro and Herin Vora

Lead organisations: Irish Centre for High-End Computing at the University of Galway and University College Dublin

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Rialtas na hÉireann
Government of Ireland

# Environmental Protection Agency

The EPA is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

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- Oversee the implementation of the Environmental Noise Directive;
- Assess the impact of proposed plans and programmes on the Irish environment.

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- Monitor developments abroad relating to nuclear installations and radiological safety;
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The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

1. Office of Environmental Sustainability
2. Office of Environmental Enforcement
3. Office of Evidence and Assessment
4. Office of Radiation Protection and Environmental Monitoring
5. Office of Communications and Corporate Services

The EPA is assisted by advisory committees who meet regularly to discuss issues of concern and provide advice to the Board.

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## What did the research aim to address?

This collaborative research project between the Irish Centre for High-End Computing at the University of Galway and University College Dublin addresses a key research gap in Ireland in relation to the carbon costs of allowing viable town buildings to remain unutilised and fall into disrepair.

This research is relevant to the construction sector, in terms of low-carbon retrofitting, and to national and local policymaking, for helping overcome the barriers to adaptive reuse of vacant and derelict building stock faced by property owners and planning authorities.

The Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy (TREBUChEt) project has three components:

1. a spatial analysis and morphology classification of vacant and derelict buildings in Irish towns to validate the choice of case study buildings and locations;
2. life cycle assessment case studies for six recently retrofitted buildings and two neighbourhood blocks.
3. a policy review and interview-based study on the existing schemes and incentives for the adaptive reuse of buildings in the three case study towns of Ballina (County Mayo), Tipperary Town and Monaghan Town.

## What did the research find?

The spatial analysis component finds that vacant buildings are disproportionately likely to be terraced town buildings that form part of vacant and/or derelict clusters in town centres. These patterns of vacancy and dereliction have important implications for policy transfer and for common template solutions according to use case, morphology, age, methods of construction and renovation history.

The life cycle assessment studies in this project show that the carbon costs of retrofitting town buildings versus constructing new builds are significantly lower and can be reduced further through greater retention of existing elements and low-carbon design choices. Additional carbon savings can be made by scaling to urban blocks, thereby tackling the pattern of systematic vacancy in Irish town centres with greater urgency.

Further consideration can be given to promoting the liveability and attractiveness of towns and to community planning. Awareness of existing grants was high, and the barriers to adaptive reuse highlighted included physical accessibility, ad hoc modifications, the legacy of outmigration from town centres, legal issues, a lack of data and the need for further resources to help and guide owners.

## How can the research findings be used?

The methods developed as part of TREBUChEt and adjacent projects are being integrated into training programmes for future urbanists and building engineers.

The life cycle assessment results and methodology in this project can be further developed to support national policies on retrofitting, taking account of the carbon savings possible in the broader context of Ireland's sectoral emissions targets for the built environment.

By further developing life cycle assessment for retrofitting, it may be possible to link restoration grants to low-carbon choices of materials and renovation pathways for town buildings. Furthermore, the results from this project support those working towards low-carbon adaptive reuse of heritage buildings in town centres and those more broadly involved in Town Centre First planning.

Project code: 2022-GCE-1156

EPA RESEARCH PROGRAMME 2021–2030

# Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy: Final Report

# (2022-GCE-1156)

## EPA Research Report

Independent scientific research funded

by the Environmental Protection Agency

Prepared by

Irish Centre for High-End Computing at the University of Galway and University College Dublin

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This report is based on research carried out/data from March 2023 to May 2025. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.


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# Executive Summary

The Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy (TREBUChEt) project advances the analysis of the costs of, and barriers to, the adaptive reuse of buildings by including embodied emissions and life cycle assessment (LCA) in decision-making. The project has three components:

1. a spatial analysis and morphology classification of vacant and derelict buildings in Irish towns;
2. six LCA case studies of buildings and two neighbourhood-scale LCA case studies;
3. a policy review and interview-based study on the existing schemes and incentives for the adaptive reuse of buildings.

Our spatial analysis finds that building vacancy is more pronounced in western and border counties away from larger cities. Vacant buildings are disproportionately, relative to the overall stock of town buildings, likely to be terraced town centre buildings.[1] These terraced buildings are far more likely to be part of vacant and/or derelict clusters on town centre streets or blocks with similarly high levels of vacancy and dereliction. The authors found that, while the overall vacancy rate may appear unremarkable, a picture emerges of systematic vacancy and dereliction in town centres. These patterns of vacancy and dereliction have implications for policy transfer and for common template solutions for building types according to morphology, age, methods of construction and renovation history.

The TREBUChEt LCA catalogue comprised six residential retrofits located in different regions throughout Ireland. This catalogue of projects includes a variety of building typologies, including terraced houses, duplexes and apartments. It was found that reusing and retrofitting existing buildings is a better option than constructing new buildings in terms of carbon management. Retrofitting is associated with lower upfront carbon levels than new construction and offers faster payback through reduced greenhouse gas emissions.

While average embodied carbon emissions per $m^2$ are lower for retrofit projects than for greenfield construction, the carbon footprint of retrofit projects can be reduced even further through the greater retention of existing elements and through design choices that reduce material intensity and incorporate low-carbon materials.[2] Design choices such as wide ceiling spans, open floor plans, cantilevers and large windows increase embodied carbon emissions per $m^2$ due to the intensity of the materials and/or engineering requirements necessary to accommodate them. The inefficient or redundant use of structural elements also increases embodied carbon emissions significantly. Concrete, steel and insulation materials were generally found to contribute the most to a building's embodied carbon emissions.

Neighbourhood-scale LCA case studies for specific urban blocks in Ballina (County Mayo) and Monaghan Town show that reusing existing buildings and infrastructure (brownfield retrofits) dramatically lowers embodied carbon emissions compared with construction on greenfield sites. In Ballina, the brownfield retrofit scenario for an urban block produced estimated emissions of 436 tonnes of carbon dioxide equivalent ($CO_2e$) per block, compared with 1318 tonnes of $CO_2e$ for an equivalent block-scale greenfield development. In Monaghan, where the brownfield scenario combined retrofitting with new infill, total embodied carbon emissions amounted to 1651 tonnes of $CO_2e$ for the overall development, compared with 2871 tonnes of $CO_2e$ for an equivalent new build on a greenfield site. In both contexts, the absence of pre-existing infrastructure at the greenfield

1 Vacancy, following the GeoDirectory service from An Post, is defined here as a building (or unit) that upon inspection and enquiry by An Post staff is found not to be inhabited, is not a holiday home and is in habitable condition or requires only cosmetic or minor repairs to become habitable.

2 Embodied carbon emissions per $m^2$ refers to the amount of greenhouse gas emissions (usually expressed in kilograms or tonnes of carbon dioxide equivalents) associated with the materials, manufacturing, transport, installation, maintenance, end-of-life and other construction processes for a building, divided by the building's floor area ($m^2$) (Cabeza *et al.*, 2013).

locations was a key factor, as carbon-intensive siteworks (infrastructure and landscaping) and new construction materials substantially increased the carbon footprints.

From the interviews with policymakers and property clinics for property owners conducted as part of this project, it was evident that the levels of awareness of existing grants and their application criteria among property owners are relatively high and that people are willing to do their part for climate mitigation. There was however limited understanding among property owners of embodied carbon emissions as compared with, for example, renewable energy and recycling. Barriers identified to the market viability of main street adaptive reuse were legacy urban planning issues (out-of-town retail, suburban sprawl, social deprivation, environmental quality) and, among landlords, negative experiences with problematic tenants and antisocial behaviour.

Accessibility challenges in relation to adaptive reuse were found to be commonplace. These challenges include buildings with vacant upper floor units no longer having independent front doors, security concerns in relation to tenants living over shops and lack of rear access and gardens.

Nevertheless, town centres have the potential to become vibrant places to live and work due to the proximity of amenities, the opportunities they could provide to people who want to downsize and/or return to town centre homes, benefits in relation to remote-working trends and hubs, and the opportunities they offer for converting commercial buildings to housing. The findings from the end-of-project policy workshops – including findings related to town-planning practices, promoting the liveability and attractiveness of towns, and broader accessibility issues – support and expand on the project findings in relation to LCA and barriers to adaptive reuse.

# 1 Introduction

Vacancy and dereliction rates are currently the subject of intense debate and research in Ireland due to a deficit in the supply of private and public housing (DRCD, 2020; Bowers, 2023; O'Callaghan *et al.*, 2023). This is predominantly felt in the catchments of major urban areas but affects supply in all regions, particularly in the rental sector. Vacant and derelict buildings are under-utilised assets and have a role to play in reducing national carbon emissions from the built environment sector.

The built environment is responsible for nearly 40% of global carbon emissions, with the construction sector driving substantial resource depletion, waste generation and environmental degradation (Eberhardt *et al.*, 2019). Buildings consume large quantities of raw materials and energy over their life cycles, particularly during the construction, renovation and demolition stages. When buildings are upgraded or replaced, waste materials are often downcycled into lower-value products or discarded, further amplifying the environmental impacts of these activities.

While renovation extends the useful life of buildings and reduces the need for new construction, it also contributes significantly to embodied carbon emissions. It is estimated that renovation accounts for 4–16% of the total carbon footprint of urban buildings (Mastrucci *et al.*, 2020). However, scaling up renovation activity and incorporating low-carbon materials and techniques could result in a 28% reduction in overall emissions by 2030, despite emissions being produced during renovation itself (Mastrucci *et al.*, 2020). This highlights the need for robust methodologies to assess and manage the environmental impact of renovation.

## 1.1 European and National Policies for a Low-carbon Built Environment

The revised European Performance of Buildings Directive (EPBD) (Directive (EU) 2024/1275) promotes the improvement of the energy performance of buildings and the reduction of greenhouse gas emissions from buildings within the EU, with a view to achieving a zero-emission building stock by 2050, taking into account outdoor climatic conditions, local conditions, requirements for indoor environmental quality and cost-effectiveness (European Union, 2024). Therein, Article 12 requires that Member States "introduce a scheme for renovation passports" by 29 May 2026, which can be made voluntary or mandatory according to the will of each EU Member State.

The EPBD also lays down requirements for the calculation and disclosure of the life cycle global warming potential (GWP) of buildings. This has implications for Member States that have not yet incorporated GWP considerations into new-building environmental assessments. Furthermore, it sets out a framework into which national building renovation passports (BRPs) can be integrated. Importantly, for building renovations, the EPBD goes beyond the metrics of energy efficiency and recommends the integration of a retrofitting roadmap for each building (Annex VIII). The passport is intended to outline the optimal sequencing of steps and provide details of these steps, including in relation to savings and reductions (in kWh and euros), and to provide information on the funding available to help ensure that these steps can be taken towards meeting energy targets. Ireland has until 29 May 2026 to transpose the provisions of the EPBD into national law.

In Ireland, there has been a series of funding options for supporting the reuse of rural and urban buildings, with the Croí Cónaithe Vacant Property Refurbishment Grant being a prominent example. The grant was announced in 2022, and, by the end of March 2025, 2096 applicants had received funding after completion of works (DHLGH, 2025). Other schemes, such as Repair and Leasing, and tax incentives are available to landlords seeking to improve their properties.[3]

3 A complete overview of European and national incentives and policies is provided in the report for Deliverable 4.1 on the project website (https://www.ichec.ie/academic/research/trebuchet).

Local authorities such as Monaghan County Council have formed town regeneration teams for coordinating and leading programmes of urban renewal (see section 2.3). Ballina (County Mayo) and Monaghan (County Monaghan) have also availed of Historic Towns Initiative funding from the Heritage Council for actions that include public realm improvement and façade repairs and restoration (Heritage Council, 2025). Regeneration efforts have also been assisted by the creation of new posts in local authorities for officers dedicated to working on matters such as vacant homes, climate, conservation and town regeneration.

## 1.2 The Role of Life Cycle Assessment

A key challenge in mainstreaming low-carbon retrofitting, particularly in Ireland, is the lack of consideration given to incorporating embodied carbon emission measurements into existing grant schemes and policy incentives, which currently focus primarily on operational energy efficiency. Consequently, sustainable alternative building materials, such as bio-based materials, remain economically less accessible, reinforcing market reliance on high-carbon materials like polyisocyanurate (PIR) insulation, concrete and steel. Moreover, the construction industry still operates under a largely linear model, where materials are extracted, used and disposed of, rather than being reintegrated into a circular economy. In this context, life cycle assessment (LCA) serves as a valuable tool for quantifying environmental impacts across the building life cycle, enabling data-driven comparisons between renovation and new construction, and informing low-carbon design decisions (Konstantinou *et al.*, 2023).

## 1.3 Aims and Objectives

The Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy (TREBUChEt) project was a 2-year project (April 2023 to May 2025) led by the Irish Centre for High-End Computing at the University of Galway and University College Dublin (UCD). It sought to address the twin challenges of persistent housing vacancy in Irish towns and the need to lower greenhouse gas emissions from the built environment sector. The project was carried out in collaboration with key stakeholders through three town case studies: Ballina (County Mayo), Tipperary Town and Monaghan Town. The project was shaped by the corresponding local authorities, who helped guide the study and set up property clinics, as well as by their national counterparts in the Department of Housing, Local Government and Heritage (DHLGH) and the Heritage Council.

TREBUChEt advanced the analysis of the costs of and barriers to the adaptive reuse of buildings by integrating embodied emissions and LCA into decision-making on adaptive reuse, while also exploring strategic initiatives for reinvigorating rural villages and towns.[4]

The project had the following objectives:

- to provide a methodology for evaluating the carbon savings associated with reusing buildings in town centres;
- to evaluate how these carbon savings could be factored into cost–benefit analyses of adaptive reuse versus new building across a range of scenarios for the project's case study buildings and locations;
- to survey existing policy frameworks and incentives for reusing buildings and for incorporating embodied emissions and associated costs into planning and construction certifications;
- to provide a roadmap and toolkit for integrating heritage and town buildings into the circular economy, evaluating the relative contribution of restoring vacant buildings versus implementing other circular economy measures;
- to provide guidance, services and training in collaboration with bodies responsible for town centre renewal, including national government and local authorities.

4 The term "adaptive reuse" indicates a change of function, where a previous use case is now obsolete and the building is adapted to accommodate a new function and the needs of new users (Stone, 2020, p. 4). Among the six LCA case studies covered in this report, four are adaptive reuse cases of buildings converted to residential use, and two are residential retrofits with extensions and changes to interior layout.

The project had three components:

1. a spatial analysis and morphology classification of vacant and derelict buildings in Irish towns, which was used to validate the choice of case study buildings and locations;
2. six LCA case studies of buildings and two neighbourhood-scale LCA case studies;
3. a policy review and interview-based study on the existing schemes and incentives for the adaptive reuse of buildings in the three case study towns.

The layout of the report follows the logical development of the project, beginning with Chapter 2 on the spatial analysis and profiling of vacancy and dereliction, followed by Chapter 3 on the LCA case studies and Chapter 4 on policy. Chapters 5 and 6 then close by summarising key recommendations and directions for future policy and research.

# 2 Spatial Patterns of Vacancy in Irish Towns

This chapter sets out the scope of the case study selection in relation to national and regional data on building vacancy. Case study selection was carried out by first generating a sample of buildings in Irish towns recorded in GeoDirectory as vacant or derelict, in order to provide a typology profile, and then analysing national datasets on vacancy to help inform the choice of case study locations.

## 2.1 Methodology

The principal sources of data on vacancy/dereliction are listed in Table 2.1. Among these, only GeoDirectory provides building-scale data, whereas the other sources provide anonymised aggregated data for different spatial units.

The national and regional pictures drawing on results prepared by the Central Statistics Office (CSO) and available at data.gov.ie are covered below. These data are readily available and are frequently drawn upon in policy debate. GeoDirectory, in contrast, is a commercial service, and a GeoDirectory dataset for March 2023 was acquired in Q4 2023 for the TREBUChEt project by the UCD research team (based on a UCD research licensing agreement). Prior to this, a legacy dataset from February 2020, previously obtained by UCD, was used to generate a random sample of buildings; later, it was compared with the March 2023 dataset.

The 2023 and 2020 datasets were imported into open-source Quantum Geographic Information System (QGIS) software (v3.36.1) for the bespoke analysis of vacancy clusters. Buffers of 20 m were added to point-based data to create a new polygon layer of circles. Clusters were identified where these 20 m-radius circles overlapped and could be combined into unified polygons, which were then filtered for those with more than 10 vacant or derelict buildings. As this process also captured many housing estates nearing completion, only buildings registered on GeoDirectory prior to 2019 were included. Furthermore, towns with a population in excess of 50,000 were not included in order to maintain the focus on small to medium-sized towns.

For the building typology random sample, visual imagery of buildings was attained primarily from Google Earth and collected and tagged using Tropy visual referencing software. Occasionally, multiple images were available on Google Earth Street View, allowing researchers to track any changes that occurred to the buildings chosen over time. In other instances, the imagery was out of date with respect to the building status. However, as this component of the project commenced with the older data, from 2020, there was greater scope to capture each building and the change in status over time.

## 2.2 Defining and Contextualising Ireland's Vacancy Rate

Data on vacancy and dereliction are collected differently across European jurisdictions, so, although comparative figures can be sought (see Figure 2.1), caution is required before drawing conclusions. As seen in Table 2.1, rates of residential vacancy in Ireland range from 3.9% (GeoDirectory, 2024) and 4.3% (CSO, 2023) (i.e. close to zero electricity consumption in 2021) to as high as 7.8%, as recorded

**Table 2.1. Data sources on residential vacancy for Ireland (as at March 2024)**

| Data source | Entity responsible for collection | National vacancy rate and date | Frequency of publication |
|---|---|---|---|
| Census | Self-reported and census enumerators | 7.8% of housing stock (2022) | Every 5 years (formerly every 10 years) |
| GeoDirectory | An Post and OSI | 3.9% residential (Q4 2023) | Quarterly |
| Local property tax | Revenue commissioners | 3.2% (1 November 2022) | Infrequently |
| Electricity consumption | Central Statistics Office | 4.3% (end of 2021) | Infrequently or one-off |

**OSI, Ordnance Survey Ireland.**


**Figure 2.1. National residential vacancy rates across Europe as collected by the Housing Europe Observatory from various national agencies. Please note that there are differences in the methodologies used across countries: Denmark, Ireland, Netherlands and England (UK) data are from 2022, whereas data for France and Scotland (UK) are from 2020, data for Germany are from 2018 and data for all other countries are from 2021. Reproduced from Turnbull (2023) with permission from the Housing Europe Observatory.**

in the census of 2022. The fact that the figure from the 2022 census is higher than the other rates can be attributed to methodological differences in how data are collected, where in the 2022 census a building was classed as vacant based on the following: "if it is unoccupied on Census Night [4 April 2022], is not used as a holiday home and is not usually inhabited by occupants who are temporarily absent at the time of census" (CSO, 2022). Enumerators were asked (and incentivised financially) to pursue local residents for information about properties for which no census form was returned before classifying them as vacant. The CSO noted "that many of the dwellings recorded as vacant were for sale, were rental properties, had a deceased owner, or were being renovated" (CSO, 2022).

Notwithstanding these varied means of data collection and differences in methodology, vacancy rates are broadly similar across north-western Europe. However, this does not provide a picture of where vacancy and dereliction are prominent and how they are experienced. CSO data provide a spatial overview of the vacancy rate in Ireland by electoral district, showing how vacancy is concentrated in western and border counties away from the commuter belts of metropolitan areas (Figure 2.2). While frequently presented as an urban issue, since the contrast between demand and wasted resources is most apparent in urban areas, the impacts of vacancy as a visual and experienced condition are greater in smaller towns and villages and the surrounding open countryside.

The census-derived picture of vacancy is corroborated by periodic GeoView reports (GeoDirectory, 2024), which show that the vacancy rates (excluding holiday homes, buildings under construction and derelict buildings) of Counties Dublin (1.2%) and Kildare (1.3%) are an order of magnitude below those of their more rural counterparts of Counties Mayo (11.2%) and Leitrim (12.2%). GeoDirectory uses the same definition of vacancy as the CSO, where a building (or a unit within a building) is classified as vacant following repeated inspection and enquiry by An Post workers to confirm lack of occupancy. In relation to the integrity of the building, it is deemed to be vacant if in habitable condition or if requiring only cosmetic renovation to restore it to use. If the building requires structural repairs or reconstruction before it can be restored

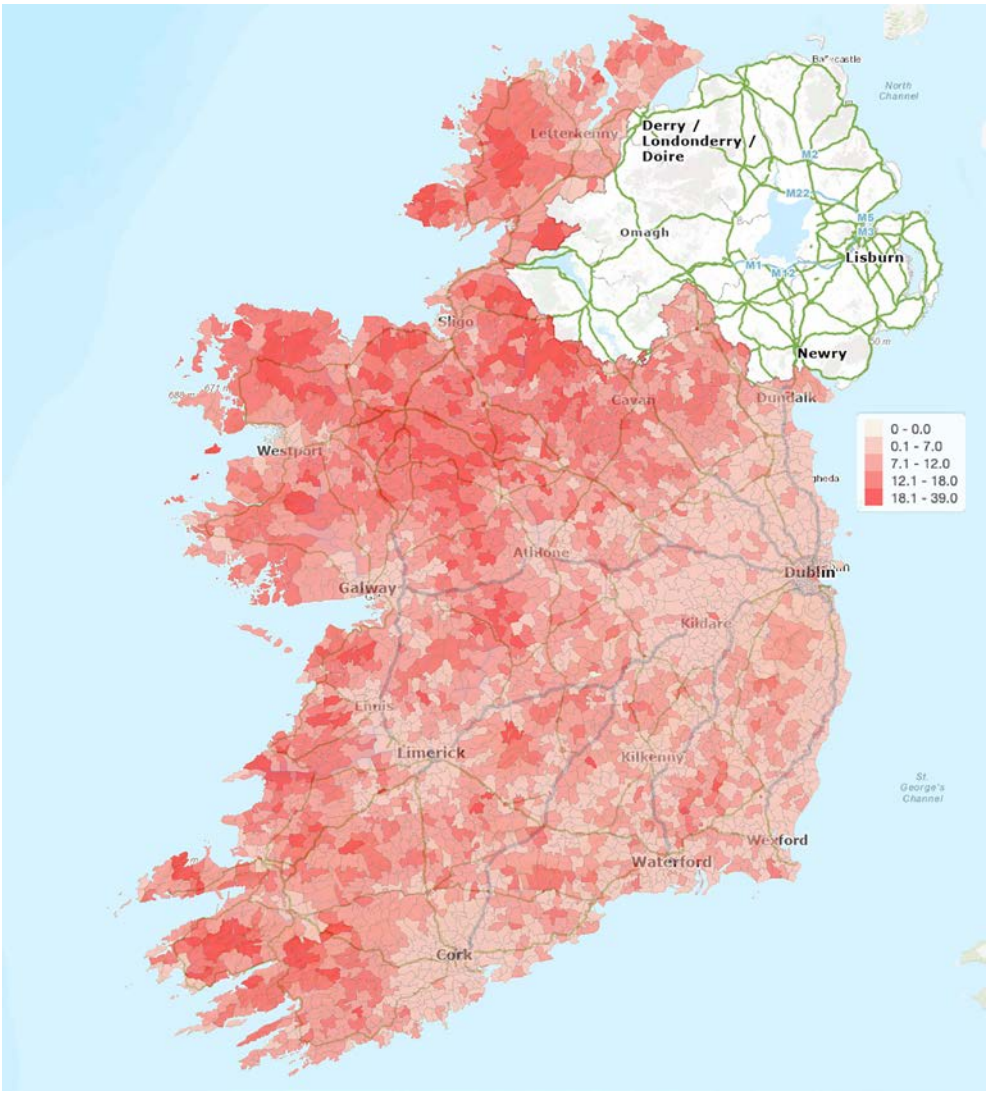


**Figure 2.2. Vacancy rate by electoral district from 2022 census data. Created using Map Viewer (CSO, 2022); licensed under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/).**

to use, it is deemed to be derelict (GeoDirectory, 2024, p. 9).[5]

Using GeoDirectory and the boundary files for settlements (sourced from data.gov.ie), it was possible to establish the combined rate of vacancy and dereliction for each town. The distribution (histogram) of vacancy and dereliction rates is shown in Figure 2.3; it averages at 5.17% but ranges from 0% to 30.37%. These data are contingent on the data collection frequency of An Post, and, while not real-time data, they broadly reflect what was seen on the ground through Google Earth Street View and by perusing Daft.ie and local press. Outliers in the higher percentiles could reflect smaller regional towns away from metropolitan areas where significant levels of construction were halted during the 2008–2015 financial crisis, such as Sneem (County Kerry) (26.71%), but also towns like Ballylongford (County Kerry) (23.84%) and Pettigo (County Donegal) (19.89%), which have exceptional numbers of vacant buildings on their main streets.

5 GeoDirectory contains separate fields for vacancy and dereliction, where “Y” or “N” responses can be toggled. Thus, a building marked as “Y” for dereliction is also marked as “N” for vacancy. Spatial analysis for this project was designed to look at both types of buildings within a broader context of urban voids. (“Invalid” entries, used to retain deleted or other legacy information, were filtered out.)

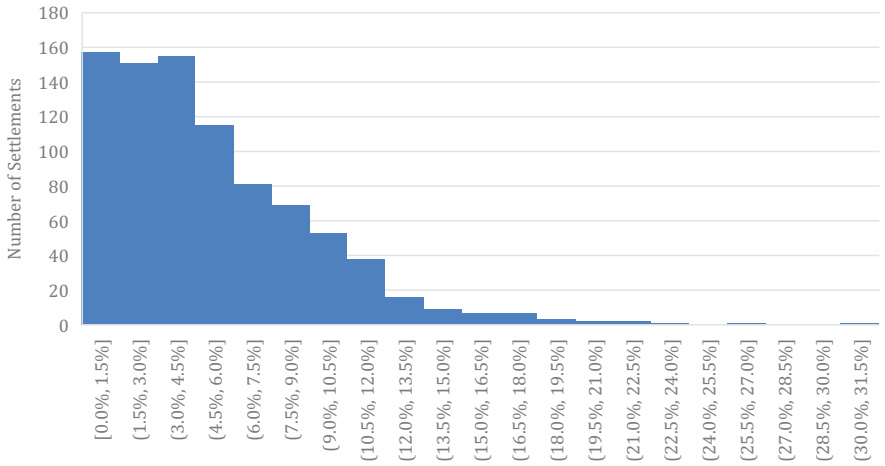


**Figure 2.3. A histogram showing the distribution of combined vacancy and dereliction rate values for 868 Irish settlements (with a population below 50,000) across increments of 1.5% on the *x*-axis and with the number of settlements within each interval on the *y*-axis (mean, 5.17%; standard deviation, 4.10%; median, 4.22%).**

### *2.2.1 Profiles of vacant and derelict buildings in Irish towns*

A random sample of 100 vacant and derelict buildings from GeoDirectory (henceforth "RS100"), while not exhaustive enough for detailed population sampling, provided an overview of the characteristics of vacant or derelict buildings versus the general building stock. By restricting the selection of buildings to those in designated urban areas whose population was fewer than 50,000 people, a total number of 760,682 buildings was found for 2020 (excluding those marked as "invalid"). Of these, 26,914 buildings were vacant and 5448 buildings were derelict, as judged by An Post personnel via visual assessment. RS100 was then derived from that combined total of 32,362 vacant or derelict structures (see Figure 2.4).[6]

For each building, a Google Earth Street View image was obtained (typically a roadside image, but occasionally only satellite imagery was available), and the image date and the number of storeys were recorded. An approximate date of construction (for those buildings pre-dating GeoDirectory itself) was estimated based on the architectural style, location and condition of the building. While GeoDirectory now collects such data, these data were incomplete at the time of analysis (March 2023).

A breakdown of the sample (RS100) according to the GeoDirectory classification of building use and typology is provided in Figure 2.5.

From visual confirmation, 10 buildings in the sample were designated as non-residential or retail structures: 4 were factory or industrial buildings, 2 were decommissioned schools, 3 were industrial heritage structures and 1 was a utility building. Among the 90 other buildings, 19 presently, or previously, accommodated retail units, 1 was a purpose-built hotel and only 1 was a multi-unit apartment complex that had been vacant since it was constructed. The main groupings of buildings are discussed below.

#### *Remains of ghost estates and the excess of the Celtic Tiger era*

As RS100 dates from 2020, unfinished post-recession housing estates were still being completed and homes sold in the intervening period up to 2023 (Figure 2.6).

6 For 2023, the respective figures are a total of 788,222 town buildings (excluding settlements with a population of >50,000), of which 23,598 buildings were vacant and 3951 buildings were derelict, marking an overall decrease in the number of derelict and vacant properties compared with 2020.

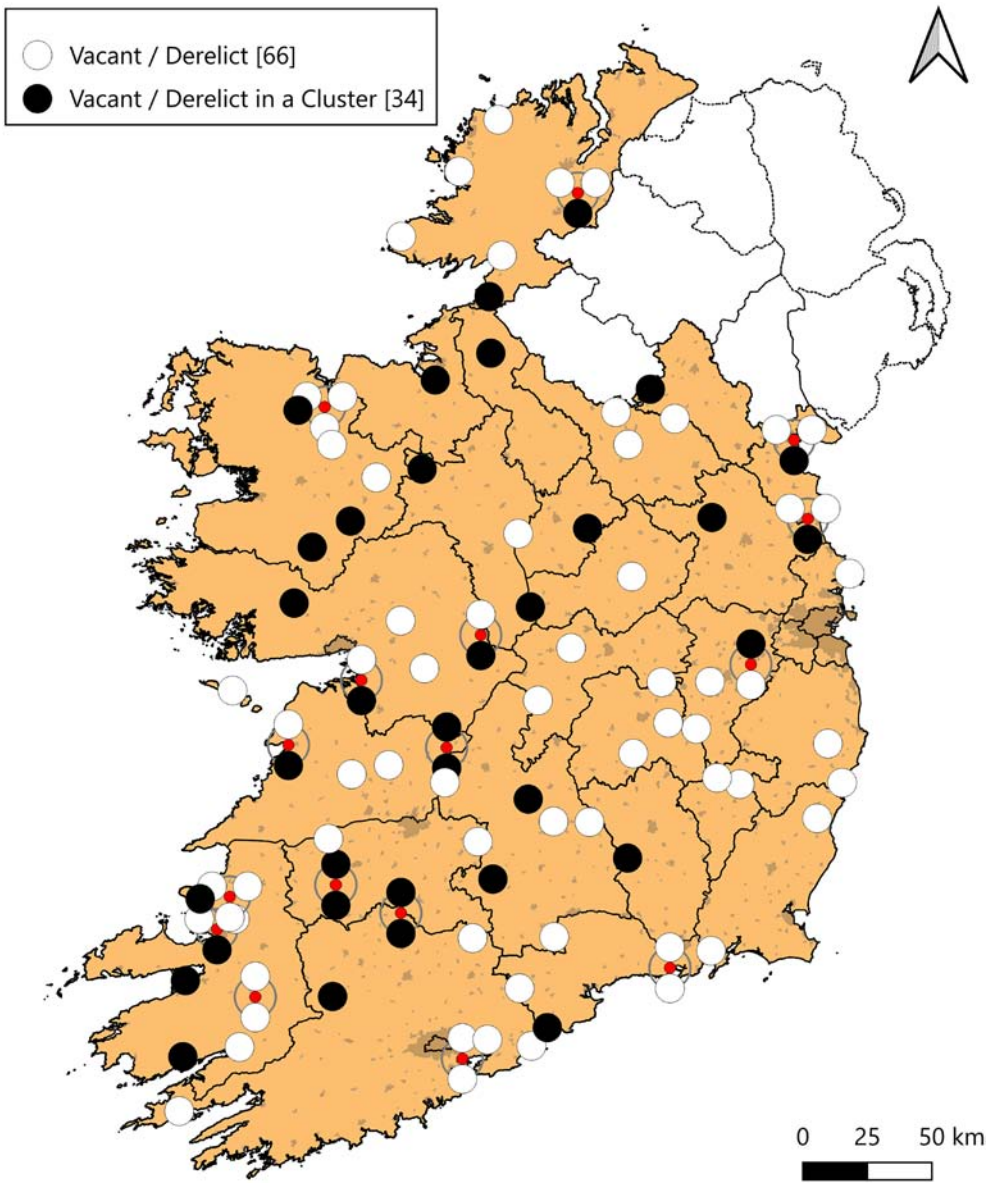


**Figure 2.4. Random sample of 100 buildings from GeoDirectory across Ireland classified as either within or outside a vacancy hotspot.**

The study of vacant housing clusters, referenced in section 2.2.3 and based on March 2023 data, would show more of these unfinished estates, being a combination of new developments and parcels of older unfinished developments coming to completion at their site edges.

*Low-density residential and rural buildings*

There were 58 detached or semi-detached residential houses in varying condition, of which 15 were bungalows, typically located on the peripheries of towns, and 9 were semi-detached dwellings, ranging from 1950s “garden city” suburban style to contemporary developer-led edge estates (see Figure 2.7).

Among the 49 detached buildings, 6 were rural vernacular longhouses, or farmsteads, within the 2015 urban settlement boundaries (Figure 2.8). Some were clearly long-term vacant or under-utilised buildings.

*A predominance of terraced townhouses and shops or public houses*

Terraced buildings, including end-of-terrace buildings, make up the bulk of the vacant and derelict housing

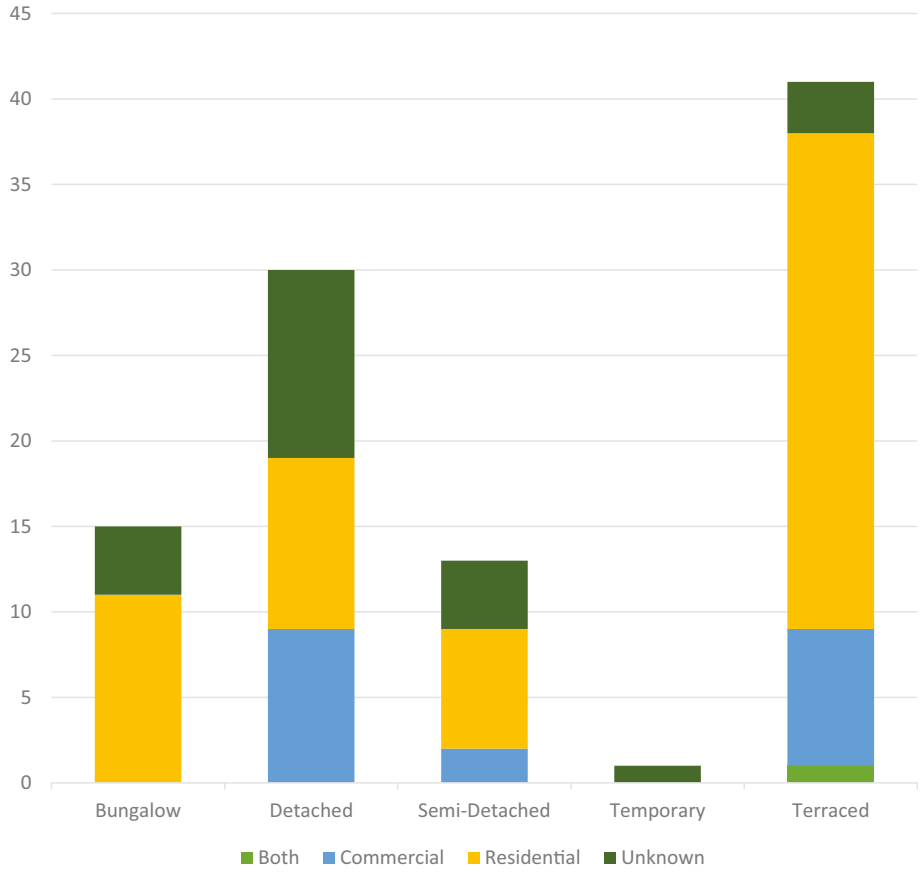


**Figure 2.5. GeoDirectory building morphology classification of the sample (RS100) by building type and use.**

**Figure 2.6. Unfinished development from a Celtic Tiger-era development within RS100, with buildings largely being completed and brought to market at the time of the research, in late 2023. Left: apartment block in Ballysadare, Co. Sligo (image © Mapillary, contributor Toho). Right: mid-terrace house in Loughrea, Co. Galway (image © Mapillary, contributor Dacor). Both images licensed under CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).**

**Figure 2.7. A vacant semi-detached mid-20th century residential building in Thurles, Co. Tipperary, from the RS100 sample. Image © Mapillary, contributor Larryolaoi, licensed under CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).**

sample. These range from architecturally refined buildings in classical proportions (see Figure 2.9) to former public houses and more irregular terraced buildings that once replaced cabins or were infill developments (Figure 2.10).

Such buildings will be on very varied plot types, ranging from those that may have retained their deep burgage plots and outhouses to those that have lost their original plots to parking spaces, utility storage and infill developments.

### *2.2.2 Sample trends versus the total population of town buildings*

As discussed, a relatively large proportion (41%) of buildings in RS100 are terraced. When taking into account only derelict status in relation to the total population of town buildings, the picture changes slightly. The average rate of dereliction in towns is 0.51%, with bungalows being the most likely to be derelict (0.82%), followed by detached dwellings (0.79%). Semi-detached dwellings are less likely to be derelict (0.23%), while terraced buildings have an average dereliction rate, at 0.51%. In contrast, when taking into account only vacancy, and not dereliction, terraced buildings are the most likely to be vacant, with 4.14% of all terraced town buildings being classed as vacant, which is just over half a percentage point higher than the proportion of detached town buildings

**Figure 2.8. A derelict vernacular longhouse and farmhouse from RS100 (only the single-storey building is listed on GeoDirectory) near Duncannon, Co. Waterford. Image © Mapillary, contributor Larryolaoi, licensed under CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).**


**Figure 2.9. A Tipperary Town shopfront with hooded windows on the upper storeys. Image © Mapillary, contributor Southglos, licensed under CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).**

(3.55%) and bungalows (3.67%) that are classed as vacant (see Figure 2.11).

In terms of the market turnover of the buildings in RS100, 64 buildings originally listed as derelict or vacant remained so in the 2023 dataset (Figure 2.12). Of the buildings that were derelict or vacant in 2020, a higher percentage of semi-detached buildings than any other building type had been returned to use by 2023 in both the sample (RS100) (6 out of 13 buildings) and in the total population of buildings (52.1%) (Table 2.2).

The slight trend for terraced buildings to be derelict or vacant in the long term, albeit based on a relatively short 3.5-year gap, seems far more pronounced when actually visiting the sites of derelict or vacant buildings in person or viewing these sites via Street View imagery. A cursory glance at surrounding streetscapes of individual buildings from the sample shows the proximity of other vacant buildings, such as those seen in Figure 2.13.

For this reason, where a building itself was found to be within the immediate vicinity of five or more other derelict or vacant buildings, the first building was classified as being in a vacancy hotpot (see Figure 2.4). These hotspots were predominantly close to terraced buildings (see Table 2.2) and found in the centres of Irish towns.

### *2.2.3 Urban vacancy clusters predominantly in border and western towns*

QGIS software was used to identify clusters of 10 or more vacant buildings in Irish towns (excluding very recent developments nearing completion) based on the March 2023 GeoDirectory data. These clusters (Figure 2.14) broadly reflected the

**Figure 2.10. A single-bay shopfront and upper two storeys in Ballinrobe, Co. Mayo. Image © Mapillary, contributor Dacor, licensed under CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).**

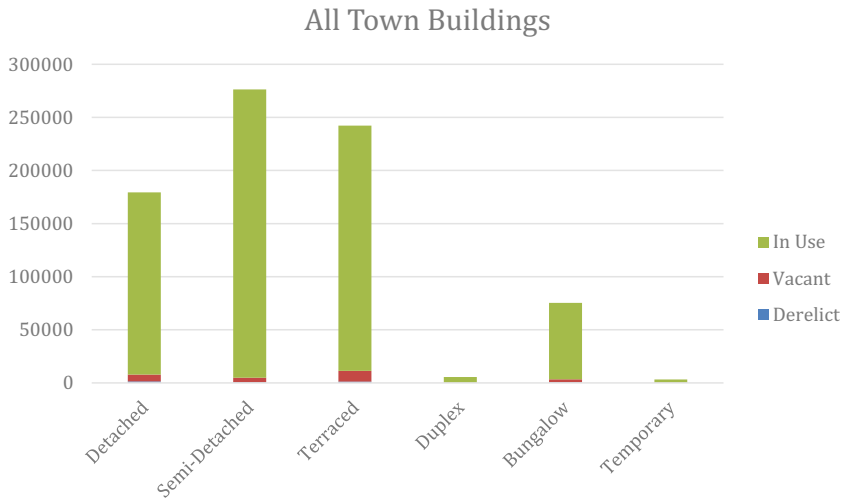


**Figure 2.11. Total number of town buildings by building type and fraction of each type listed as being either vacant or derelict in March 2023 GeoDirectory data.**

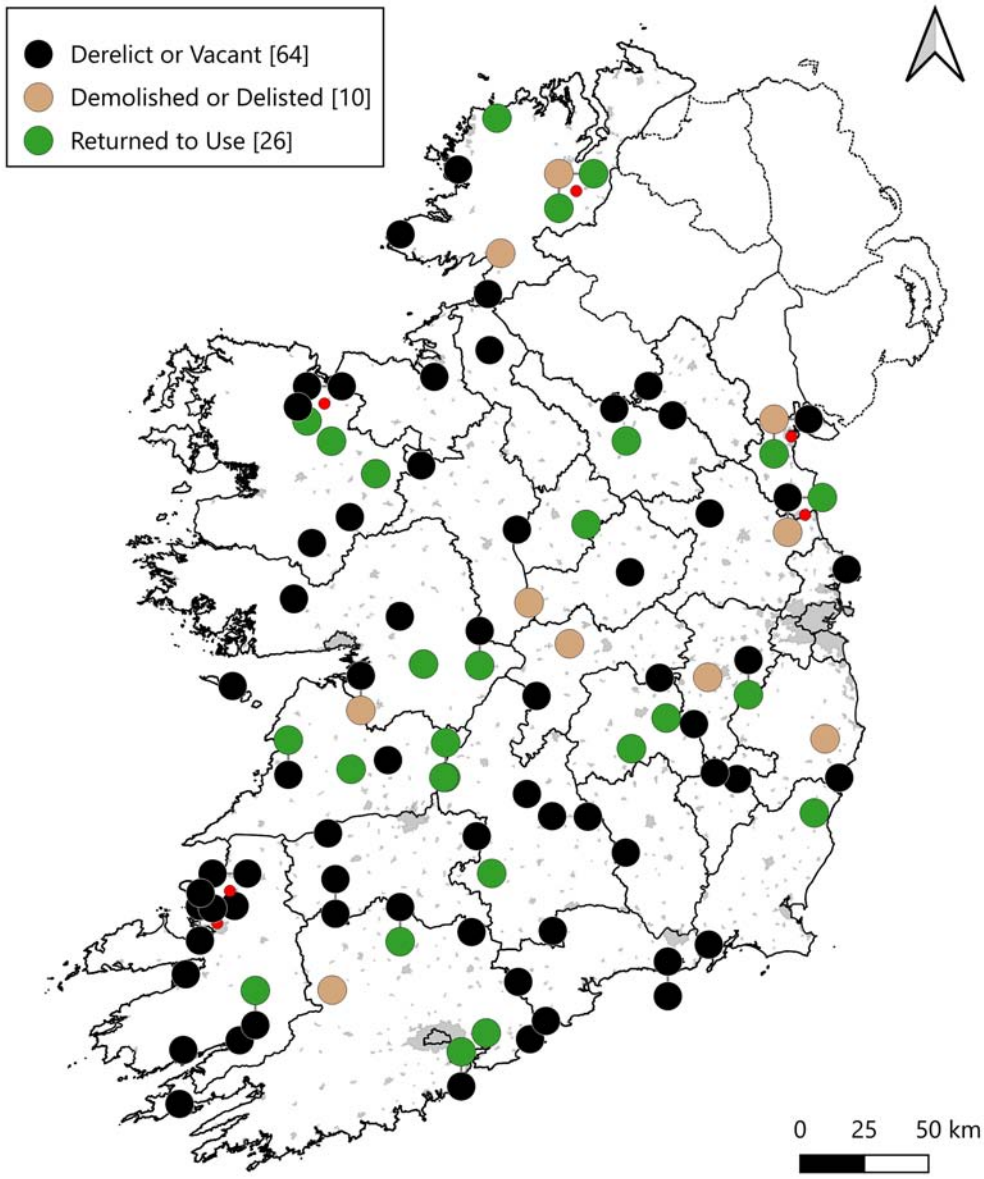


**Figure 2.12. March 2023 status of RS100 buildings that were listed as vacant or derelict in January 2020 GeoDirectory data.**

electoral district vacancy rate shown in Figure 2.2, with a predominance around western and border counties inasmuch as they contain settlements larger than villages.

Of the western and border counties, County Mayo and County Donegal stand out, as they have in excess of 20 vacant town clusters whereas the south-western counties have vacant town cluster counts in the mid-teens. This is partly a consequence of their land area, with County Louth and County Limerick (excluding Limerick City) also having high concentrations of vacant towns relative to their sizes and populations. At the national scale, point markers overlap for towns with several vacant town clusters; the number of clusters per county is shown in Figure 2.14. The occurrence of such clusters decreases in frequency closer to the metropolitan areas of Dublin, Cork and Galway.

The clusters are also more likely to be in the centre of settlements. By calculating the spatial centre (centroid) of each settlement, a distance figure can be provided for each point and cluster. It was found that any vacant or derelict (combined) town building is most likely to be 200 m closer to the settlement centroid than the average town building, while clusters of vacant or derelict buildings will be 350 m closer to the centroid than the average building.

**Table 2.2. Persistent vacancy of RS100 buildings after approximately 3.5 years, plus the number of buildings by type in "vacancy hotspots"**

| Building type | Number of D/V buildings in 2020 | Number of D/V buildings in 2023 | Percentage of buildings remaining D/V in 2023 | Number of buildings in vacancy hotspots |
|---|---|---|---|---|
| Bungalow | 15 | 12 | 80% | 2 |
| Detached | 30 | 20 | 67% | 5 |
| Semi-detached | 13 | 5 | 38% | 5 |
| Temporary | 1 | 0 | 0% | 0 |
| Terraced | 41 | 27 | 66% | 22 |
| Total | 100 | 64 | 64% | 34 |

**D/V, derelict or vacant.**

**Source: January 2020 and March 2023 GeoDirectory data.**


**Figure 2.13. Set piece of urban vacancy, which forms part of a cluster of 21 vacant and 3 derelict buildings in the town centre of Thurles, Co. Tipperary, on Croke Street, March 2024. Credit: Liam Heaphy.**

This research shows that, while it may be argued that national figures show a market system that brings properties back into use over time, a scaled-down analysis of smaller urban areas shows a different picture, indicating systematic issues of vacancy and dereliction in Irish town centres. This is most evident on main streets, squares and side streets in the urban core, where vacancy rates further erode community capacity to self-renew over time, resulting in urban voids. These patterns have implications for policy transfer and for common template solutions for building types according to morphology, age, methods of construction and renovation history.

## 2.3 Case Study Town Profiles

Case study locations were chosen on the basis of the following criteria:

- being part of the Collaborative Town Centre Health Check programme;
- having a population of fewer than 50,000 inhabitants;
- experiencing notable rates of town centre vacancy and dereliction.

Such locations were invariably outside major commuting catchment areas, and the project team

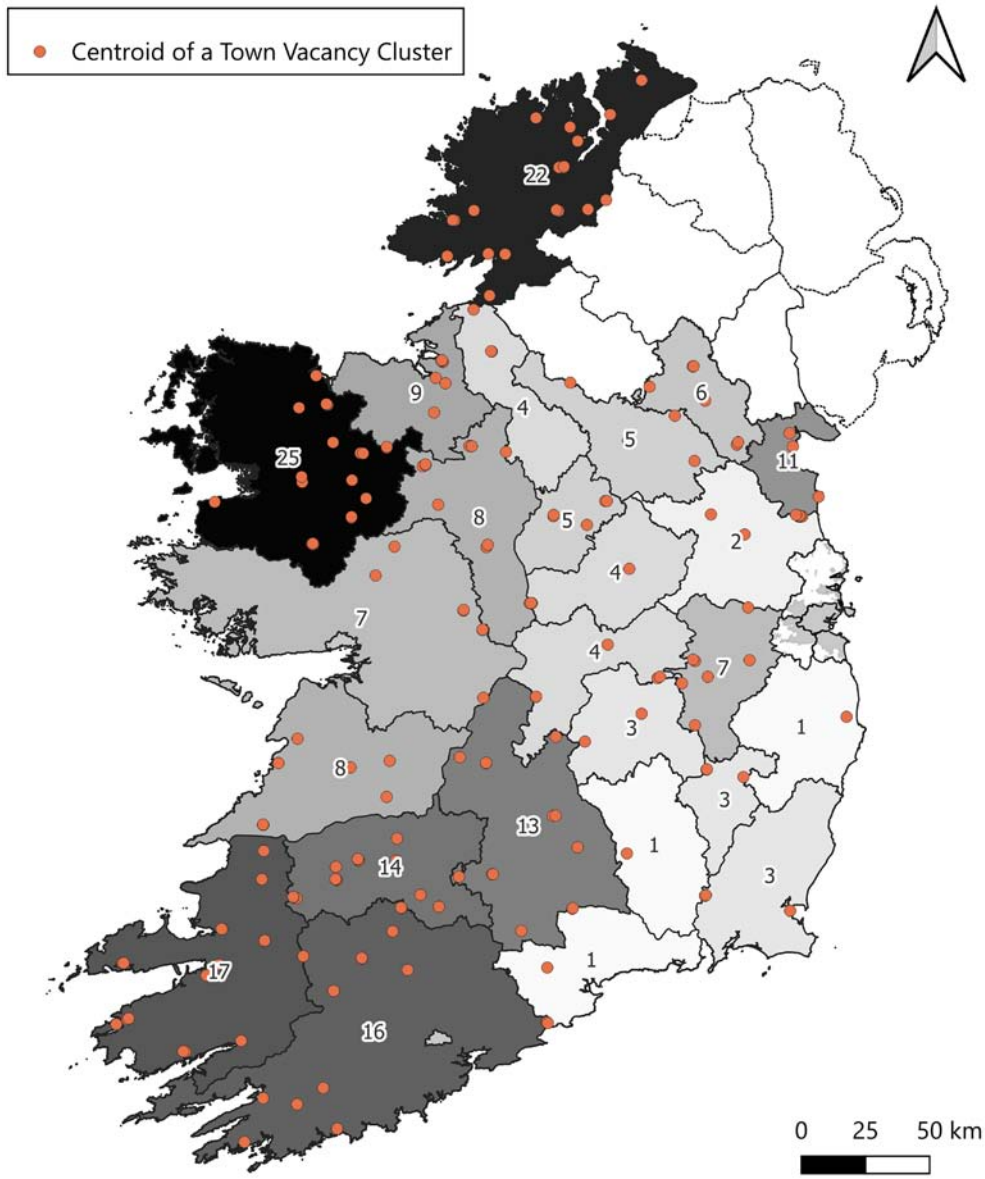


**Figure 2.14. Locations of clusters of 10 or more vacant or derelict buildings in Irish towns (with a population of <50,000) and numbers of such clusters in each county in Ireland.**

chose Ballina (County Mayo), Monaghan Town and Tipperary Town based on the criteria above and because of the ongoing work in these towns to address long-standing issues of vacancy at the building and neighbourhood scales.

All three towns have reversed long-term population decline in recent years, provide multiple services to the surrounding hinterlands and county, and are home to growing multi-ethnic populations (see Table 2.3).

All three towns conform with the general pattern of development of Irish towns in the late 20th and early 21st centuries: high levels of one-off housing on approach roads, low-density edge estates, moderate levels of out-of-town car-based retail outlets and moderate to high levels of vacancy in the town centre. Nevertheless, all locations also featured larger-scale retail stores in the town centre, partly on account of older urban areas having been cleared to allow for sufficient car parking.

### *2.3.1 Monaghan Town, County Monaghan*

Monaghan Town is the largest town in its namesake county and is located within 10 km of the border with Northern Ireland, with much of its natural hinterlands on the other side of the border. Situated in the Drumlin Belt, the landscape of the town undulates around small

**Table 2.3. Population and building profiles for the three case study locations based on census and GeoDirectory data**

| Town | Population (2016) | Population (2022) | Change in population (2016–2022) | Non-Irish-born population (2022) | Number of buildings (2023) | Dereliction/ vacancy rate (2023) |
|---|---|---|---|---|---|---|
| Ballina, Co. Mayo | 10,171 | 10,556 | 3.79% | 18.1% | 5271 | 6.81% |
| Monaghan Town | 7678 | 7894 | 2.81% | 37.4% | 3455 | 4.40% |
| Tipperary Town | 4979 | 5387 | 8.19% | 22.2% | 2806 | 4.99% |

hills interspersed with small lakes. The town centre is compact, focused around a civic district containing the Diamond and Church Square. The south side of the town centre is fronted by a large shopping centre and parking area, and beyond that are various housing estates, council buildings and religious centres. To the north-east, the town is bounded by the grounds of St Davnet's Hospital and various amenity and industrial sites. Negotiating the geography of the town's slopes and two lakes, North Street and Glaslough Street form an inner urban ring linking the town centre to the former train station and newly built Monaghan Peace Campus.

Monaghan Town has two vacancy clusters in the town centre, one on the east side and one on the west (Figure 2.15). The town has an overall combined vacancy and dereliction rate of 4.4% within its settlement boundaries. The eastern cluster is focused on Dublin Street and has been an area of interest for the county council's planning department for several years, resulting in significant plans and progress being

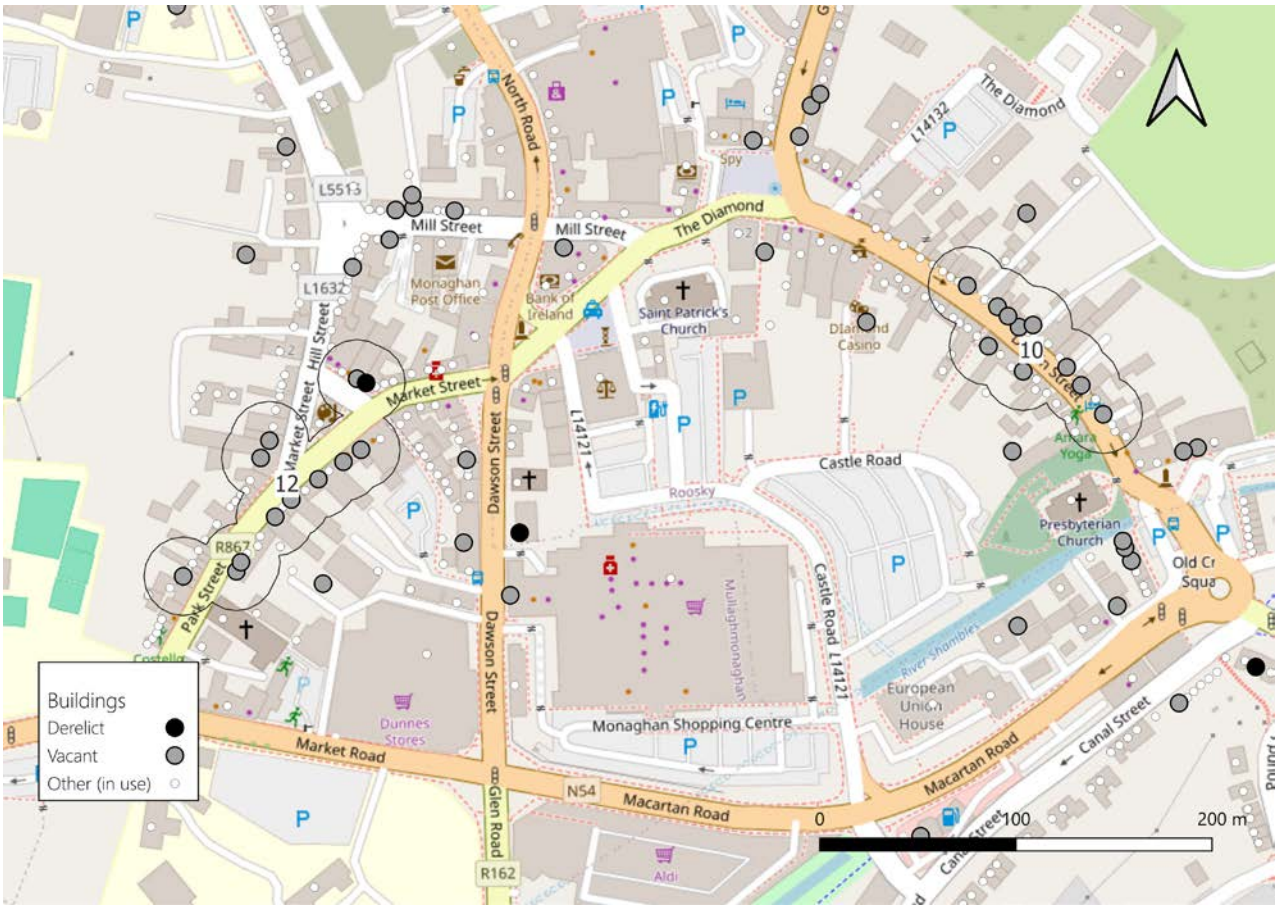


**Figure 2.15. Two clusters of vacant (grey) and derelict (black) buildings in Monaghan Town based on 2023 GeoDirectory data, over an OpenStreetMap layer.**

made to bring some of these buildings back into use. The western cluster on Park Street and Market Street has since become another site of interest, presenting opportunities for the functional restoration or adaptive reuse of these town buildings.

Combined, the two clusters contain 22 buildings, all of which are terraced. The majority are classified as having commercial use as their primary function. Five buildings are residential, two are both residential and commercial and one is of unknown use.

Several sites are being considered for development or are in the advanced stages of planning, including the St Louis convent site to the south-west of the town, which is part of a larger heritage-led plan (Monaghan County Council, 2024), and the new civic offices to the north of Dublin Street on the east side of the town (Local Government Ireland, 2024). The Dublin Street plan discussed in the interviews conducted as part of this project (see section 4.2.1) relates to these proposals, as the new civic offices imply considerable changes to it.

The project team's engagement with Monaghan County Council commenced in December 2023, when a research team member held two informal online meetings with council representatives. Following these informal online meetings, a site visit was conducted with a focus on vacancy and dereliction around Dublin Street.

### *2.3.2 Tipperary Town, County Tipperary*

Tipperary is the sixth largest town in County Tipperary. It has a train station, a river and ample parks and green spaces, and is within commuting distance of Limerick City. While the town does feature a considerable area of out-of-town retail space on Limerick Road built during the Celtic Tiger era, it also has large supermarkets in the town centre with parking provision. The town has a large community space on the site of the former town hall. A local dairy factory provides employment and the weekly cattle mart brings people to the town on Fridays. While some of the urban fabric has been converted to parking space for supermarkets, the town has notable footfall in spite of long-standing traffic issues due to the absence of a bypass for heavy goods vehicles.

The research team had its first online meeting with the Tipperary Town Revitalisation Manager and a councillor on 13 June 2023. It was reported that, at the time, there were 84 vacant buildings in the town, but that a strategy and action plan (Tipperary Town Revitalisation Task Force, 2022) had been published for Tipperary Town and a local area plan was also being developed. The Tipperary Town Revitalisation Task Force (or town regeneration team) had several town building acquisition and restoration projects under way and was participating in the Reimagine Ireland programme of the Irish Architecture Foundation (2025).

The town has a central thoroughfare and adjacent streets that form part of an architectural conservation area. It was reported that finding uses for town buildings was a challenge given the presence of out-of-town retail options, which, together with online shopping, means that many of these town buildings may not find a profitable commercial use in retail. However, office space is in demand, and the local chamber of commerce wishes to retain all ground floor commercial units, if possible. According to the task force, the county planning department has now become more aware of the negative effects of out-of-town retail on urban vitality. Further challenges to the town highlighted by the task force in the preliminary meetings with the project team were social deprivation and poor levels of education attainment, particularly in the eastern part of the town.

Tipperary Town has two vacant clusters in the town centre and an overall vacancy and dereliction rate of 4.99%. The first cluster, in the east, is where Main Street meets St Michael's Street as a linear cluster, while the second is formed around the urban block formed by Main Street, John Street and James Street (Figure 2.16).

Of the 26 buildings in these clusters, 4 are classified for both commercial and residential use, 14 for commercial use only, 6 for residential use only and 2 for unknown use. Moreover, 23 of the 26 buildings are terraced and the remaining 3 are detached.

A site visit was made in July 2023 by two members of the project team, prior to further visits by one member, and a property clinic was held in July 2024 and attended by three members of the project team.

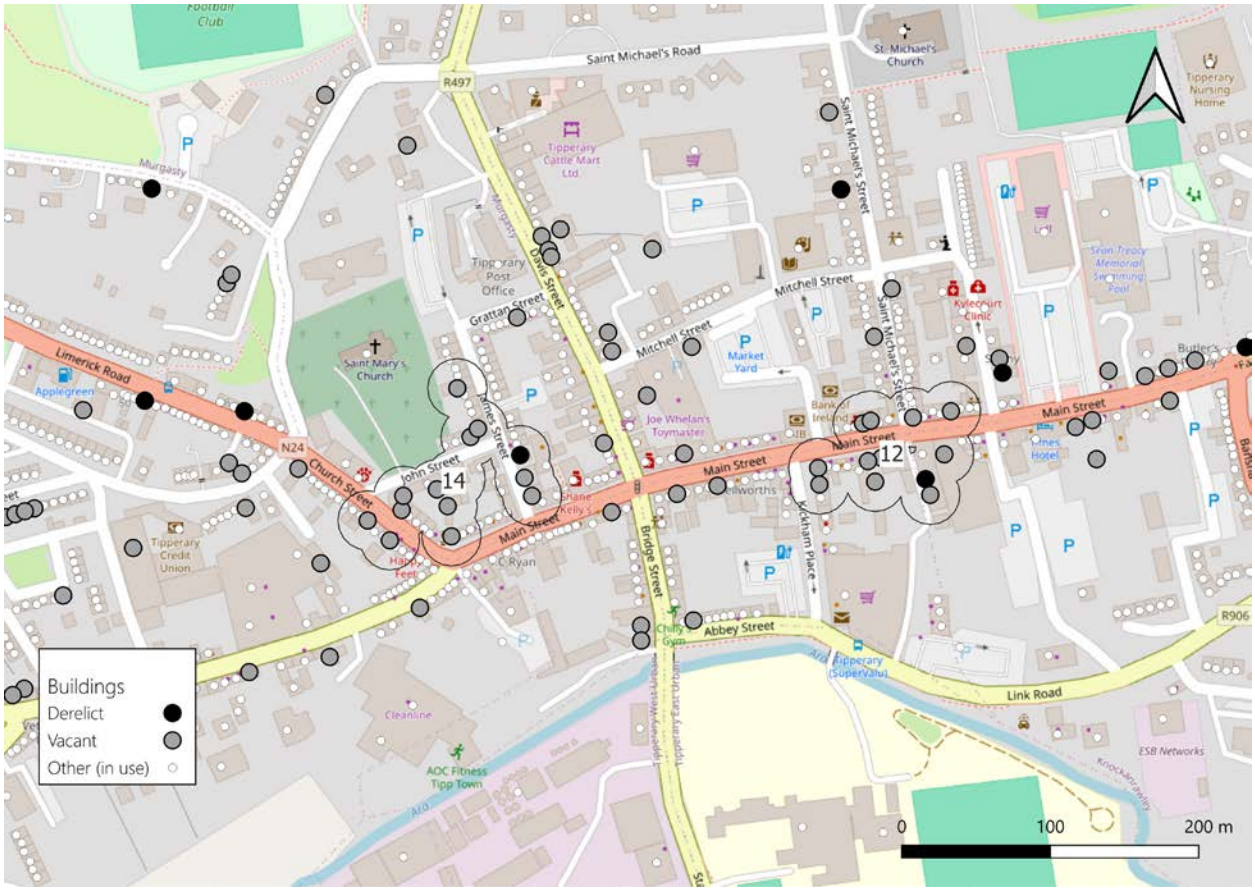


**Figure 2.16. Two clusters of vacant (grey) and derelict (black) buildings in Tipperary Town based on 2023 GeoDirectory data, over an OpenStreetMap layer.**

The quality and preservation of the main street is noteworthy, with its stylistic and individualised façade treatment and shopfronts dating from the late 18th and early 19th centuries (Figure 2.17) (cf. Quinlan *et al.*, 2007).

Under way or in planning at the time the research was carried out (July 2023) were a project to restore a former rectory for use as an enterprise centre and a project for the adaptive reuse of the partially used bridewell and courthouse. Outstanding legacy issues identified were the failed reuse in the 1990s of the famine-era workhouse, which, although intact, needs considerable work and a sustainable use case would need to be developed. The site visits also highlighted the importance of the block-scale treatment of vacancy and dereliction.

### *2.3.3 Ballina, County Mayo*

Ballina is the largest of the three case study towns, with over 10,000 inhabitants. Its closest larger urban area is Sligo Town and it is bisected by the navigable Moy River, with the scale of development being greatest on its western bank. Like Tipperary Town, it has a sizable retail footprint in, or adjacent to, the town centre, with extensive areas used for car parking. Recent projects in the town include the Mayo County Council-led conversion of the barracks (Figure 2.18) into an innovation quarter and public amenity space, and the ongoing work on Pearse Street and Walsh Street.

Several project team members had worked with local stakeholders in recent years, so they were familiar with the town and its recent development. A combined event was held in July 2024 for the TREBUChEt project and another EU-funded project focused on heritage-based development. At this event, interviews were conducted with property owners in relation to barriers to adaptive reuse and their experiences of negotiating grants and schemes. In addition, a further event was held by the project team in December


**Figure 2.17. Traditional shopfront on Church Street, Tipperary Town, July 2023. Credit: Liam Heaphy.**

2024, featuring speakers from the Housing Agency and DHLGH. These speakers presented details of the grant schemes available to the public for retrofitting and restoring buildings, including conservation considerations for traditional buildings.

The level of vacancy within Ballina's town centre is relatively high, yet the settlement as a whole has a vacancy and dereliction rate of 6.8% within its boundaries according to data from 2023. This figure exceeds the average vacancy and dereliction rate of 5.17% for settlements with a population of under 50,000, but is not an outlier in the region. Its four vacancy clusters comprise 95 buildings and are all located around the main thoroughfares of the town (Figure 2.19).

Of the 95 buildings, 44 are classified as residential, 42 as commercial, 8 as both commercial and residential, and 1 as of unknown use; 86 of the buildings are terraced, 6 are semi-detached and 3 are detached.

**Figure 2.18. Adaptive reuse of Ballina Military Barracks as an innovation quarter and public amenity space, led by Mayo County Council, July 2024. Credit: Liam Heaphy.**

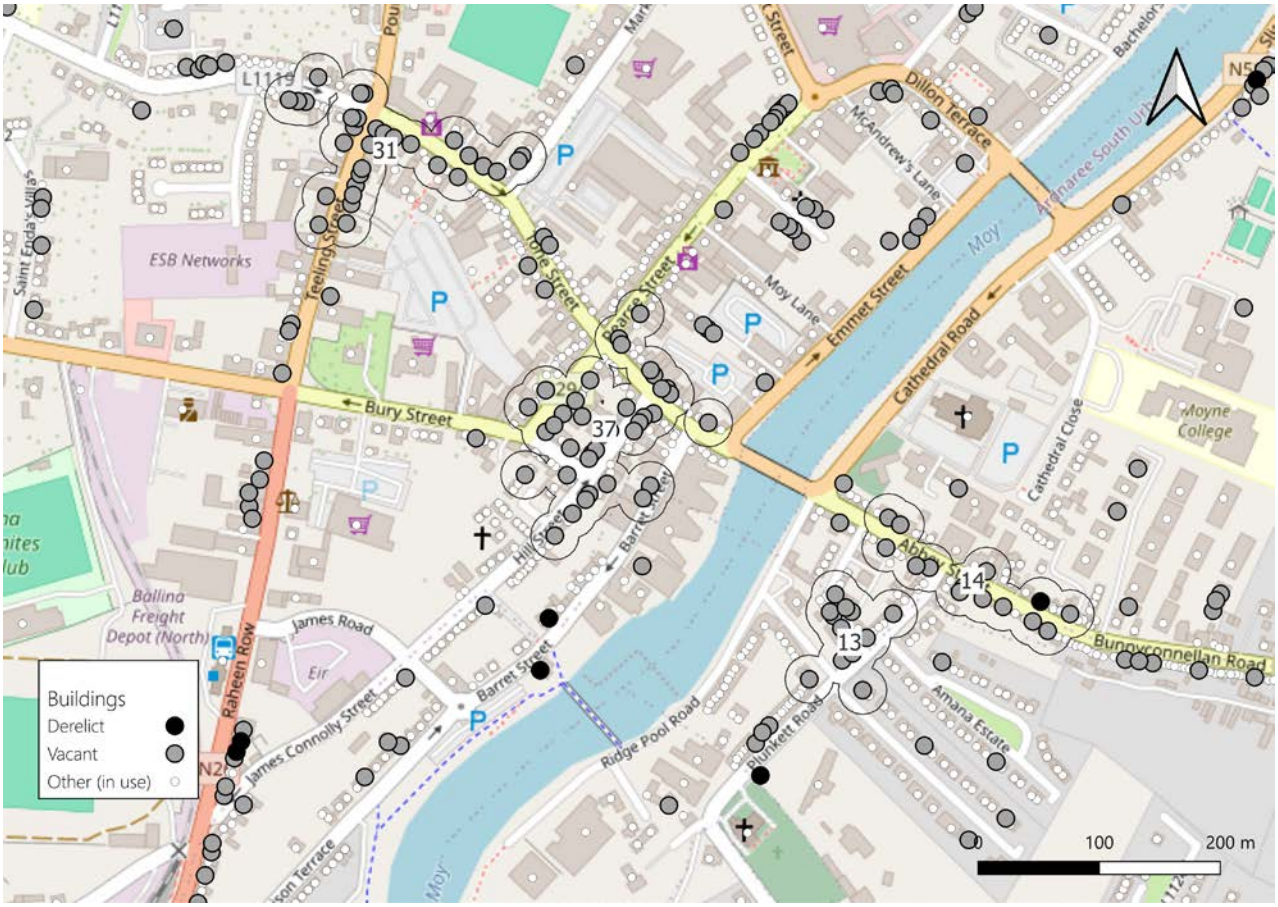


**Figure 2.19. Four clusters of vacant (grey) and derelict (black) buildings in Ballina, Co. Mayo, based on 2023 GeoDirectory data, over an OpenStreetMap layer.**

# 3 Life Cycle Assessment Case Studies of Vacant Building Retrofits

This chapter presents an analysis of the embodied carbon emissions of selected retrofit case studies in Ireland, carried out using LCA based on the life cycle modules A1–A5 of standard EN 15.978 (CEN, 2011). The findings aim to inform more standardised and sustainable renovation practices, contributing to Ireland's and the EU's broader climate and resource-efficiency objectives.

## 3.1 The Role of Life Cycle Assessment for Retrofits

LCA is a widely recognised method for evaluating the environmental impacts of buildings across their life cycle, offering critical insights into both embodied and operational carbon emissions. In the context of retrofitting, LCA enables the quantification of the carbon savings resulting from material reuse and reduced reliance on new materials, and it provides a means to weigh the environmental trade-offs involved in renovation strategies. For example, James *et al*. (2024) demonstrated how retrofitting can significantly lower embodied carbon emissions compared with new construction, while maintaining competitive operational performance. Similarly, Besana and Tirelli (2022) employed LCA integrated with building information modelling (BIM) to optimise material selection, emphasising the value of bio-based and low-carbon materials in reducing life cycle emissions.

LCA typically covers several stages of a building's life: product and construction (modules A1–A5 of EN 15.978), which include material production, transport and assembly; use (module B), which encompasses maintenance and replacement; and end of life (module C), which accounts for demolition, disposal or recycling. An optional module D may capture potential benefits beyond the system boundary, such as material reuse or recycling (see Figure 3.1 for a visualisation of all stages).

Table 3.1 presents a representative selection of recent LCA studies focused on building retrofits. These examples illustrate a range of methodological scopes, tools and outcomes, providing context for the LCA approach adopted in this report.

Across Europe, the application of LCA to retrofit projects remains limited, with no country yet having introduced legally binding limit values for renovation LCAs (Lund *et al.*, 2024). However, major renovations are increasingly being integrated into voluntary LCA standards and sustainable building certification schemes. For instance, the EU "Level(s)" framework explicitly includes large-scale retrofit projects and promotes life cycle thinking across all stages (A1–C4) (see Figure 3.1), with an emphasis on resource efficiency (European Commission, 2021).

In Germany, the Bewertungssystem Nachhaltiges Bauen (BNB) certification scheme for assessing the sustainability of public buildings (BMWSB, 2025) incorporates major refurbishments, supporting LCA application in substantial retrofit interventions. Likewise, the LCA standard of the Swiss Society of Engineers and Architects defines non-binding impact thresholds for embodied, operational and transport-related emissions, including climate impact, primary energy use and non-renewable energy – although compliance with these limits remains voluntary (Beaudoin, 2023; Lund *et al.*, 2024, p. 17). France's Haute Qualité Environnementale (HQE) (Green Building Standard) certification scheme introduces a notable methodological advancement by recognising the "residual impact" of existing materials not yet at the end of their life cycle at the time of renovation. This contrasts with most LCA methodologies, which typically account only for replacement impacts through module B (Lund *et al.*, 2024).

A report for Ireland's DHLGH by Carrig Conservation International describes the application of LCA to evaluate the whole-life carbon emissions of a 19th century brick dwelling (DHLGH, 2024b). It was used to assess three scenarios: maintenance, retrofitting to two energy efficiency levels and new construction. The analysis found that a deeper retrofit would reduce emissions by 35% over 60 years as compared with a new build, with insulation and heat pump use playing

**Table 3.1. Summary of LCA studies in retrofit contexts**

| Study | Scope/modules | Key methodology | Key findings | Methodological implications |
|---|---|---|---|---|
| Hasik *et al.* (2019) | A1–A3, B | Comparative LCA of retrofit vs new build; reused components; focus on embodied impacts | Retrofit reduces impacts by 53–75%, with GWP, energy use and acidification all being reduced | A1–A3 captures upfront embodied impacts; excluding carbon avoids penalising existing materials; ensures scope parity for fair comparison |
| Vilches *et al.* (2017) | A1–A3; excludes B6–B7, C | Focus on GWP and embodied energy; consistent scope for comparability | Retrofit reduces GWP and embodied energy use via reuse of embedded carbon | Narrow A1–A3 scope minimises variability; supports consistent, replicable LCA comparisons across retrofit cases |
| Besana and Tirelli (2022) | A1–A5; excludes B6–B7, C1–C4 | BIM + One Click LCA; circular economy; bio-based materials | Milan retrofit shows 91% reduction in embodied carbon via material optimisation | Adding A4–A5 captures transport and construction impacts; integrating BIM and LCA enhances material-level decision-making |
| James *et al.* (2024) | A1–A3; used BIM and EPDs | BIM for material quantification; EPDs for emissions; assessed material additions in retrofits | Retrofits lower embodied carbon; new builds slightly better operationally; retrofits better over whole life cycle | A1–A3 focuses on upfront carbon; highlights need to integrate material data with operational forecasts for net-zero alignment |
| IEA, Annex 56 (Almeida and Ferreira, 2017) | A1–C4; focus on A1–A5, B6, C1–C4 | LCA + LCC for renovation depths in six EU countries | Deeper retrofits = higher embodied but lower operational energy; data consistency vital | Full A1–C4 scope essential for holistic renovation analysis; combines environmental and cost factors; requires data standardisation |
| Lasvaux *et al.* (2013) | A1–C4 | Comprehensive LCA for energy retrofits; tool and data impact explored | Tool and data choices greatly impact LCA results; standardisation needed | Results vary by tool and dataset; highlights need for harmonised tools and location-specific EPDs in retrofit LCAs |
| Dodoo *et al.* (2010) | A1–C4 | Passive House retrofit in cold climate; embodied vs operational trade-offs | Retrofit of wood-frame houses greatly cuts life cycle emissions | A1–C4 scope necessary to model climate-sensitive trade-offs; supports regional LCA calibration for accurate retrofit assessments |
| Wallhagen *et al.* (2011) | A1–A3, B6, C3–C4 | LCA climate impact of office retrofit; focus on materials/energy | Retrofits rival new builds if materials optimised; impacts from materials and energy | Partial LCA scope still reveals material and energy trade-offs; stresses accurate material selection modelling |
| Zimmermann *et al.* (2023) | Sweden: A1–A5; Denmark: A1–A3, B4, B6, C3–C4; Finland: A1–A5, B4, B6, C1–C4 | Comparative GHG emissions using national LCA methods; Danish retrofit case | Retrofit had lower upfront emissions, with reductions in GHG emissions as follows: Sweden, 68%; Finland, 32%; Denmark, 10% | System boundaries and operational energy inclusion alter outcomes; highlights need for scope harmonisation to fairly assess retrofits |

**EPD, Environmental Product Declaration; GHG, greenhouse gas; LCC, life cycle costing.**

a key role in emission reductions. The report highlights that current LCA tools are ill-suited for assessing traditional buildings, as they lack data for heritage materials (e.g. lime mortar, traditional masonry) and are aligned with modern construction standards. Tools like One Click LCA and SimaPro rely on generic datasets and do not fully support Irish standards (Irish Standard EN 15.978:2011), particularly in modelling both embodied and operational carbon emissions holistically. This limits their accuracy and usability, especially for smaller architectural practices without LCA experts in house. The report calls for the development of tailored LCA tools that incorporate traditional materials, address data gaps and enable the balanced assessment of carbon trade-offs, ensuring that heritage preservation and emission reductions can be pursued in tandem.

### 3.1.1 *Scope harmonisation and methodological guidance for retrofit life cycle assessment*

Inconsistencies in LCA system boundaries and life cycle stages are major sources of variability in the environmental impacts reported for renovation projects. For example, methodological differences have been shown to result in a 2.5-fold variation in the GWP values reported for identical buildings, depending on the inclusion or exclusion of modules such as B4, B6 and C1–C4 (Beaudoin, 2023). Such disparities highlight the need for harmonised and transparent scopes, especially for retrofits, where assessments are often constrained by limitations to tools and data.

To address these limitations, frameworks such as the *Whole Life Carbon Assessment for the Built Environment*, 2nd edition (WLCA), of the Royal Institution of Chartered Surveyors (RICS) (RICS, 2023) and the Level(s) framework of the European Commission (2021) offer clear guidance. Consistent with EN 15.978, RICS WLCA specifies that emissions from retained materials are excluded from modules A1–A5, as these are considered to have already been emitted. Only new materials introduced during renovation are included under A1–A5, while maintenance and repair of existing elements are covered under module B. This supports a balanced life cycle perspective and underscores the carbon-saving potential of material reuse. However, retrofit LCAs face data limitations, especially regarding heritage or reused materials, as most LCA tools and Environmental Product Declarations (EPDs) are geared towards new construction. To maintain rigour, RICS WLCA recommends using transparent assumptions and scenario modelling, particularly when specific data are unavailable.

From a climate perspective, retrofits often result in lower upfront embodied carbon emissions than new builds, enabling faster carbon payback – a key advantage given 2030 emission reduction targets. Both RICS WLCA and Level(s) advocate for standardised, life cycle-based assessments, improving comparability and accountability in evaluating the environmental performance of renovation projects. Table 3.2 outlines how different material scenarios are treated within the embodied carbon accounting of modules A1–A5 in accordance with RICS WLCA and EN 15.978.

## 3.2 Life Cycle Assessment Methodology at the Building Scale

This study adopts a focus on A1–A5, which encompass raw material extraction, processing and manufacturing – the stages responsible for the

**Table 3.2. A1–A5 embodied carbon emissions in retrofits: scenarios and rationale (adapted from RICS WLCA and EN 15.978)**

| Material type/scenario | A1–A5 embodied carbon accounting | Rationale |
|---|---|---|
| Retained existing materials | Not re-quantified – emissions are considered “sunk”. Excluded from A1–A5. | Promotes reuse and circular economy; avoids double-counting emissions. |
| New materials in retrofit | Fully quantified under A1–A5: extraction, manufacture, transport, installation. | Required to capture additional carbon burden of renovation. |
| Maintenance of retained materials (module B) | Not included in A1–A5. Accounted for in B2–B4: maintenance, repair, replacement. | Ensures future impacts of retained elements are considered without inflating initial embodied carbon. |
| Demolition of existing materials | If demolished, quantify end-of-life impacts in C1–C4. Not counted in A1–A5. | Helps assess environmental cost of not reusing materials; important for retrofit vs demolition comparison. |
| Biogenic carbon in bio-based materials | Biogenic carbon storage is reported separately in A1–A3. Must disclose if included or excluded. | Transparency in biogenic carbon accounting ensures accurate comparison and aligns with Level(s) and RICS WLCA requirements. |
| Transport of reused materials | If materials are reused from off-site, A2 (transport) and A5 (installation) must be counted. | Promotes local reuse; helps assess whether reuse still offers carbon savings when considering transport impacts. |
| Operational energy (module B6) | Not included in A1–A5. Reported separately. Important for retrofit strategies aiming for energy efficiency upgrades. | Highlights the trade-off between embodied and operational carbon. |
| Carbon payback period | Not part of A1–A5, but analysis of time to offset carbon of retrofit vs new build. | Supports decision-making in climate policy context; retrofits often have shorter payback periods. |

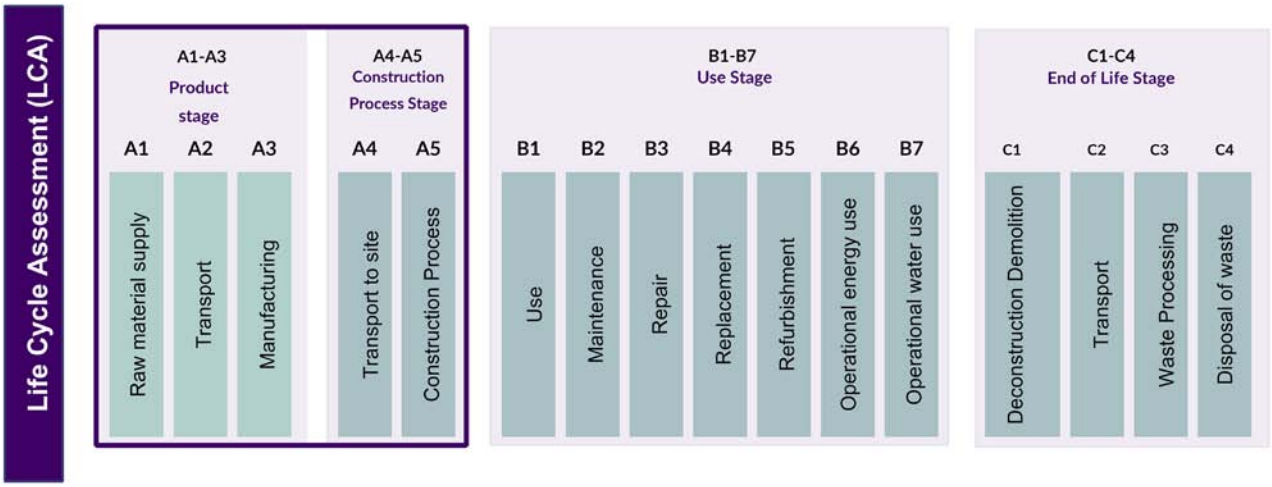


**Figure 3.1. Scope of the TREBUChEt building case studies based on the life cycle modules of EN 15.978.**

majority of embodied carbon emissions (Vilches *et al.*, 2017; Hasik *et al.*, 2019). These modules provide standardised, measurable data, ensuring comparability across case studies.

By excluding the operational energy (B6–B7) and end-of-life (C1–C4) stages – often based on speculative modelling – this study delivers robust, actionable insights. Using modules A1–A5 allows for the accurate evaluation of carbon savings resulting from material reuse versus new material additions, supporting low-carbon design strategies and circular economy principles (Besana and Tirelli, 2022; Lima *et al.*, 2024).

LCAs were conducted for six building retrofit projects. The purpose of these assessments was to better understand the impacts on embodied carbon emissions of retrofitting pre-20th century buildings, most of which were constructed of stone, with a smaller proportion built of brick. Their adaptive reuse as apartments, duplexes or single-family homes provided an opportunity to examine the carbon trade-offs inherent in retrofitting compared with alternative design approaches.

Retrofit interventions vary significantly depending on factors such as building condition, intended use and the extent of upgrades required. Based on the four-level classification by Carrig Conservation International (DHLGH, 2024b), the selected case studies underwent Level 1 (minimal intervention with partial insulation and energy efficiency upgrades) or Level 2 (deep retrofits with full insulation and renewable energy) retrofitting, enabling comparison between low- and high-intervention approaches in terms of embodied carbon outcomes.

The project's LCA methodology was adapted from previous UCD research projects and from established industry standards, RICS WLCA and EN 15.978 (see Table 3.2), which promote transparent, consistent LCA boundaries. The methodology focused on the new materials introduced during the renovation process, aiming to provide accurate results while excluding existing materials, which may be either retained or demolished (Table 3.3).

The methodology has been applied to six case studies of buildings with different typologies and varying scopes of material removal and addition, with floor areas ranging from 68 to 587 $m^2$. Their new functions include apartments and single-family homes, with duplexes representing a smaller proportion.

The process is composed of four steps, as follows (Figure 3.2):

- **Step 1: collect technical documents.** Gather construction drawings and bills of quantities; convert PDF files to Automatic Computer-Aided Design (AutoCAD) (.DWG) files as needed.
- **Step 2: define renovation types.** Clearly specify the types of renovations to be assessed.
- **Step 3: perform quantity takeoffs.** Estimate material quantities from documentation, supplementing these with assumptions or construction photos if necessary.
- **Step 4: quantify carbon emissions.** Utilise the Upfront Carbon Calculator tool of the Irish Green Building Council (IGBC) to calculate carbon emissions, focusing on production phase impacts (A1–A3).

**Table 3.3. Key parameters and rationale for carbon assessments of retrofits**

| Parameter | Details | Rationale |
|---|---|---|
| Scope | A1–A5: embodied carbon from material extraction, processing and manufacturing. | Captures key upfront impacts; avoids uncertainty in use/end-of-life stages; ensures comparability. |
| Tool | Upfront Carbon Calculator (Elkhayat *et al.*, 2025). | Aligns with national standards; accessible; detailed LCAs offer deeper case-specific insights. |
| Type of building | Pre-20th century terraced buildings typical of rural Irish towns; residential focus. | Relevant to town centre reuse; supports context-sensitive, low-carbon retrofit strategies. |
| Level of retrofitting | Range from soft to deep retrofit (e.g. insulation, windows, low-carbon materials). | Captures carbon trade-offs; assesses impacts from vacancy; identifies optimal interventions. |
| Goal of assessment | Quantify embodied carbon savings; assess carbon costs of retrofit interventions; support adaptive reuse and increased urban density. | Highlights retrofit carbon efficiency; supports material optimisation and sustainable planning decisions. |

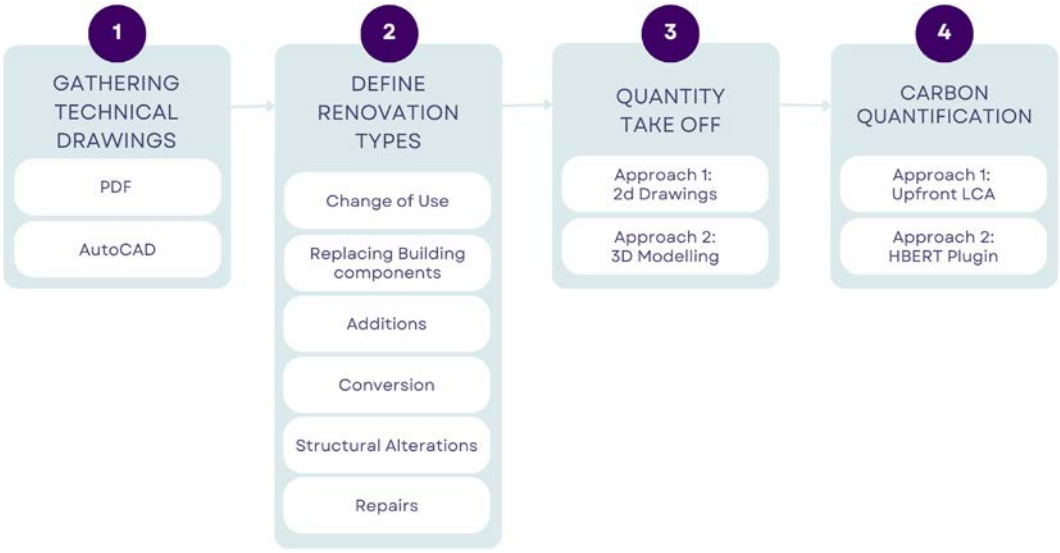


**Figure 3.2. LCA methodology workflow. HBERT, Hawkins/Brown Emissions Reduction Tool.**

## 3.3 Life Cycle Assessment Results at the Building Scale

The LCAs evaluate six residential retrofit projects across Ireland, covering a range of typologies, from compact terraces to large apartments, as described in Table 3.4. Each LCA illustrates how renovation scope, design choices and material use influence embodied carbon emissions. While all six retrofits achieved lower embodied carbon emissions than greenfield construction, extensions consistently contributed disproportionately to emissions due to the introduction of concrete, steel and synthetic insulation.

### *3.3.1 Summary of life cycle assessment findings for each retrofit project*

*Bridge Street, Clifden, County Galway (68 m², three-storey terrace)*

A derelict stone-walled terrace house was renovated with a new back garden extension. Most interior floors and walls were demolished and replaced with timber, insulation and a concrete slab. The extension, built largely in concrete and block, drove embodied carbon emissions up to 229 kg carbon dioxide equivalent ($CO_2e$)/m², three times higher than the renovation portion alone.

**Table 3.4. TREBUChEt building case study LCA results**

| Project | Location | Area ($m^2$) | Typology | Kg $CO_2e/m^2$ A1–A5 | |
|---|---|---|---|---|---|
| | | | | Retrofit (excluding extension) | Total |
| Bridge Street[a] | Clifden, Co. Galway | 68 | Three-storey terrace | 134 | 229 |
| Castleblayney Fire Station | Castleblayney, Co. Monaghan | 370 | Single-storey terrace and three-storey apartment | – | 234 |
| The Glove Factory | Tipperary Town | 276 | Three-storey apartment | – | 214 |
| Mount Street[a] | Dublin | 587 | Five-storey terrace apartment | 55 | 114 |
| The Quay | Ramelton, Co. Donegal | 291 | Three-storey duplex | – | 257 |
| Reuben Street[a] | Dublin | 95 | Two-storey terrace | 70 | 180 |

[a]**Retrofit works include a new extension.**

*Castleblayney Fire Station, County Monaghan (370 $m^2$, single-storey terrace and three-storey apartment)*

A planned social housing scheme will reuse two protected structures, the Horsemarket and Store Building, dating from 1910. While original stone walls and roof elements will be retained, new slabs, insulation and partitioning will be introduced. Despite design efforts to use low-carbon materials (e.g. ground granulated blast furnace slag concrete, wood fibre insulation), the Horsemarket structure is associated with particularly high levels of embodied carbon emissions due to its single-storey form and heavy new slab, contributing to an overall footprint of 234 kg $CO_2e/m^2$.

*The Glove Factory, Tipperary Town (276 $m^2$, three-storey apartments)*

A 1930s glove factory was converted into six apartments as part of a heritage-led regeneration project. The stone envelope and windows were retained, and a new ground floor slab and stair core were constructed from concrete and block. The upper floors were framed with steel joists attached to the pre-existing masonry walls. Floors emerged as the main carbon hotspot, with steel joists and fire-rated partitions raising emissions. Overall, the relatively high level of embodied carbon emissions (214 kg $CO_2e/m^2$) highlights the difficult trade-offs between fire safety standards and carbon reduction.

*Mount Street, Dublin (587 $m^2$, five-storey Georgian terrace)*

Part of the former Georgian House Museum, this retrofit reinstated four large apartments. Minimal intervention in the original structure meant emissions for the renovation alone were exceptionally low, at 55 kg $CO_2e/m^2$. However, rear extensions for kitchens and bathrooms, built from concrete and steel, raised the combined footprint to 114 kg $CO_2e/m^2$. The project demonstrates the carbon benefits of retaining historic fabric, while also showing how extensions can quickly increase impacts.

*The Quay, Ramelton, County Donegal (291 $m^2$, three-storey duplex)*

A former warehouse, vacant for 7 years, was adapted into two duplex units. Heavy use of concrete in new upper floors and blockwork support walls led to an embodied carbon intensity of 257 kg $CO_2e/m^2$, the second highest in the catalogue. Flood-proofing measures, including an elevated concrete ground floor slab, were necessary but carbon intensive, reflecting trade-offs between resilience and decarbonisation.

*Reuben Street, Dublin (95 $m^2$, two-storey terrace)*

This Victorian terrace was retrofitted with an open-plan interior and a rear kitchen extension. The renovation remained relatively light (70 kg $CO_2e/m^2$), but the extension registered a large footprint, of 492 kg $CO_2e/m^2$, driven by concrete walls, a new steel frame and large glass openings, meaning that, overall, embodied carbon emissions amounted to 180 kg $CO_2e/m^2$. Design choices, particularly open floor

plans and expansive glazing, strongly influenced the project's carbon footprint.

### *3.3.2 Life cycle assessment findings for adaptive reuse of vacant or derelict buildings*

The LCAs demonstrated that the extent of intervention was the strongest factor influencing embodied carbon outcomes. Projects that retained most of their original structure consistently showed lower emissions, benefiting from avoiding demolition and reducing demand for new materials. By contrast, retrofits involving substantial replacement or structural additions recorded higher levels of embodied carbon emissions per $m^2$, at times approaching those of new construction. This highlights that adaptive reuse is not inherently associated with low carbon emissions; its advantages depend heavily on the scope of the works carried out.

Design decisions also had a clear impact. Architectural choices such as wide spans, open-plan layouts, cantilevers and large glazed openings often required material-intensive or technically complex solutions.

These design strategies, while offering architectural flexibility, carried a significant carbon cost. In several cases, redundant or inefficient structural elements further amplified impacts on embodied carbon emissions, underscoring the importance of careful design integration.

Material selection was another defining factor across the case studies. Structural steel and *in situ* concrete emerged as recurring carbon hotspots, particularly when used in large quantities to replace existing load-bearing elements. Insulation also played a disproportionate role: despite representing a relatively small share of overall mass, its petroleum-based composition meant that it consistently ranked among the highest contributors. This illustrates the broader tension between reducing operational energy use and managing embodied emissions.

When compared with new construction (Figures 3.3 and 3.4), these findings demonstrate that adaptive reuse can deliver substantial carbon savings, but only if interventions are restrained, design choices are carefully considered and material hotspots are addressed.

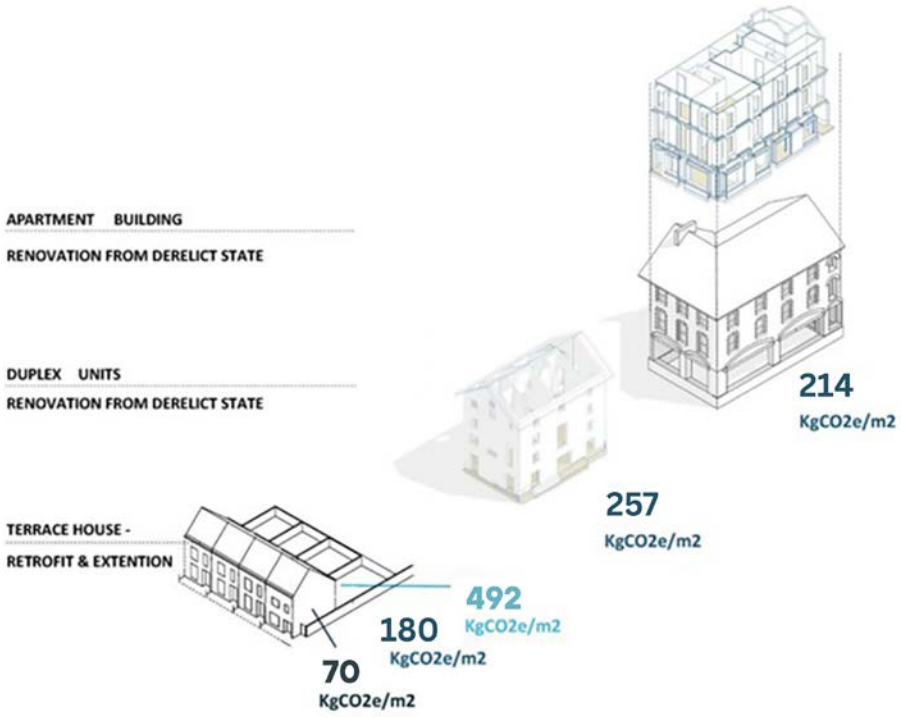


**Figure 3.3. Embodied carbon emissions (A1–A5) for three of the six TREBUChEt case studies (top to bottom: the Glove Factory, the Quay and Reuben Street) with values for the terraced house on Reuben Street (bottom) corresponding, from left to right, to the original house, the overall average and the extension.**

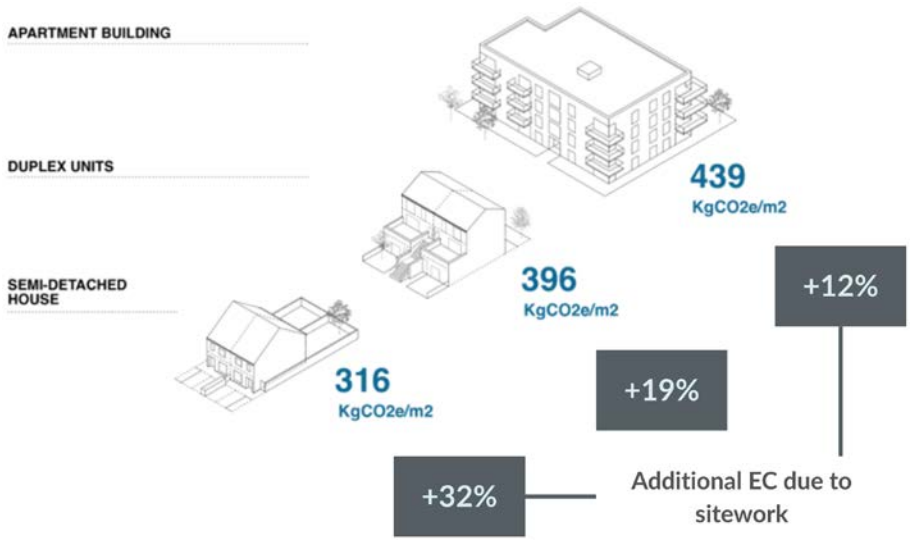


**Figure 3.4. Embodied carbon emissions (A1–A5) of new-build equivalents of the TREBUChEt case studies from the Reducing Emissions through Compact Urban Growth in Ireland (RE-CUGI) project funded by the Sustainable Energy Authority of Ireland, excluding site costs, which are provided as percentage values to be added to attain total embodied carbon costs (siteworks include infrastructure and landscaping). EC, embodied carbon.**

## 3.4 Life Cycle Assessment Methodology at the Neighbourhood Scale

This study applied LCA to compare two development strategies at the neighbourhood scale: brownfield reuse with infill construction and greenfield development of equivalent floor area. The objective was to evaluate how adaptive reuse and compact urban growth influence carbon outcomes.

The methodology builds on the framework proposed by Slabik *et al*. (2022), which adapts building-level LCA (EN 15.978) for application at broader spatial scales. In this approach, individual building LCAs first establish a catalogue of environmental impacts across key typologies. These results then serve as proxies for modelling neighbourhood scenarios, ensuring consistency and scalability across different contexts.

Two scenarios were assessed for each neighbourhood (see Figure 3.5):

1. **Brownfield scenario:** retrofit of existing vacant buildings combined with new infill construction.
2. **Greenfield scenario:** entirely new construction of equivalent floor area on undeveloped land.

This methodology accommodated neighbourhoods with both newly constructed and retrofitted buildings, ensuring scalability (Figure 3.6). LCAs were conducted for individual buildings representing various typologies and types. These typologies served as proxies to estimate environmental impacts at the neighbourhood scale. The analysis considered two types:

1. **Retrofit projects:** proxies were based on the building case studies from Deliverable 3.1 of the TREBUChEt project,[7] with LCA results covering life cycle modules A1–A5 for the existing retrofitted portion of the building, excluding any extensions where applicable (see Table 3.4).
2. **New construction projects:** proxies were drawn from a catalogue developed through the Reducing Emissions through Compact Urban Growth in Ireland (RE-CUGI) project,[8] including additional infrastructure, with LCA results for modules A1–A5.

7 Deliverable 3.1 of the TREBUChEt project assessed the embodied carbon emissions of six residential retrofit projects located throughout Ireland representing a variety of building typologies. Several were vacant or derelict for extended periods prior to their renovation. The Deliverable 3.1 report can be found on the project website (https://www.ichec.ie/academic/research/trebuchet).

8 The RE-CUGI project is funded by the Sustainable Energy Authority of Ireland and is led by UCD in collaboration with the IGBC. It focuses on whole-life carbon assessments of new and existing buildings (2023–2026).

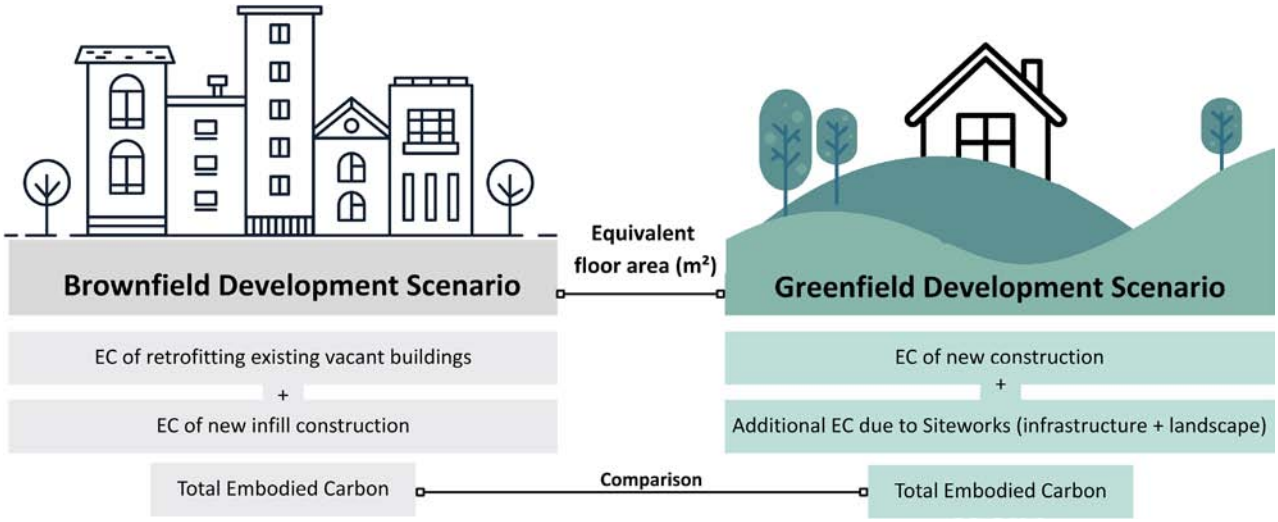


**Figure 3.5. Diagram illustrating the approach followed in this study. EC, embodied carbon.**

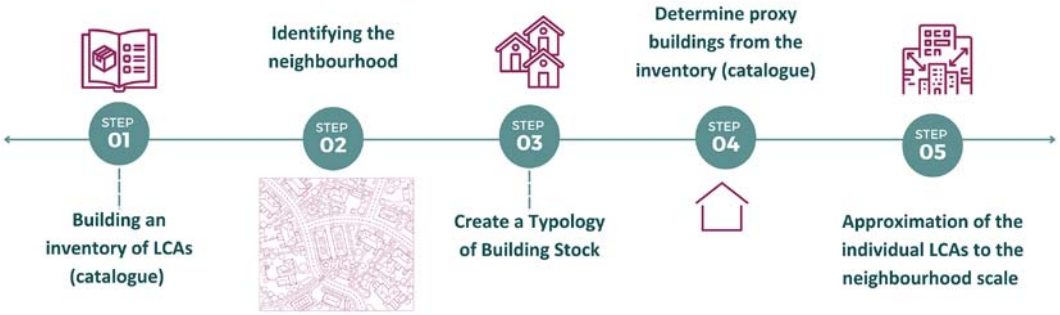


**Figure 3.6. Diagram illustrating neighbourhood-level LCA methodology.**

Although the LCA results catalogue includes both A1–A3 and A1–A5 stages, this study used A1–A5 to enable a consistent comparison with a parallel project on new construction, for which results were already prepared using the A1–A5 stages.

Two neighbourhoods were selected within Ballina and Monaghan Town, each consisting of a mix of vacant buildings and opportunities for new infill construction. The proposed scenario involves renovating existing vacant buildings and introducing new infill development to support compact urban growth. Within each neighbourhood, buildings were categorised to align with the proxy typologies. New construction typologies were classified based on building form and materials (e.g. Typology 1, Typology 2, Typology 3). Retrofit typologies were classified according to the existing building type and the level of retrofit required.

Neighbourhood buildings were matched to proxy typologies from a catalogue developed by the project team. Where detailed architectural drawings were unavailable, approximate gross internal area (GIA) was derived using initial sketches or scaled measurements in software such as AutoCAD. Finally, each neighbourhood building was assigned a proxy from the LCA catalogue. The LCA result of the matched proxy was then multiplied by the building's GIA to calculate its estimated carbon impact.

An Excel sheet was created to systematise the methodology, ensuring consistency across neighbourhoods with varying scales and characteristics.

## 3.5 Life Cycle Assessment Results at the Neighbourhood Scale

This study was carried out for both Ballina (Figure 3.7) and Monaghan Town to compare the carbon impacts of brownfield and greenfield development. Across both towns, the results reveal a consistent pattern: reusing existing buildings and infrastructure dramatically


**Figure 3.7. LCA results at neighbourhood scale for Ballina, Co. Mayo. Top: reuse of existing buildings; bottom: comparison with greenfield new build for equivalent area. EC, embodied carbon.**

lowers embodied carbon emissions, while new construction on greenfield sites drives emissions sharply upwards. It was assumed that the brownfield site would already benefit from existing infrastructure, whereas additional carbon impacts from siteworks were included in the greenfield scenario.

In Ballina (Figure 3.8), the brownfield retrofit scenario produced an estimated 436 t$CO_2$e, compared with 1318 t$CO_2$e for an equivalent greenfield development. In Monaghan Town (Figure 3.9), where the brownfield scenario combined retrofitting with new infill, total embodied emissions amounted to 1651 t$CO_2$e, which is far lower than the 2871 t$CO_2$e associated with the greenfield development. In both contexts, the absence of pre-existing infrastructure in greenfield locations proved significant, as carbon-intensive siteworks and new construction materials pushed the footprint substantially higher.

Taken together, these findings demonstrate the extent of the carbon savings that can be unlocked when development is channelled back into existing town centres. Prioritising brownfield strategies, through adaptive reuse and sensitive infill, avoids the high carbon costs of entirely new construction while making full use of existing infrastructure. At the scale of neighbourhoods or urban blocks, this approach delivers more than embodied carbon emission savings. Compact urban growth reduces transport emissions by promoting proximity to services, workplaces and public transport, while also curbing urban sprawl and preserving natural or agricultural land, by minimising carbon-intensive change.

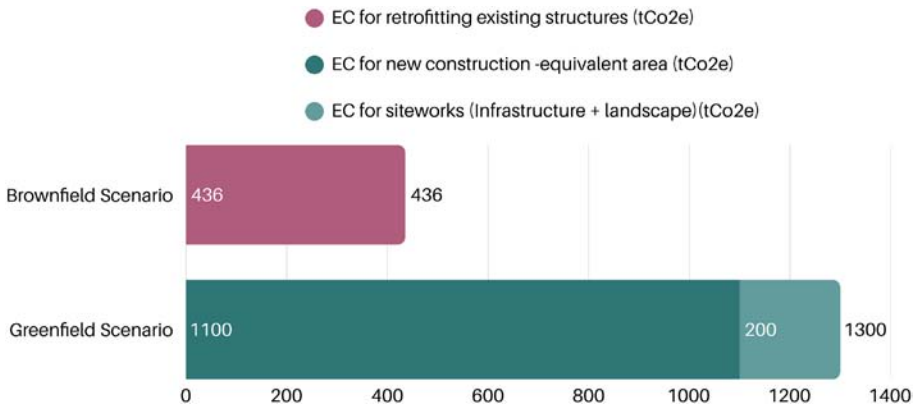


**Figure 3.8. LCA results for Ballina at the neighbourhood scale. EC, embodied carbon.**

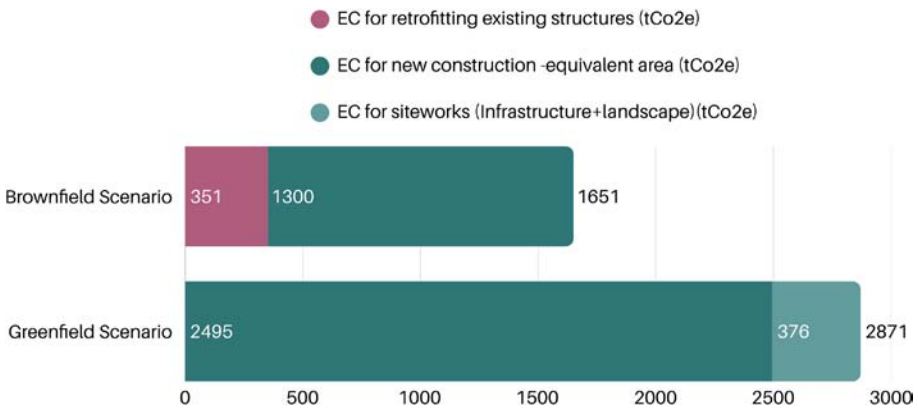


**Figure 3.9. LCA results for Monaghan Town at the neighbourhood scale. EC, embodied carbon.**

Although this study focuses on embodied carbon emissions in construction, the additional benefits of avoiding land use change and reducing transport demand further strengthen the case for revitalising town centres. The consistent results from Ballina and Monaghan Town underline a clear message: compact, brownfield-led development is a powerful pathway for reducing emissions, supporting sustainable communities and advancing Ireland's low-carbon future.

# 4 Incentivising the Adaptive Reuse of Vacant Town Buildings

The policy component of the project covered a desk study of policies, interviews with stakeholders, property clinics with property owners and policy workshops with stakeholders (see Tables 4.1 and 4.2). This chapter reports on the interviews, property clinics and workshops, with further details (including the policy review) available in the technical reports on the project website (https://www.ichec.ie/academic/research/trebuchet).

## 4.1 Methodology

### *4.1.1 Stakeholder engagement, interviews and property clinics*

A limited but targeted set of interviews ($n = 13$) was conducted for the three case study locations: Ballina, Monaghan Town and Tipperary Town (see Table 4.2). Ten of these interviews took place in the context of property clinics, which were organised in collaboration with local stakeholders and advertised on social media channels and to which owners of vacant properties were invited to attend. This was possible for Ballina and Tipperary Town but was not possible for Monaghan Town at the time of the research on the advice of Monaghan County Council. Therefore, the Monaghan Town case study was based on three local policymaker interviews and a site visit led by a local planning officer. This was in addition to multiple informal meetings and site visits for the other two locations.[9]

Table 4.1 details the context of the stakeholder and site visits during which the property clinics and interviews took place.

For the property owners, an interview question sheet was prepared in advance, along with an information sheet and consent form. The interviews sought to identify and understand the challenges and barriers associated with traditional and existing ownership issues that hinder the repurposing of vacant buildings. In addition, it covered property owners' interest in sustainably retrofitting their building(s) and their awareness of the circular economy. Their participation was largely driven by national policies to incentivise reuse and penalise vacancy and dereliction, as well as the actions of councils to acquire vacant properties by compulsory purchase order. In other cases, the property, or at least a portion of it, was already planned to become the primary home of the participant. Interviews ranged in duration from 30 to 60 minutes.

The property clinics took place in person in accessible public buildings in the town centres of Tipperary Town and Ballina and were co-organised by local authority staff. In addition, the second property clinic in Ballina formed part of an extended retrofitting workshop, with talks being given by representatives from DHLGH and the Housing Agency.

Interviews were recorded and then transcribed, with transcriptions being corrected during a subsequent listen-through. The corrected transcripts, with associated images and field notes, were then imported into MAXQDA software and analysed for recurring themes, patterns and associations, following a Grounded Theory approach (Glaser and Strauss, 2009).[10]

### *4.1.2 Policy workshops*

Two 1-hour policy workshops were held online in May 2025, inviting participation from the project stakeholder working group, the EPA steering committee for the project, and relevant national departments and agencies with responsibility for the built environment and housing. A total of 42 people were invited and

9 UCD ethics approval reference LS-LR-24-233-Crowe was received for stakeholder engagement and interviews.

10 Grounded Theory is an interactive, recursive process that aims to generate theory primarily from qualitative data (Bryman, 2012, p. 240). In this study, given that it is a relatively small component of a wider project, it was used to generate concepts and ideas that were then related to the other components (LCA case studies and policy workshops).

**Table 4.1. Summary of the engagement activities carried out for each of the three towns**

| Location | Engagement method | Stakeholder | Activity objective | Date |
|---|---|---|---|---|
| Monaghan Town | Two informal online (Zoom) meetings | Planner with Monaghan County Council | Discuss the details, objectives and An Bord Pleanála's rejection of the Dublin Street North and South Dublin Street and Backlands Regeneration Project. | December 2023 |
| | Site visit (in person) | Planner with Monaghan County Council | Facilitate firsthand observation of the Dublin Street area. | 7 December 2023 |
| | Online (Zoom) semi-structured interview | Town regeneration officer from Monaghan County Council | Discuss vacant and derelict properties in Monaghan Town, focusing on ongoing research projects and the implementation of governmental grants for their revitalisation. | 25 June 2024 |
| | Online (Zoom) semi-structured interview | Planner with Monaghan County Council | Understand the challenges and opportunities associated with compact urban growth in Monaghan Town. | 27 June 2024 |
| | Online (Zoom) semi-structured interview | Architect (private) who has worked on redevelopment plan for Dublin Street area | Understand the challenges of revitalising vacant properties in Monaghan Town, focusing on the Heritage Council-funded project at No. 24 Dublin Street (Sherry's) and broader urban regeneration efforts. | 5 November 2024 |
| Tipperary Town | Site visit (in person) | Task force revitalisation manager | Facilitate firsthand observation of the town centre and recent projects. | 28 July 2023 |
| | Property clinic (in person) | Property owners | Identify current barriers and challenges to bringing vacant properties back into use. | 26 June 2024 |
| Ballina | Property clinic, site visit (in person) | Property owners | Identify current barriers and challenges to bringing vacant properties back into use. | 26 July 2024 |
| | "Reimagining Retrofit & Remaking Town" event (in person) | Property owners, architects and planners from Mayo County Council | Offer participants an opportunity to engage in discussions about the potential of adaptive reuse and explore retrofitting possibilities across various scales. | 12 December 2024 |
| Online | Online (Zoom) policy workshops | Stakeholder working group, policymakers from case study area, national agencies and government departments | Map out policy priority areas across several themes at the building, neighbourhood, regional, national and European scales. | 6 and 13 May 2025 |

**Table 4.2. Participant details for the three case study locations**

| Participant code | Activity | Date | Role | Location |
|---|---|---|---|---|
| INT_BC1 | Property clinic | 26 July 2024 | Property owner | Ballina |
| INT_BC2 | Property clinic | 26 July 2024 | Property owner | Ballina |
| INT_BC3 | Property clinic | 26 July 2024 | Property owner | Ballina |
| INT_BC4 | Property clinic | 12 December 2024 | Property owner | Ballina |
| INT_BC5 | Property clinic | 12 December 2024 | Property owner | Ballina |
| INT_BC6 | Property clinic | 12 December 2024 | Property owner | Ballina |
| INT_M1 | Interview | 25 June 2024 | Vacant homes officer (Monaghan County Council) | Monaghan Town |
| INT_M2 | Interview | 27 June 2024 | Planner (Monaghan County Council) | Monaghan Town |
| INT_M3 | Interview | 5 November 2024 | Architect (private) | Monaghan Town |
| INT_TC1 | Property clinic | 26 June 2024 | Property owner | Tipperary Town |
| INT_TC2 | Property clinic | 26 June 2024 | Property owner | Tipperary Town |
| INT_TC3 | Property clinic | 26 June 2024 | Property owner | Tipperary Town |
| INT_TC4 | Property clinic | 26 June 2024 | Property owner | Tipperary Town |

8 people attended the first workshop and 10 people attended the second, in addition to the project team (5 team members attended each workshop).[11] The two workshops were identical, providing two separate opportunities to attend and therefore facilitate better attendance. Held via Zoom, they comprised a presentation of the project findings, an opportunity to discuss or ask questions and a digital whiteboard-based activity using Miro software.

The three areas covered in the presentation were barriers to adaptive reuse of vacant and derelict town buildings (based on the property clinics and interviews), the catalogue of LCA studies and district-scale LCA case studies for the three case study towns. Some of the participants, such as those from our stakeholder working group, had advance knowledge of the emerging research findings, while for others this was their first contact with the project aside from the information sheet sent in advance. Therefore, questions focused on both specificities and generalities, and were balanced between low-carbon retrofitting and the challenges identified during the property clinics in the case study towns.

The interactive part of the workshops sought informed opinions from stakeholders on areas of priority for policy and research at the building and neighbourhood scales, and the regional, national and European scales. A virtual table was provided, with the *y*-axis organised by scale and individual unordered placeholder boxes being shown on the *x*-axis. Participants were provided with virtual colour-coded thematic sticky notes, which they were invited to place on a virtual whiteboard. The D5.1 report (on the project website: https://www.ichec.ie/academic/research/trebuchet) provides images of the four completed whiteboards from the workshops. The whiteboards and moderator notes were used to create a structured table of findings, which have been grouped under thematic headings as recounted in section 4.2.3.

## 4.2 Results

The three sets of data are discussed below: interviews with local authority planners and a private architect; interviews that took place in the context of property clinics in Ballina and Tipperary Town in 2024; and the results of the policy workshops in May 2025.

### *4.2.1 Monaghan Town interviews and site visit*

These preliminary discussions explored challenges related to the Dublin Street North Regeneration Project and the South Dublin Street and Backlands Regeneration Project, including their rejection (JA18.322.359) by An Bord Pleanála (now An Coimisiún Pleanála). Other topics included the projects' alignment with compact urban growth principles and the potential use of LCA to evaluate their environmental, social and economic impacts.

High levels of vacancy and dereliction were visible along both sides of Dublin Street. Quantitative data revealed significantly lower levels of vehicular traffic on Dublin Street than other locations. This suggested a pattern of north–south traffic flow through the town centre, with east–west traffic primarily utilising Broad Road. Park Street also exhibited high levels of vacancy and dereliction and traffic during the site visits. The historic core, including The Diamond (Figure 4.1), had visible vacancy.

Glaslough Street also had vacant properties and significant vehicular traffic. The courthouse area had higher levels of pedestrian traffic than other areas, particularly near the car park to the east. Public events, such as the farmers market, increased pedestrian movement in this area.

*INT_M1, vacant homes officer*

**Variability in local authority implementation.** The meeting highlighted the variability in how local authorities implement national policies, specifically regarding vacant homes and derelict properties. The roles and responsibilities of vacant homes officers, as well as the structures of town regeneration teams, differ considerably. This participant noted a disparity in the uptake of the Vacant Property Refurbishment Grant between rural and urban areas. Rural residents, particularly farmers, appear to be more proactive

11 The online workshops followed Chatham House rules, according to which neither the identity nor the affiliation of participants should be revealed. Hence, the affiliations here are described in general terms as being from a range of relevant national agencies and case study local authorities.

**Figure 4.1. Western Arms Hotel on The Diamond, Monaghan Town, December 2023. Credit: Liam Heaphy.**

in utilising government grants, possibly due to their familiarity with such programmes.

**Barriers to adaptive reuse.** The meeting identified several barriers to the adaptive reuse of vacant and derelict properties, including complex bureaucratic processes (e.g. solicitor involvement, land registry requirements), financial constraints, reluctance of property owners to engage with authorities and a lack of awareness of available grants and support.

*INT_M2, planner (Monaghan County Council)*

The Town Regeneration Office team's multidisciplinary structure fosters a holistic approach to urban development, but it was noted by this participant that the absence of architects within the team or council can limit the team's ability to address architectural and adaptive reuse challenges effectively. Collaboration between planners and engineers was also recognised as important.

**Urban regeneration strategies.** Practical barriers to sustainable urban regeneration were highlighted. The failed planning submission for the master plan of the area south of Dublin Street, due to the extensive demolition proposed, illustrates the tensions between development, heritage preservation and environmental sustainability. A similar challenge arose at the St Louis convent site, where cost and conservation constraints ultimately prevented the conversion of a former home into social housing, despite the site's redevelopment potential.

**Funding challenges and financial constraints.** Financial incentives and grant programmes, such as the Ready to Build Scheme (DHLGH, 2022a) for serviced sites, were also discussed. The participant noted the limited implementation of schemes like the Ready to Build Scheme, attributing this to the fact that, until recently, prices for second-hand properties were lower than the costs of constructing new buildings, but that this has now changed with rising property prices. Financial constraints emerged as a recurring theme, particularly unit cost limitations imposed by funding bodies that favour greenfield developments over town centre regeneration.

**Vacancy and dereliction.** These remain key challenges in Monaghan Town. The Regeneration Team commissions surveys and collaborates with the housing section to identify derelict properties and carry out redevelopment. However, aggregating derelict properties into viable projects, such as was done in the Clones Scheme (Craftstudio Architecture, 2022), remains difficult.

**Carbon cost versus financial pragmatism.** While there is an aspiration to integrate carbon analysis into decision-making, financial factors remain the dominant driver.

*INT_M3, architect (private sector)*

**Funding and coordination.** The Collaborative Town Centre Health Check and the Town Centre First programmes were referenced as critical frameworks for understanding town centre health and revitalisation strategies. The Heritage Council-funded project at No. 24 Dublin Street was put on hold due to funding constraints and the property owner's concerns about the potentially high costs involved.

**Dublin Street Regeneration Plan (designed by Sheridan Woods in 2017).** The implementation of this plan and its impact on the town centre were discussed. The participant raised concerns regarding the alignment of subsequent developments with the plan's objectives and potential discrepancies in its application.

**Barriers to urban revitalisation.** The participant suggested that barriers include property ownership complexities (e.g. probate issues, absentee ownership and family disputes), the responsiveness of local councils and interdepartmental coordination, cost perception, planning regulations in relation to development pressures and the dominance of car-centric planning.

At the building scale, the participant discussed the challenges of meeting fire safety regulations and energy efficiency standards for renovation projections. Another complicating factor was the complex histories of buildings as a result of haphazard additions and of properties interconnecting over time. For LCA, the participant emphasised the importance of accurate data, including bills of quantities and detailed architectural drawings.

### *4.2.2 Interviews with property owners*

The property owners interviewed provided different perspectives from those of the policymaker and architect interviews described above. Property owners discussed their personal connections to buildings in some cases, and their plans to develop recently acquired property in others, typically with strong family links to the town in question. Four of the properties discussed were in Tipperary Town. Among the owners of these buildings, two resided outside the town, one was returning to the town and the couple who owned the fourth building were living on Main Street. Among the Ballina owners, two lived in the town, a third outside the town, a fourth in neighbouring Castlebar and, finally, three (a couple and an individual) were primarily discussing two properties in nearby Killala, where they also resided. The heterogeneity of the participants lends itself to gathering diverse stories and narratives about the practicalities of restoring vacant and derelict buildings, yet, from these stories and narratives, a number of core themes emerge concerning both the buildings and their context within the town as a living social and physical unit.

*Barriers to adaptive reuse*

Costs associated with redevelopment, related to local market conditions and individual circumstances, were cited as a barrier. Property owners with renovation plans were going ahead with these plans but appealed for further tax breaks (e.g. for town centre buildings) and were critical of taxes and rates on property for which they were searching for viable use prospects. The funding mechanisms cited by participants were the Vacant Property Refurbishment Grant (DHLGH, 2022b), the Repair and Leasing Scheme (DHLGH, 2018), Sustainable Energy Authority of Ireland (SEAI) retrofitting grants (SEAI, 2024) and the aid from councils received through the façade renewal scheme. These existing schemes are transformational, but it was noted that it is very difficult to comply with completion deadlines due to labour and skills shortages. In some cases, price inflation due to grant-adjusted pricing was noted (INT_BC6).

In other cases, the absence of reliable tenants was cited as a barrier. Landlords, whether experienced or prospective, were wary of being stuck with problematic tenants, citing their own or others' anecdotal experiences of tenants with mental health and behavioural issues (INT_BC1, INT_BC2). Squatting was also mentioned (INT_TC1, INT_BC2). Another participant cited having tenants living above a shop as being a security consideration (INT_TC2). This was also mentioned in relation to the Repair and Leasing Scheme, in the sense that this scheme was perceived as means of enabling councils to house the more socially vulnerable and problematic council tenants. This provoked fear of possibly upsetting social relations among established residents:

> Yeah, you see, I wouldn't really be, I wouldn't like to do that. You know what I mean? There's nice neighbours up there as well in the street, so you have to take neighbours into consideration as well. (INT_BC3)

After citing issues with a relative's squatting tenants, a property owner noted the paucity of reliable tenants:

> For our building, people have come looking to rent it, to rent the ground floor and they haven't been what I would call tenants that you would be able to rely on, and we have tried to let it, we are letting only as a whole building let because we can't subdivide it. (INT_TC1)

Issues were also cited regarding the economic viability of commercial tenants in lower-tier businesses like mobile phone shops, charity shops and coffee shops. In other cases, there was a desire to accommodate people who held aspirations with regard to career development, starting a family and contributing to the community, such as "a young couple out on the property ladder" (INT_BC2).

Property owners were also questioned about their willingness to consider collective approaches to streets or urban blocks, in which case participants expressed scepticism about finding agreement and reciprocity among groups of neighbours. Two participants (INT_BC1, INT_BC3) used the metaphor of sports and teamwork, for example:

> Sometimes those things, it's kind of like, so, you know, it's like a sport. If the rest of the team don't turn up, you're on your own. (INT_BC3)

"Holding out" behaviour in the case of long-term vacant properties acquired through inheritance reflects sentimental attachment and complex family relations, with implications for how inheritance is managed. Participants also cited issues with deeds and titles, although these were largely related to pre-independence landholding titles, which were largely ignored thereafter but caused administrative delays for the purposes of property exchange.

In relation to protected structures, owners cited delayed responses from conservation officers and planners as an issue, as well as difficulties in finding commonality on sticking points such as preservation of timber sash windows. This may relate to staffing and resourcing issues rather than objections per se to protected status, and the present set of schemes was considered highly beneficial in relation to addressing the potentially high costs of renovating older buildings.

*Sustainability and heritage*

Participants stated their interest in doing their part to mitigate climate change through improved energy efficiency and reuse of buildings. The property owners interviewed had a relatively high level of awareness of existing grants and their application criteria, with discussion being focused more on the terms and conditions rather than it being a case of the project team notifying the participants of the existence of available grants. Participants were also aware of retrofitting energy grants, and had in mind upgrades such as solar panels, triple-glazed windows, heat pumps and insulation.

While participants understood what was meant by the circular economy, in relation to the "reuse, repair, recycle" principles, the understanding of the embodied carbon aspect was largely related to ensuring homes were energy efficient and not reliant on fossil fuels.

> That would be a major concern. You'd like to see it, in fact, not just that, but also from things like water use and water conservation. … If I ever was to build a new house or new home that you would actually futureproof for both water conservation and energy conservation and … that it would be powered by some sort of renewable sources. (INT_TC2)

At the same time, there was scepticism among some about the pace of change in the building sector in relation to the long-term durability of new building components and the shelf life of promoted technologies, comparing the construction sector to the rush for dairy in the agriculture sector (INT_BC1). Similarly, concerns about asthma and allergies were associated with the trend towards airtight buildings, which may not have sufficient mechanised or passive ventilation for clean air as compared with draughty older buildings:

> And I'd say the windows was [*sic*] left open, probably round the year, whereas it's different now in the houses we've got comfort, so much heat and insulation and airtight and… but yes, there's so many youngsters sick, like you look and see how many the youngsters has asthma, it's frightening. (INT_BC3)

Discussions on heritage and sustainability were invariably interspersed with the idea of inheritance and continuity.[12] It was seen as taboo to sell off family properties without good reason (INT_TC1, INT_BC3, INT_TC4), with family members preferring to seek tenants where necessary or live in the properties themselves.

> It's our family home, so I want to keep it. Yes, I'm not going to sell it, and I'm not going to, you know, it won't be sold when I'm alive. (INT_BC3)

In other cases, property owners were professional developers and consequently they did not have any sentimental attachment to properties that they had purchased on the open market, but they did express similar thoughts on their family properties. In relation to the actual physical qualities of heritage buildings that they value, people cited the thick stone walls and solidity of older town buildings, their proximity to amenities in the town and their compact designs.

### *Urban condition*

Accessibility issues were cited by five of the property owners. Changes reported included the accumulation of infill buildings on rear garden plots and yards that blocked rear access. Multiple ad hoc extensions further limit the potential to create the gardens that people seek when they choose country homes. Indeed, in Ballina, it was apparent from both participants and stakeholders, and from site visits, that the town centre was subdued outside office and retail hours due to the absence of a live-in, multi-generational population.

> [T]he point was to move out and get your own place and that would have been my parents' dream as well certainly my mother's dream to have had a little garden somewhere … (INT_TC1)

> My boys only, well, till they were 10, 11, but, I mean, they wouldn't have had the same lifestyle I had when we were growing up, do you know what I mean? Because the street that that's where them houses are – sure, it was alive with people. You know, it's all changed now. The dynamics has changed. (INT_BC3)

The exodus of urban families to individual homes in the open countryside has been amply studied in relation to the post-colonial complexities of Irish urban heritage (Parkinson *et al.*, 2020; Mulvin, 2021; Heaphy and Scott, 2022; Kayanan *et al.*, 2023). However, as Parkinson *et al*. (2017) discovered, new collective memories of urban spaces are being formed all the time. For example, grand urban dwellings become convents, which become schools, which become arts centres, and so on. Even buildings synonymous with trauma and colonial mistreatment, such as the famine workhouses, have been reutilised in many towns including Tipperary Town and Athlone. An under-studied aspect is that of family linkages to urban space and how they evolve over successive generations.

The legacy of town depopulation, through outward flows of people to the hinterlands, is related to the Celtic Tiger legacy of shopping malls and out-of-town retail parks (see UCD Centre for Irish Towns, 2025). Nevertheless, demand for parking is constant, and participants did not speak out against the conversion of urban space to parking provision so much as decry the lost opportunities to keep retail and amenities within the town boundaries.

> Dunnes were trying to come into the centre of the town and there was uproar and they blocked it, so it was built outside the town. … There's just little things along the way that would make, would have made a massive difference. … And then, yeah, Lidl went up

12 As an aside, these are broadly similar to the Irish language words *dúchas* and *oidhreacht*, reflecting a constellation of cultural inheritance, patrimony, community and continuity.

> there a few years later, and there's nothing, they were all grand with that. If they had the Dunnes in the centre of town it'd bring more people around the town and stuff. (INT_TC4)

The concern in the above case was the contrast between free parking in the out-of-town Dunnes store versus paid parking in Tipperary Town centre. Other places, like Westport, accommodated popular demand by creating free parking zones outside the immediate and congested town centre, which anticipated and deflected resistance for public realm improvements that took back public space (Heritage Council, 2016). Tipperary remains the only route of significance for heavy goods vehicles moving between Limerick and Waterford, and its bypass is still under consultation. The town is infamous for its choking traffic, which provides a further large impediment to its revitalisation (Tipperary Town Revitalisation Task Force, 2022).

Another Tipperary property owner with development plans for town centre housing talked of how schemes for town centre housing could provide investment prospects while alleviating doughnut development (INT_TC3). At the same time, the conversion from ground floor commercial to residential property is not favoured by the community or the Tipperary Town Revitalisation Task Force, given its focus on restoring retail as well as residential vitality. This leads to tensions related to prioritisation for housing such as might be delivered by approved housing bodies versus commercial and mixed use-led revitalisation.

The abandonment by the professional and middle classes of town centres, along with ex-urban retail units, feed into the problems of social deprivation, antisocial behaviour and low market prospects for empty town centre commercial units. Tipperary Town, in particular, has a legacy of social deprivation aggravated by the loss of semi-skilled employment in the 1990s. The visual baggage of poverty itself is increasingly cited as a disincentive to town centre investment:

> You see it depends which town you are talking about, like, if people say but this is very much like a working class area and if you come outside your front door and there is a crowd of people going up and down with runners tucked into their socks and fags, and buggies and all like, you know, just you don't want to be around that kind of thing, you know, whereas if you're in other places you don't have that. You have what you might call more normal people! [chuckles] And you can't give out about that, that's just life, you know? Personally, I wouldn't like living in town the way things stand at the moment. (INT_TC3)

Without fixing the underlying causes of town centre abandonment, attempts to improve liveability through public realm improvements are occasionally thwarted by vandalism and antisocial behaviour, due to the concentration of social deprivation in small areas. One such scheme was the provision of benches and flower arrangements on Kickham Place, just outside an off-licence and opposite a series of vacant buildings, thereby bequeathing day drinkers with a comfortable public space to congregate. This provided an ironic contrast to architects' renderings of such spaces featuring, "with respect, pictures of people like yourselves sitting down, sipping a coffee" (INT_TC3).

### *Urban renewal opportunities*

In Killala, 13 km north of Ballina, the centre is compact but largely empty and bereft of people and full of vacant period buildings sited around a late medieval street morphology (Figure 4.2).

While also suffering disproportionately from outmigration, the town's reduced population is now further dispersed in space, with the community centre being located 500 m south from the town centre and newer housing having been built at lower densities to the north of the village. The small settlement, and region, received a massive employment boost when Asahi Corporation created a large industrial manufacturing plant in the 1970s, but this closed 20 years later.

> My mother and father moved there in the 1970s. When Asahi came and all that. The centre of it is basically hollowed out so it is, and there is a big push to try because it could be quite a remarkable …. It's a really nice village. You have all the amenities you need if you could just get people move there. Put something modern. I like that idea. Because … nobody buys old houses and lives in it. It's how do we make that viable and then sell it, and that has been vacant since. (INT_BC1)

**Figure 4.2. Selection of vacant and utilised townhouses in Killala, near Ballina, Co. Mayo, December 2024. Credit: Liam Heaphy.**

Towns such as Tipperary Town, Ballina (and Killala) and Monaghan Town have retained much of their public amenities, services and hitherto prominent buildings such as banks and other institutions, which could become busier spaces again if they recapture their population. Participants talked of the attractors of people to small urban spaces, namely providing amenities and community without the (perceived) social problems of cities. For others, who had lived formerly in cities like Dublin and Berlin, the exchange of private garden spaces for public gardens and compact walkable spaces was seen as positive.

> I think if you give people that kind of facility, you don't need front and back gardens. That fact is that my own house has a front and back garden and we're thinking about moving to a smaller house, you know? We don't want it. (INT_BC2)

A further attractor of people to towns is the opportunity to downsize from larger hinterland homes to comfortable townhouses instead. A Tipperary Town participant (INT_TC3) provided an overview of urban houses recently returned to residential use in the parts of the town not subject to heavy traffic. Another attractor relates to remote working, with some of the aforementioned professional in-migration linked to remote flexible workers and the provision of remote-working hubs in Tipperary Town. A final, but critically important, attractor of people to towns is family ties. Many participants had roots, from their parents or through their partners, in both the town itself and the rural hinterlands. As such, rural individual houses offered a compelling alternative to people, since they would also fulfil the criteria of being close to family networks and providing generational continuity. These competing attachments between town living and acquiring or self-building a house in the countryside (cf. Heaphy and Scott, 2022) are important considerations when designing incentives.

### *4.2.3 TREBUChEt policy workshops*

The purpose of the workshops was to deliberate on policy recommendations generated from the project in relation to the LCA of retrofitting vacant or derelict town buildings. The findings from the workshops expand on those from the rest of the project, namely those from the LCA case studies, interviews and property clinics. They include findings related to town-planning practices, promoting the liveability and attractiveness of towns, and broader accessibility issues. They are grouped according to their scale of applicability and are summarised in Table 4.3.

**Table 4.3. Summary of key recommendations abstracted from interactive whiteboards and discussion on TREBUChEt findings at policy workshops**

| Scale | Themes |
|---|---|
| Buildings and construction | Building training and apprenticeship capacity for new generations of construction and conservation specialists |
| | Incentivising the use of low-carbon retrofits and materials |
| | Providing greater guidance on and showcasing best practice for the treatment of historic buildings |
| | Revising building regulations and guidance documents to favour low-carbon, careful restoration |
| Town planning | Strengthening community and town-planning capacity |
| | Local authorities and town teams acting as a clearing house for problematic buildings, units and blocks |
| | Ensuring better horizontal integration across schemes, departments and teams |
| | Improving the liveability, walkability and attractiveness of towns |
| National/European | Strengthening incentives and penalties to favour the careful restoration and adaptive reuse of town centres |
| | Showcasing and supporting best practices for town centre planning |
| | Consolidating a national database of buildings linked to BRPs |

*Buildings and construction*

### Building training and apprenticeship capacity for new generations of construction and conservation specialists

**The lack of specialised skills** for conservation was raised as a concern, including in relation to the interpretation of regulations and following best practices. The distribution of that expertise can differ across regions, including within local authorities according to one participant. This pointed to a lack of expertise within both the private sector and local authorities in handling the complexities of retrofitting older buildings.

The need for **dedicated training and upskilling opportunities for architects and engineers** across regions was strongly advocated by a participant. Addressing this skills gap requires national investment in training programmes for architects, engineers, planners and tradespeople specialising in sustainable conservation and retrofitting.

### Incentivising the use of low-carbon retrofits and materials

The **higher cost and limited availability of certified low-carbon and sustainable materials** was raised during a discussion about material incentives, and it was noted that this presents a significant economic barrier for many property owners, especially those with tight budgets or negative equity. Tax incentives were proposed and issues with certification were raised. The high cost of certified sustainable materials and the challenges for local manufacturers to meet certification standards were highlighted as major barriers. The limited return on investment when refurbishing older properties, especially those in negative equity or with very low value, may rule out the use of premium-priced sustainable materials. There is consequently a need to examine the economic viability of low-carbon materials. This will also depend on design and location.

**Insurance costs and risk assessment can also drive up costs**, such as where risk is held by private consultants who then prefer to mitigate this risk ownership by demolishing and rebuilding to current regulations with associated high carbon and financial costs. A further barrier is the difficulty in obtaining **reliable and comprehensive information about the fabric of existing buildings**. The lack of such details makes accurate LCA and informed design decisions challenging.

### Providing greater guidance on and showcasing best practice for the treatment of historic buildings

While there has been more guidance of late in relation to DHLGH reports and Heritage Council initiatives (DHLGH, 2023, 2024a), it was suggested that further efforts could be made in relation to showcasing and advising on the heritage restoration of town buildings. Participants considered during the meeting whether there is a correlation between protected structures and vacancy in Ireland. This was not tested in the original spatial study, where the primary correlation found was

that between vacancy and terraced town buildings, which are by default more likely to be in town centres given the legacy of low-density edge development.

Further support at the block level that might be considered would be integrating heritage restoration with renewable energy programmes, with the *comunidades energéticas* or "energy communities" programme in Spain (IDAE, 2021) being cited as having potential for supporting heritage restoration.

A further consideration mentioned by multiple participants was the importance of having more resources to provide **initial help and consultation** at the pre-planning stage. This support would comprise both digital support and face-to-face interactions, first with people who can act as the equivalent of an SEAI One Stop Shop and provide assistance with identifying appropriate grants for a given property or properties and second through using a decision tree to help navigate the plethora of grants available. It was noted that a rationalisation of grants might also reduce complexity.

#### Revising building regulations and guidance documents to favour low-carbon, careful restoration

Regulatory inflexibility was cited by several participants as a barrier to adaptive reuse. Fire safety regulations and building standards, often geared towards new builds, are perceived as overly restrictive and lacking nuanced guidance for the complexities associated with retrofitting historic and older structures. This can lead to unnecessary interventions and higher costs. An example given was that of appropriate ventilation design for former shopfronts converted to residential use, where guidance is required.

### *Town planning*

#### Strengthening community and town-planning capacity

In the case study locations, the project team observed the value of town-scale regeneration teams tackling long-term dereliction and decline. Participants stressed the importance of providing a "**bridging facility" between the local authority and communities**. There are currently posts being created at the county level to fulfil this capacity, and the importance of the roles of town regeneration officers and the Housing Activation Office were highlighted. The work of these regeneration teams should be **aligned with community well-being and housing objectives for maximum impact**.

New planning schemes of interest include Ready to Build (DHLGH, 2022a) for serviced sites, which might be reconsidered in terms of town centre development, and the inclusion of Land Activation Units as outlined in the 2025 Programme for Government (Rialtas na hÉireann, 2025).

The strengthening of forward planning and design is tied to **community integration and a healthy and productive culture of deliberation**. Participants called for a deliberation culture where proposals can be tabled early in the process, addressing specific concerns such as the loss of parking for traders and providing flexibility to work around the challenges of differing commitments and investments from property owners. The role of **town champions** was highlighted, as well as the potential for **heritage-led development to drive regeneration** forwards.

#### Local authorities and town teams acting as a clearing house for problematic buildings, units and blocks

Drawing on the results presented by the project team at the start of the workshops (see section 4.2), a major barrier identified was the **difficulty of coordinating retrofitting and regeneration efforts among multiple independent property owners** within a block or street. One speaker highlighted the challenge of "getting the owners together to decide on one thing" as a "real important barrier" to meeting objectives such as the implementation of shared infrastructure and holistic improvements. It was also suggested that a team be created at the neighbourhood level to tackle issues such as compliance with fire regulations, conservation of built heritage, waste disposal and collection points, and the provision and maintenance of shared external spaces. This would also alleviate tensions arising from individual arrangements and provide a uniform approach.

Ownership uncertainty and legal entanglements, relating to issues around deeds, titles, inheritance complexities and boundaries, were frequently cited in the interviews as barriers to adaptive reuse

(see the section "Barriers to adaptive reuse" in section 4.2.2 and the D4.1 report).[13] The use of compulsory purchase orders, as experienced in Limerick, was mentioned as a tool for overcoming ownership uncertainty and legal entanglements and creating a "clean slate". The concept of a "clearing house", where the local authority could lead on clearing titles and ownership issues, in addition to dealing with long-standing vacant properties, was reinforced in the discussions. Also cited were instruments such as the Community Right to Buy policies in Scotland and addressing over-the-shop units, with Killaloe and Scariff in County Clare being given as examples of leaders in over-the-shop restoration.

### Ensuring better horizontal integration across schemes, departments and teams

The avoidance of silos was discussed in relation to coordination across agencies, grants, town regeneration teams and regions. While there are the Town Centre First initiative and county-level town regeneration officers, their capacity to build greater levels of coordination is limited. It was pointed out in the workshops that towns in the same locality can have quite different functions and that these functions should be taken into account. There should also be stronger overarching performance metrics and horizontal integration in relation both to the Town Centre First initiative and to town centre regeneration in general across regions and counties.

### Improving the liveability, walkability and attractiveness of towns

This was one of the key emerging topics in the workshops, as it was in the interviews (section 4.1.1), and pertains to **reversing town centre decline** and making town centres attractive to businesses and residents across the social spectrum. In the absence of communities and local authorities taking the lead, participants mentioned that a **vicious circle can emerge from a lack of investor confidence**. Building on the presentation given at the workshops, participants talked of the negative effects of derelict buildings and how a perceived lack of overall improvement in a neighbourhood can erode investor confidence, making individual property owners hesitant to undertake significant retrofitting projects. One speaker shared an anecdote from a town centre living initiative where individuals were hesitant to invest due to the "town going downhill" and uncertainty about the future of neighbouring properties. Concerns about incompatible or undesired use further highlighted the need for a more coordinated confidence-building approach at the neighbourhood level.

Linked to town centre decline are **public realm neglect** and **car dominance, as discussed in the first workshop**. Inadequate investment in high-quality public spaces and long-standing car-centric urban design diminish the attractiveness and liveability of town centres, indirectly impacting the viability of building retrofits. Expanding on earlier discussion in the workshop, the state of the public realm was seen as critical. The observation that town centre blocks often have "quite wide streets" that are "only used for car parking visitors and deliveries" led to the suggestion of re-evaluating this space. The ideas of closing off one side of the square and pedestrianisation were proposed as a way to enhance the desirability of the area and "change the economics of investment" for street-facing urban blocks.

The "**super block**" was mentioned as a potential model for reconfiguring urban spaces (Charmes, 2010; Nieuwenhuijsen *et al.*, 2024). This reconfiguration should expand beyond the buildings' footprints and open up opportunities for the **creative rethinking of backlands, recreation areas and other amenities**. As mentioned in the context of tenant issues, the lack of well-managed communal services like waste disposal and the absence of shared green spaces or amenities can deter potential residents and make town centre living less appealing.

Finally, the general view was that it is the role of local authorities and communities to create the conditions required for town centre desirability and an appropriate social mix. Creating these conditions also involves changing mindsets and showcasing the advantages of town living. Several participants stressed the importance of **age-friendly spaces** and transport for older and younger community members without

13 This was particularly the case in Tipperary Town in relation to the historic Smith-Barry estate and illustrated how antiquated legal structures can create significant obstacles to regeneration and development at a neighbourhood level.

the dangerous presence of rapidly moving heavy urban traffic.

*National/European policies*

**Strengthening incentives and penalties to favour the careful restoration and adaptive reuse of town centres**

While incentives like the Vacant Property Refurbishment Grant are important, they may not adequately address the specific challenges and higher costs associated with deep retrofits and the use of sustainable materials in older buildings. The need for **broader tax incentives and further financial support options** was raised.

It was suggested that further increases to penalties for the owners of vacant and/or derelict properties are needed, as "we know this works". As one participant pointed out, the lack of strong disincentives for leaving properties vacant and derelict perpetuates the problem and hinders regeneration efforts. The idea of a "tax bill for this vacancy" was suggested.

**Showcasing and supporting best practices for town centre planning**

The status quo, while slowly shifting, favours the out-of-town individual house in the country or the suburban low-density house with front and back gardens and ample parking. It was highlighted that there is a **bias towards low-density new-build developments** and apprehension about tackling existing buildings. It was stressed that this applies across the social scale, but notably so among the middle and professional classes, including key policy actors themselves.

Overcoming the ingrained preference for suburban living and fostering a renewed appreciation for the social and environmental benefits of town centre living requires a broader cultural shift supported by national campaigns and local initiatives. This should include, it was said, the use of national media outlets like RTÉ to showcase best practices for town renewal and extol the virtues of town living. Participants noted that restoration brings about a virtuous circle, reducing antisocial behaviour, increasing footfall and creating new commercial opportunities.

**Consolidating a national database of buildings linked to building renovation passports**

Participants highlighted **weaknesses in data collection and performance monitoring**. A lack of comprehensive data on the existing building stock's energy performance and embodied carbon emissions, coupled with inadequate monitoring of regeneration initiatives, make it difficult to assess progress and refine policies. This is also discussed in Chapter 6 in relation to further research and BRPs (see also section 1.1).

# 5 Key Messages and Recommendations

This chapter provides a brief overview of the key recommendations in relation to, first, LCA and low-carbon retrofitting and, second, incentives and policies to reduce vacancy and dereliction and facilitate adaptive reuse.

## 5.1 Recommendations for the Life Cycle Assessment of Retrofits

Recommendations at the building (Table 5.1), national policy (Table 5.2) and neighbourhood (Table 5.3) scales are outlined below, building on the empirical work discussed in the preceding chapters.

## 5.2 Barriers to the Adaptive Reuse of Town Buildings

From the research carried out for this project, it is evident that there is a relatively high level of awareness of existing grants and their application criteria and that people are aware and willing to do their part for climate mitigation. However, there was

**Table 5.1. Recommendations for architects and developers at the building scale**

| Recommendation | | Details |
|---|---|---|
| **BLD1** | Educate clients about the importance of reducing embodied carbon emissions | While some clients might only be concerned with a project's cost, others may be receptive or even enthusiastic when it comes to lowering the embodied footprint of their building. Informing clients early on about the importance of reducing embodied carbon emissions can make them more amenable to low-carbon design and help the project set more ambitious targets for reduction. |
| **BLD2** | Carry out a comprehensive survey of the existing structure prior to design | Care should be taken to accurately and meaningfully assess the state of the existing structure to avoid needless demolition of structurally sound elements. Damaged components could perhaps be repaired rather than demolished. While some demolition is likely to be inevitable in a retrofit project, the goal should be to minimise the amount of material that is removed and reintroduced. |
| **BLD3** | Limit the scope of retrofit works and avoid unnecessary demolition | In the case studies, projects that limited the scope of demolition and reconstruction of building elements had significantly lower embodied carbon emissions than those that carried out a greater scale of renovation. While demolition is often unavoidable, care should be taken at the design stage to limit the extent of new material introduced to the building. |
| **BLD4** | Account for embodied carbon emissions at the early stages of design | Integrating embodied carbon considerations from the outset of a project will reduce its final footprint and help avoid costly and time-consuming revisions at later stages. Setting goals for embodied carbon targets from the beginning can help guide the design team to reduce the project's environmental impact. |
| **BLD5** | Ensure that building elements are not over-engineered | Structures must be sufficiently robust to ensure the safety of building inhabitants. However, there is a tendency to size structural elements far beyond the loads that will be placed on them, leading to a significant increase in embodied carbon emissions, especially in the case of structural steel. To avoid this unnecessary carbon surplus, it is important to verify that structural engineers are actually performing appropriate load calculations, rather than simply selecting oversized elements that they know to be well in excess of the requirements. |
| **BLD6** | Carefully consider the carbon trade-offs of design choices | Aesthetic design choices such as large windows, open floor plans or steel cantilevers can greatly increase the embodied carbon footprint of a project. While it is unrealistic to expect a building's aesthetic design to be dictated solely by embodied carbon considerations, designers should meaningfully consider the carbon implications and trade-offs of their design choices. |
| **BLD7** | Prioritise the efficient use of materials | In the context of residential retrofits, embodied carbon emissions generally correlate with the volume of new material introduced to the structure. Therefore, the embodied footprint of the project can be reduced by using new material efficiently and avoiding structural redundancy. For instance, the load-bearing capacity of the existing walls should be utilised rather than introducing an additional load-bearing inner leaf to support the upper floors. |
| **BLD8** | Use materials with lower carbon intensity | The choice of building materials has a major effect on a project's embodied carbon emissions. Architects and builders should prioritise the use of low-carbon materials wherever possible. While structural and/or regulatory demands may impose limitations, a wide variety of low-carbon alternatives that are suitable for most situations are increasingly available on the market. |

**Table 5.2. Recommendations for policymakers**

| Recommendation | | Details |
|---|---|---|
| **POL1** | Establish limits for embodied carbon emissions from the built environment | The most effective means of reducing embodied carbon emissions from the built environment is to establish upper limits on embodied emissions allowed for both retrofit and new-build projects. Limits can be implemented per $m^2$ of internal floor space, per number of bedrooms or based on other metrics that allow for meaningful cross comparison between structures. However, this requires an accurate and transparent carbon-accounting methodology to ensure compliance, as well as reliable data for formulating assumptions. |
| **POL2** | Subsidise EPDs for Irish manufacturers | EPDs are a critical tool in carbon accounting, allowing architects and developers to accurately quantify the embodied emissions of their projects. However, many Irish manufacturers do not have EPDs for their products.[a] Subsidising EPDs will increase their uptake in the Irish construction industry and make Irish products more competitive abroad. |
| **POL3** | Expedite the creation of a national embodied carbon database | Embodied carbon accounting is only as accurate as its underlying assumptions. Policymakers are urged to assist with the ongoing work of the IGBC to develop a national embodied carbon database for building materials on the Irish market. Once established, this database will serve as the baseline reference point for calculating embodied carbon within the built environment. |
| **POL4** | Require justification for building demolition | The TREBUChEt and RE-CUGI projects have shown that the embodied emissions of a retrofitted building are significantly lower than those of a comparable newly constructed building. Therefore, developers should be encouraged to preserve existing structures rather than demolish them. Requiring a justification for demolition will ensure that buildings are not needlessly demolished and will incentivise developers to utilise and adapt existing structures to fit their needs. This is now standard practice in places such as London and the Brussels-Capital Region, and also in some local authorities in Ireland such as Dún Laoghaire Rathdown County Council. |
| **POL5** | Require embodied carbon calculations prior to planning approval | This recommendation is in line with the recently revised EU Energy Performance of Buildings Directive, which stipulates that whole-life carbon calculations will be required for all new buildings by 2030. Requiring embodied carbon calculations prior to planning approval will ensure that embodied carbon considerations form an integral part of design rather than just being an afterthought. |
| **POL6** | Charge a premium on demolition waste | In the case of building retrofits, projects that carried out greater demolition and reconstruction of building elements had much higher embodied footprints than those that reduced the scope of their intervention. S.I. No. 441/2024 – Circular Economy (Waste Recovery Levy) Regulations 2024 already applies a levy of €10/tonne to construction and demolition waste, including concrete, bricks, tiles, glass, plastic and certain types of soil and stone. |
| **POL7** | Nurture the localised production of sustainable construction materials | A significant share of embodied emissions comes from the import of construction materials from overseas. These embodied transport emissions can be reduced by sourcing materials locally, particularly if done in line with the principles of a circular economy. For example, Storm Éowyn in January 2025 felled hundreds of millions of euros worth of timber (O'Brien, 2025), which could yet be harvested rather than left to rot. The domestic production of sheep wool insulation represents another major source of untapped potential for growing the bioeconomy while at the same time producing a carbon-negative alternative to petroleum-based materials.[b] |
| **POL8** | Incentivise the use of low-carbon materials | Although several incentivisation programmes are in place to reduce operational emissions, there are currently no national incentives for the use of low-carbon materials.[c] Incentivising the use of low-carbon construction materials will both increase their uptake in the industry and bolster the growing market for sustainable building products. |

**[a]The IGBC's EPD campaign website states that "Whilst many manufacturers in Ireland are developing EPD many don't, because they say they are not asked. By publicly committing to promote the use of EPD amongst your staff and in your specifications we can change this" (IGBC, 2026).**

**[b]A feasibility study from the Government of Ireland notes that "insulation is [a market] where the circularity, sustainability and natural credentials [of wool] should earn a premium in the large market for retrofitting homes – and if this could all be achieved without the material leaving the island then that will save on transporting a low-density product" (DAFM, 2022, p. 99).**

**[c]In France, the Environmental Regulation 2020 was introduced in 2022. It sets a threshold for the total embodied emissions of construction materials used in new buildings, with limits set to tighten every 3 years until 2031 (Ministères Aménagement du territoire et Transition écologique, 2025).**

some scepticism about the pace of technological change as well as a limited understanding of embodied carbon emissions as compared with, for example, renewable energy and recycling.

Legacy urban planning issues hinder the market viability of main street adaptive reuse; these issues include out-of-town retail outlets, suburban sprawl, social deprivation and heavy traffic. Experiences

**Table 5.3. Recommendations for neighbourhood-scale retrofits**

| Recommendation | | Details |
|---|---|---|
| **NSR1** | Promote low-carbon design at the neighbourhood level | Encourage building designs that minimise material demand (e.g. avoid unnecessarily large spans, cantilevers or redundant structures) and introduce design review processes that explicitly assess embodied carbon impacts.[a] |
| **NSR2** | Integrate neighbourhood LCA tools into planning | Apply proxy-based LCA models to test different development scenarios (retrofit + infill vs a greenfield equivalent) and use results to guide neighbourhood plans, local development plans and climate action strategies. |
| **NSR3** | Engage communities in compact growth | Involve local residents, business owners and stakeholders in visioning exercises to build support for brownfield reuse. Showcase benefits beyond carbon (revitalisation, walkability, access to services, preservation of green space). |
| **NSR4** | Enable the development of replicable models | Pilot retrofit and infill strategies in selected neighbourhoods, document outcomes and create toolkits for replication across other Irish towns. Share learning between municipalities to scale up compact growth practices. |
| **NSR5** | Prioritise the retrofitting and reuse of vacant buildings | Identify vacant and derelict properties within the neighbourhood through mapping and local surveys. Establish retrofit-first policies for regeneration projects, ensuring retention of existing structures wherever possible. |
| **NSR6** | Support infill development over expansion | Use small-scale infill on brownfield plots to increase density while maintaining existing urban fabric. Avoid low-density greenfield expansion by channelling growth into underused sites within the neighbourhood boundary. |
| **NSR7** | Leverage existing infrastructure | Reuse roads, utilities and public spaces to avoid carbon-intensive siteworks. Upgrade and adapt existing infrastructure rather than replacing it. |
| **NSR8** | Prioritise material efficiency and circularity | Prioritise retention of foundations, floor slabs and structural walls, and promote the use of low-carbon alternatives to concrete and steel; support the reuse/recycling of materials within the neighbourhood. |

**[a]Professional institutes such as the Royal Institute of the Architects of Ireland, the Irish Planning Institute, the Royal Town Planning Institute and Engineers Ireland could develop guidance and a review process that generates a report that must be submitted at the pre-planning consultation stage and/or with the planning application.**

of problematic tenants were cited as disincentives to availing of the Repair and Leasing Scheme and related to broader issues of urban decline and town centre abandonment.

The key findings in relation to barriers to adaptive reuse that emerged from the interviews (as covered in Chapter 4) are thematically grouped in Table 5.4.

Accessibility issues were commonplace, for example in buildings with vacant upper floor units no longer having independent front doors, security concerns in relation to tenants living over shops and a lack of rear access and gardens. Nevertheless, town centres still have the potential to become desirable locations for adaptive reuse due to the proximity of amenities, the opportunities they could provide for people who want to downsize and/or return to town centre homes, the benefits conferred through remote-working trends and hubs, and the opportunities they offer for converting commercial buildings to housing.

**Table 5.4. Thematically grouped findings on barriers to adaptive reuse**

| Theme | Findings |
|---|---|
| Spatial patterns of vacancy and dereliction | Vacancy and dereliction tend to cluster along specific streets or public spaces rather than being evenly distributed. |
| | Streets with poor pedestrian environments or excessive vehicular dominance appear more prone to disinvestment and abandonment. |
| | Targeting interventions at the street or block level, rather than isolated buildings, may be more effective at tackling systemic urban decay. |
| Heritage and built identity | Many vacant buildings are of architectural or historic significance and are critical to the identity of towns. |
| | Adaptive reuse of heritage assets may face disproportionate challenges due to planning constraints, high costs and complexity of ownership. |
| | A lack of public understanding of the value of smaller-scale or vernacular heritage features can contribute to neglect and loss of place identity. |
| Legal, administrative and data challenges | Property ownership is often unclear, with unresolved issues around deeds and titles creating legal and financial barriers to reuse. |
| | There is a general lack of transparency in real renovation costs, especially for complex or protected buildings. |
| | Inconsistencies in local authority structures and operations – such as the differing roles and capacities of town regeneration officers and vacant homes officers – hinder consistent delivery of national policies. |
| | Inadequate data sharing and lack of architectural documentation make reuse assessments (e.g. LCAs) difficult to conduct accurately. |
| Scale and strategic approaches | Addressing vacancy building by building is seen as ineffective where vacancy extends across whole streets or blocks. |
| | Larger-scale neighbourhood approaches could resolve shared management challenges such as bin storage, fire safety and access routes. |
| | Neighbourhood-scale approaches also offer potential for more coordinated and impactful design and planning interventions that realise the full potential of town centres. |
| Funding and policy structures | Adaptive reuse is often less financially attractive than greenfield development, especially under current funding, planning and assessment/accounting frameworks. |
| | There is a need for more nuanced financial models that account for the long-term benefits of revitalising the existing urban fabric. |
| | Bureaucratic complexity and inconsistencies in local policy interpretation undermine trust and engagement among property owners. |
| | Socioeconomic disparities affect the uptake of grant schemes and access to support, leading to uneven regeneration outcomes. |
| Socioeconomic and demographic dimensions | The dominance of a single socioeconomic group in the centre of some towns limits diversity, inclusion and social or commercial activity. |
| | Broader patterns of disinvestment, social fragmentation and economic marginalisation are underlying drivers of abandonment. |
| | A preference for rural detached homes over town centre living remains a strong counterforce, linked to perceptions of comfort, freedom and ownership. |
| | Trends like downsizing and remote working are emerging as important factors shaping future demand, but they are not yet well integrated into regeneration strategies. |
| Stakeholder engagement and governance capacity | Many property owners remain cautious about getting involved in renewal schemes due to perceived risks, costs and red tape. |
| | It is perceived that there is limited coordination between planners, conservation officers, housing staff and community-facing officers within councils. |
| | Community awareness and pride in the built environment vary, and deeper outreach (e.g. lectures, exhibitions) could foster stronger local engagement. |
| | Councils often lack the internal capacity and resources to lead proactive regeneration programmes and facilitate collaboration with researchers or community stakeholders. |

# 6 Conclusion

The TREBUChEt project addressed a key research gap hitherto overlooked in Ireland in relation to the carbon costs of allowing viable town buildings to remain unutilised and fall into disrepair. Since this project was initiated, the ongoing implementation of the EPBD and the importance of reducing emissions from the built environment sector have brought the use of LCA into practice for new buildings. However, the feasibility of meeting targets for the built environment is dependent on the implementation of a successful retrofit programme tailored for the Irish building stock (O'Hegarty *et al.*, 2022).

The current housing crisis, exacerbated by continued economic expansion and population growth, has brought town and rural buildings back into the market, as shortfalls extend into areas characterised by higher levels of town vacancy. The combination of high demand for construction or renovation and growing recognition of the importance of environmental considerations such as greenhouse gas emissions and biodiversity may help to produce a sustainable blueprint for urban development.

## 6.1 Outputs and Further Development

### *6.1.1 Toolkit for life cycle assessments of retrofits*

The project team is working with the IGBC and DHLGH to further refine and disseminate the bespoke methodology developed for retrofit LCAs for town buildings. The project methodology uses the Upfront Carbon Calculator of the IGBC (as well as other tools for drawings and plans). This methodology will be further discussed with the IGBC and DHLGH, to further standardise the national accounting of built environment carbon emissions.

By developing an accessible LCA method for adaptive reuse and retrofit projects, it may be possible to link restoration grants to low-carbon choices of materials. This would encourage property owners and construction specialists to use low-carbon materials wherever possible. Associated BRPs could provide pathways for ensuring that buildings align with climate goals, yet are also cognisant of conservation and heritage policies.

### *6.1.2 Training and guidance*

The methods being developed as part of TREBUChEt and adjacent projects are being integrated into training programmes for future urbanists and building engineers within the MArch programme at the UCD School of Architecture, Planning and Environmental Policy, specifically in module ARCT41210 "Architecture in a Climate Emergency".

The project team is also connected to a broader community of practitioners interested in LCA and will continue to disseminate case studies and methodology, to inform other third-level training programmes in Ireland and Europe. TREBUChEt project partners participated in many peer workshops during the project and afterwards. These include the EPA-funded REBUILD workshop in June 2025, the Digital Academy for the Sustainable Built Environment conference in May 2024 and a workshop for the IGBC project CIRCULAR_BUILD in February 2024. The project team attended these workshops in addition to attending several academic conferences per year and individual meetings with other research teams.

## 6.2 Limitations of the Methodology

At its core, the TREBUChEt project compared the findings of LCA case studies of buildings that are representative of the vacant and derelict properties frequently found in Irish towns with the carbon costs of greenfield new builds. These case studies were then also used to build neighbourhood-scale LCA studies that considered whole urban blocks or components of a given streetscape. However, on their own, the case studies do not speak to the issues that people face in relation to re-animating town centres. The qualitative interviews, site visits and stakeholder engagement activities sought to ensure the policy relevance of the LCA case studies and to inform recommendations on how such considerations of the carbon cost of the

construction sector could be reflected in urban town centre policies.

Our qualitative work was largely focused on property owners and other stakeholders and thus does not reflect the hands-on community planning engagement activities of the Town Centre First scheme, or the detailed building use and traffic studies of the preceding Collaborative Town Centre Health Check programme run by the Heritage Council under Alison Harvey. Other studies (O'Callaghan and Stokes, 2021; O'Callaghan *et al.*, 2023) have explored in greater detail the phenomenon of urban vacancy in Ireland, albeit with an emphasis on cities. Similarly, Stokes and Connolly (2024) looked in particular at unit-level vacancy above shops, an area that was outside the scope of this project, which focused on building- and neighbourhood-scale LCAs. It will be useful for policymakers to analyse the findings of the aforementioned studies, along with those of the similarly funded IGBC project CIRCULAR_BUILD (IGBC, 2025), in tandem with the independently generated, yet similar, findings and recommendations emerging from the TREBUChEt project.

## 6.3 Further Research

We identified several tracks for further research at various scales, as outlined below.

**Neighbourhood-scale case studies**. The LCA work expanded from LCAs of individual buildings to neighbourhood-scale LCAs. With further funding and time, much more could be done on this, including bringing block-level plans to local communities and co-developing urban interventions alongside measuring and reporting on the environmental and social benefits of avoiding demolition and new builds.

**LCA and building renovation passports**. BRPs (see section 1.1) can be critical components of a structural system to support scaled retrofits of town buildings. The EPBD (Directive (EU) 2024/1275) requires that LCA data in relation to BRPs be provided for new buildings only, but Annex VIII to this directive discusses a number of components relevant to this project, namely optimal paths for improving energy performance, data on circularity and component reuse, and data on adaptive reuse potential (European Union, 2024).

**Refining LCA methods to develop a national assessment process for retrofit LCAs**. In collaboration with relevant partners (IGBC, DHLGH, SEAI, Department of Climate, Energy and the Environment, Heritage Council, etc.), the LCA methodology for TREBUChEt (as detailed in D2.2/2.3, and expanded on in D3.1 and D3.2 for case study buildings and neighbourhood blocks, respectively)[14] could be further developed to better calibrate national policy on retrofitting versus new construction, thereby assisting in the development of national policies on the built environment and embodied carbon emissions (O'Hegarty *et al.*, 2022, 2025).

14 Project deliverable reports on LCA (D2.2/D2.3, D3.1, D3.2) – as well as deliverable reports on the spatial analysis of vacancy and dereliction (D2.1), policies and barriers relevant to adaptive reuse (D4.1) and the end-of-project online policy workshops (D5.1) – are available on the project website (https://www.ichec.ie/academic/research/trebuchet).

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# Abbreviations

| | |
|---|---|
| **AutoCAD** | Automatic Computer-Aided Design |
| **BIM** | Building information modelling |
| **BRP** | Building renovation passport |
| **$CO_2e$** | Carbon dioxide equivalent |
| **CSO** | Central Statistics Office |
| **DHLGH** | Department of Housing, Local Government and Heritage |
| **EPBD** | European Performance of Buildings Directive |
| **EPD** | Environmental Product Declaration |
| **GIA** | Gross internal area |
| **GWP** | Global warming potential |
| **IGBC** | Irish Green Building Council |
| **LCA** | Life cycle assessment |
| **QGIS** | Quantum Geographic Information System |
| **RE-CUGI** | Reducing Emissions through Compact Urban Growth in Ireland |
| **RICS** | Royal Institution of Chartered Surveyors |
| **RS100** | A random sample of 100 vacant or derelict buildings from GeoDirectory |
| **SEAI** | Sustainable Energy Authority of Ireland |
| **TREBUChEt** | Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy |
| **UCD** | University College Dublin |
| **WLCA** | *Whole Life Carbon Assessment for the Built Environment*, 2nd edition |

# An Ghníomhaireacht Um Chaomhnú Comhshaoil

Tá an GCC freagrach as an gcomhshaol a chosaint agus a fheabhsú, mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ar thionchar díobhálach na radaíochta agus an truaillithe.

## Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

**Rialáil:** Rialáil agus córais chomhlíonta comhshaoil éifeachtacha a chur i bhfeidhm, chun dea-thorthaí comhshaoil a bhaint amach agus díriú orthu siúd nach mbíonn ag cloí leo.

**Eolas:** Sonraí, eolas agus measúnú ardchaighdeáin, spriocdhírithe agus tráthúil a chur ar fáil i leith an chomhshaoil chun bonn eolais a chur faoin gcinnteoireacht.

**Abhcóideacht:** Ag obair le daoine eile ar son timpeallachta glaine, táirgiúla agus dea-chosanta agus ar son cleachtas inbhuanaithe i dtaobh an chomhshaoil.

## I measc ár gcuid freagrachtaí tá:

### Ceadúnú

- Gníomhaíochtaí tionscail, dramhaíola agus stórála peitril ar scála mór;
- Sceitheadh fuíolluisce uirbigh;
- Úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe;
- Foinsí radaíochta ianúcháin;
- Astaíochtaí gás ceaptha teasa ó thionscal agus ón eitlíocht trí Scéim an AE um Thrádáil Astaíochtaí.

### Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Iniúchadh agus cigireacht ar shaoráidí a bhfuil ceadúnas acu ón GCC;
- Cur i bhfeidhm an dea-chleachtais a stiúradh i ngníomhaíochtaí agus i saoráidí rialáilte;
- Maoirseacht a dhéanamh ar fhreagrachtaí an údaráis áitiúil as cosaint an chomhshaoil;
- Caighdeán an uisce óil phoiblí a rialáil agus údaruithe um sceitheadh fuíolluisce uirbigh a fhorfheidhmiú
- Caighdeán an uisce óil phoiblí agus phríobháidigh a mheasúnú agus tuairisciú air;
- Comhordú a dhéanamh ar líonra d'eagraíochtaí seirbhíse poiblí chun tacú le gníomhú i gcoinne coireachta comhshaoil;
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

### Bainistíocht Dramhaíola agus Ceimiceáin sa Chomhshaol

- Rialacháin dramhaíola a chur i bhfeidhm agus a fhorfheidhmiú lena n-áirítear saincheisteanna forfheidhmithe náisiúnta;
- Staitisticí dramhaíola náisiúnta a ullmhú agus a fhoilsiú chomh maith leis an bPlean Náisiúnta um Bainistíocht Dramhaíola Guaisí;
- An Clár Náisiúnta um Chosc Dramhaíola a fhorbairt agus a chur i bhfeidhm;
- Reachtaíocht ar rialú ceimiceán sa timpeallacht a chur i bhfeidhm agus tuairisciú ar an reachtaíocht sin.

### Bainistíocht Uisce

- Plé le struchtúir náisiúnta agus réigiúnacha rialachais agus oibriúcháin chun an Chreat-treoir Uisce a chur i bhfeidhm;
- Monatóireacht, measúnú agus tuairisciú a dhéanamh ar chaighdeán aibhneacha, lochanna, uiscí idirchreasa agus cósta, uiscí snámha agus screamhuisce chomh maith le tomhas ar leibhéil uisce agus sreabhadh abhann.

### Eolaíocht Aeráide & Athrú Aeráide

- Fardail agus réamh-mheastacháin a fhoilsiú um astaíochtaí gás ceaptha teasa na hÉireann;
- Rúnaíocht a chur ar fáil don Chomhairle Chomhairleach ar Athrú Aeráide agus tacaíocht a thabhairt don Idirphlé Náisiúnta ar Ghníomhú ar son na hAeráide;
- Tacú le gníomhaíochtaí forbartha Náisiúnta, AE agus NA um Eolaíocht agus Beartas Aeráide.

### Monatóireacht & Measúnú ar an gComhshaol

- Córais náisiúnta um monatóireacht an chomhshaoil a cheapadh agus a chur i bhfeidhm: teicneolaíocht, bainistíocht sonraí, anailís agus réamhaisnéisiú;
- Tuairiscí ar Staid Thimpeallacht na hÉireann agus ar Tháscairí a chur ar fáil;
- Monatóireacht a dhéanamh ar chaighdeán an aeir agus Treoir an AE i leith Aeir Ghlain don Eoraip a chur i bhfeidhm chomh maith leis an gCoinbhinsiún ar Aerthruailliú Fadraoin Trasteorann, agus an Treoir i leith na Teorann Náisiúnta Astaíochtaí;
- Maoirseacht a dhéanamh ar chur i bhfeidhm na Treorach i leith Torainn Timpeallachta;
- Measúnú a dhéanamh ar thionchar pleananna agus clár beartaithe ar chomhshaol na hÉireann.

### Taighde agus Forbairt Comhshaoil

- Comhordú a dhéanamh ar ghníomhaíochtaí taighde comhshaoil agus iad a mhaoiniú chun brú a aithint, bonn eolais a chur faoin mbeartas agus réitigh a chur ar fáil;
- Comhoibriú le gníomhaíocht náisiúnta agus AE um thaighde comhshaoil.

### Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta agus nochtadh an phobail do radaíocht ianúcháin agus do réimsí leictreamaighnéadacha a mheas;
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha;
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta;
- Sainseirbhísí um chosaint ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

### Treoir, Ardú Feasachta agus Faisnéis Inrochtana

- Tuairisciú, comhairle agus treoir neamhspleách, fianaise-bhunaithe a chur ar fáil don Rialtas, don tionscal agus don phobal ar ábhair maidir le cosaint comhshaoil agus raideolaíoch;
- An nasc idir sláinte agus folláine, an geilleagar agus timpeallacht ghlan a chur chun cinn;
- Feasacht comhshaoil a chur chun cinn lena n-áirítear tacú le hiompraíocht um éifeachtúlacht acmhainní agus aistriú aeráide;
- Tástáil radóin a chur chun cinn i dtithe agus in ionaid oibre agus feabhsúchán a mholadh áit is gá.

### Comhpháirtíocht agus Líonrú

- Oibriú le gníomhaireachtaí idirnáisiúnta agus náisiúnta, údaráis réigiúnacha agus áitiúla, eagraíochtaí neamhrialtais, comhlachtaí ionadaíocha agus ranna rialtais chun cosaint chomhshaoil agus raideolaíoch a chur ar fáil, chomh maith le taighde, comhordú agus cinnteoireacht bunaithe ar an eolaíocht.

## Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an GCC á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóir. Déantar an obair ar fud cúig cinn d'Oifigí:

1. An Oifig um Inbhunaitheacht i leith Cúrsaí Comhshaoil
2. An Oifig Forfheidhmithe i leith Cúrsaí Comhshaoil
3. An Oifig um Fhianaise agus Measúnú
4. An Oifig um Chosaint ar Radaíocht agus Monatóireacht Comhshaoil
5. An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tugann coistí comhairleacha cabhair don Ghníomhaireacht agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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