

D1.4: Catalogue of Use Cases

SMARTLAB | Work Package 1, Task 1.4

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List of Acronyms

CCI	Carrig Conservation International
CCZ	City Centre Zone
CSO	Central Statistics Office
DIY	Do-It-Yourself
ED	Electoral Division
EU	European Union
GDPR	General Data Protection Regulation
IESRD	Integrated Environmental Solutions Research & Development
LCCC	Limerick City and County Council
SAP	Small Area Population
SMARTLAB	Smart Building Living Lab
SRI	Smart Readiness Indicator
TCL	The Convex Lens
UL	University of Limerick
WP	Work Package

Executive Summary

This Deliverable outlines the Use Cases of the SMARTLAB project. These Use Cases are based on buildings which have been selected by project partners to give an accurate representation of the building stock in the project area in Limerick city. They draw on an analysis of available sources of statistical data on Irish buildings and insights from the project partners' areas of expertise. This Deliverable sets out the process used to identify Use Cases within the project and outlines a schematic of those Use Cases chosen by SMARTLAB partners. Fundamental to the discussion of Use Cases in the project was a decision on the project focus area, as any Use Case would have to fit an area profile once this decision was made. Accordingly, this Deliverable also delineates the process by which the project boundary was agreed.

1 Introduction

This Deliverable outlines the Use Cases of the SMARTLAB project. These Use Cases are based on buildings which have been selected by project partners to give an accurate representation of the building stock in the project area in Limerick city. They draw on an analysis of available sources of statistical data on Irish buildings and insights from the project partners' areas of expertise. This Deliverable sets out the process used to identify Use Cases within the project and outlines a schematic of those Use Cases chosen by SMARTLAB partners. Fundamental to the discussion of Use Cases in the project was a decision on the project focus area, as any Use Case would have to fit an area profile once this decision was made. Accordingly, this Deliverable also delineates the process by which the project boundary was agreed.

Project Use Cases are embedded across the objectives and timeline of the project and are fundamental to project activity by all partners. It was therefore important that partners worked together to agree priorities for Use Cases, and to agree how Use Cases will be harnessed within the project. Use Cases will support the team in making decisions on the types of participants to target for engagement, on the work of sensor installation, and on data analysis towards policy recommendations. They will inform the production of all major outputs of the SMARTLAB project.

Commitments regarding Use Cases in the project are:

T1.4	UL	Generate a number of use cases , which will be utilised across all other WPs to ensure solutions are designed with the end user in mind.
D1.4	UL	Catalogue of Use Cases (Due M6)
T2.3	TCL	Based on the different use cases developed in WP1 address the technical and financial challenges to both city-scale and building level objectives and specifications for the city-scale infrastructure, DIY toolkits and associated software infrastructure.
T3.3	IES	Develop a framework for how to upgrade the SRI of buildings with respect to the different use cases outlined in WP1.
D3.2	IES	Framework for upgrading the SRI of existing buildings linked to DIY toolkits for building owners and operators, taking into account different building types and complexities.
T6.1	UL	Create a framework for data governance and ethics to enable data use across three strands, public, community and business – linked to WP1 use cases – to enable the delivery of public and private shareable datasets in a GDPR-compliant format.
D6.1	UL	Framework for data governance and ethics

2 Use Case Development

It was important to proceed systematically in our decision-making, so that final decisions around Use Cases would be well-founded in existing data and agreed by all partners. The identification of Use Cases was also dependent on the selection of a project study area, and so this Deliverable encompasses a description of the process by which that area was identified and agreed.

2.1 SMARTLAB Project Boundary

Use Cases need to be representative of the project study area, and so the discussions towards identifying SMARTLAB Use Cases were carried out in tandem with partner debate around the project boundary. In the original plan for the SMARTLAB project as represented in the project bid, the project boundary was defined as the Decarbonisation Zone of Limerick city, a spatial area within the city identified by the local authority, in which "a range of climate mitigation, adaptation and biodiversity measures and action owners are identified to address local low carbon energy, greenhouse gas emissions and climate needs to contribute to national climate action targets" (Department of Housing, Local Government and Heritage Circular Letter LGSM01-2021). It was during the scoping work to define Use Cases that partners began to reassess that boundary. Early research into the building and inhabitant data in the Decarbonisation Zone showed a skewed profile which would be unlikely to produce a fully realised study of a typical Irish city. This is because the Decarbonisation Zone (Figure 1) is tightly focused on the extreme inner city, with a preponderance of commercial and office space with few examples of typical residential building typologies.

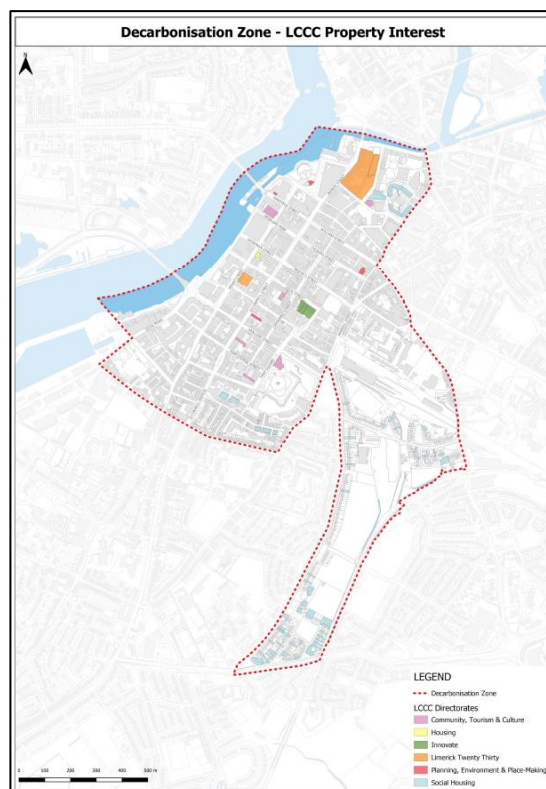


Figure 1. Limerick's Decarbonisation Zone with LCCC property interests displayed.

In order to identify a more representative study area, partners began considering other existing boundaries which could be used. Existing rather than newly created boundaries were prioritised as it was important to identify a solid rationale for any boundary choice, particularly for purposes of communication with the public, as this boundary would define who was eligible to apply for free sensor installation through the project. Other existing boundaries considered included the boundary of the Cellnex network, seen below Figure 2, which is the absolute technical boundary of the project. SMARTLAB sensors will need this network access in order to function.

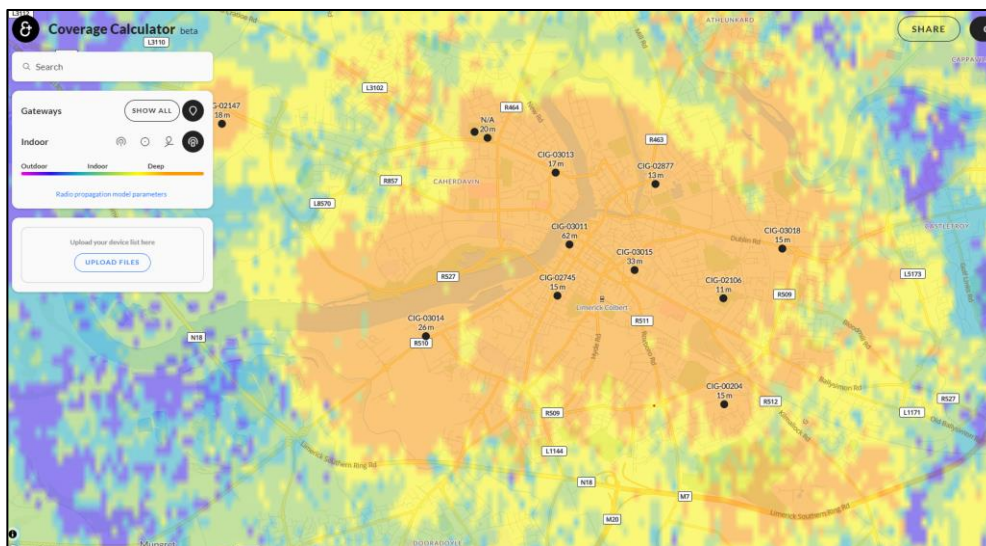


Figure 2. Cellnex gateway coverage across Limerick.

It was apparent that the Cellnex map would not produce an appropriate project boundary, as its coverage was too wide, encapsulating all the large suburban estates of Limerick with thousands of buildings. A study of 100 buildings within this area would struggle to make robust claims about its overall makeup.

Limerick City and County Council (LCCC) suggested that the team consider the City Centre boundary (Figure 3), which is the area defined as the city centre in the Limerick Development Plan 2022-28. As this Plan has a statutory basis, this area definition provided a robust justification. It would also be useful as an analytical unit for future policy focus by the Council. As the City Centre Zone did not conform to boundaries identified by the Central Statistics Office (CSO), partners considered whether to include the adjoining areas – either adjoining Electoral Divisions (EDs) or Small Area Populations (SAPs). CSO data would be crucial to the analytical work of the SMARTLAB project, and using CSO boundaries made it possible to do so clearly. On examination it was decided that adjoining Electoral Divisions were too large an addition to the project study area, but that Small Area Populations would be useful for analysis:

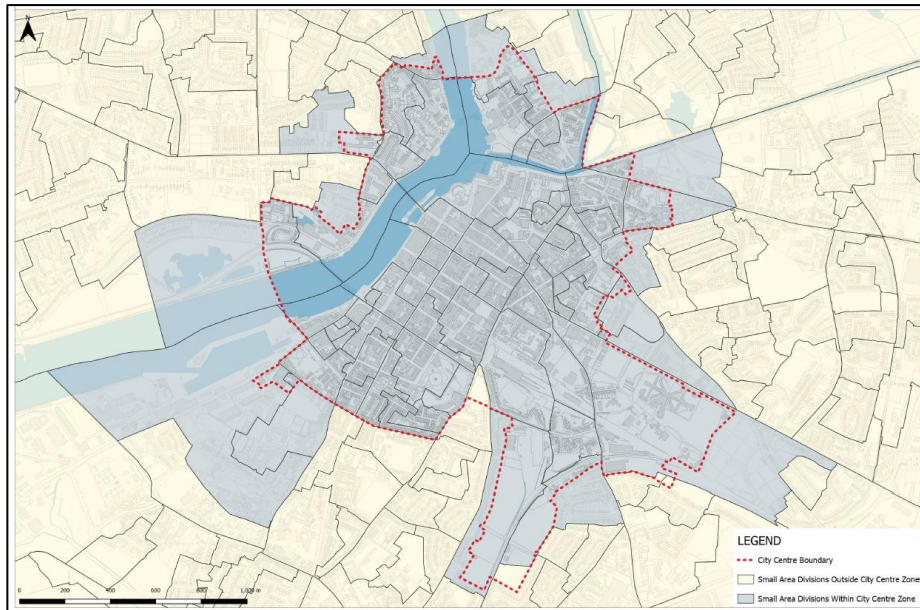


Figure 3. Limerick City Centre Zone with adjoining Small Area Populations shown in grey highlight.

Finally, it was decided that the project would use the City Centre Zone as the public facing map of the project, and that this area remains the primary focus of SMARTLAB activity and research. The adjoining SAPs would remain a secondary focus, with applicants from borderline SAP areas still eligible to join the project. Below is the final project boundary map (Figure 4), which is being used by the project in all public communications:

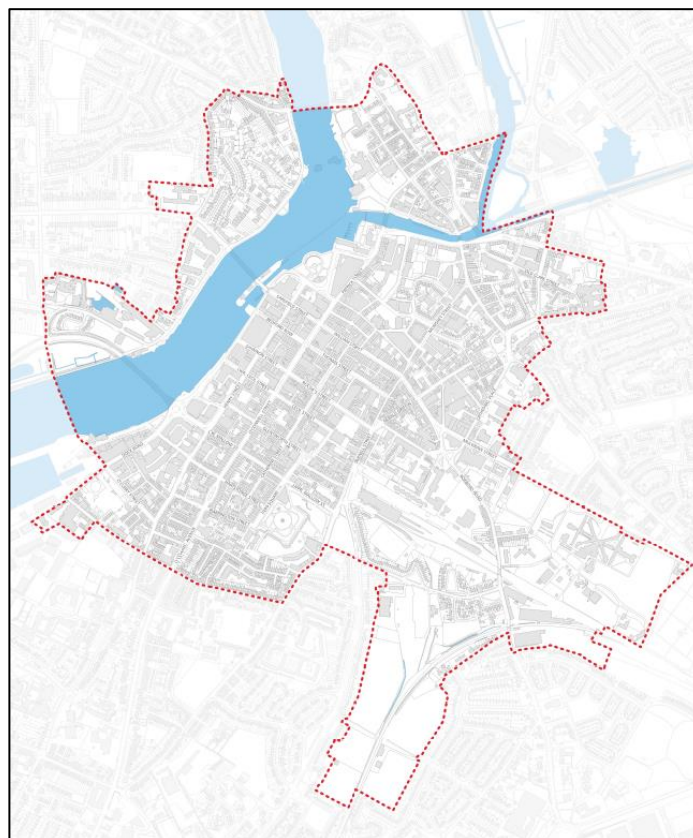


Figure 4. Official boundary map of the SMARTLAB project.

2.2 SMARTLAB Use Case Identification Process

SMARTLAB Use Cases are foundational to the work of the project, determining the work of several Deliverables, in particular **WP3-D2 Framework for upgrading the SRI of existing buildings linked to DIY toolkits for building owners and operators, taking into account different building types and complexities**, and **WP6-D1 Framework for data governance and ethics**. The ramifications of the choice of Use Cases will be felt throughout the project, however, as they will guide the team's analytical approach. In order to decide on the final content of Use Cases, partners focused on three categories of building attributes – building age, building use, and the level of smartness of the building. Each category was researched to identify useful precedents and to pinpoint any particularity within the Limerick context.

2.2.1 Category 1: Building age

First, it was important to define a coherent and useful approach to the dating system we would use for SMARTLAB Use Cases. Within the Limerick context, buildings date from the late 1700s, which is the early Georgian period. There is a significant cohort of Georgian buildings within the city centre – Newtown Pery, or the Georgian Neighbourhood – which pose particular challenges for energy retrofit and smartness upgrades. Some work has already been done on this within the +CityxChange project in Deliverable D4.4: "Limerick DPEB Implementation Guide 1." As the heritage buildings of the city have been identified as a research priority within the project, it has been agreed that a minimum of 30% of Use Cases will refer to buildings built pre-1940. The other predominant building date within the project boundary are "Celtic Tiger" era buildings, related to the building boom of the late twentieth and early twenty-first century. The majority of these buildings in Limerick are purpose-built apartment buildings, and these are solidly represented within the Use Case list.

The categorisation of building ages by era was also an important decision. The project team considered first using CSO dating methods, which refer to buildings pre-1945 as a block and then move to 10-year periods from then. See Table 1 below for analysis of this research, which formed the backbone of age categorisation. These calculations necessarily comprehend some buildings outside the City Centre Zone, as data is only available by Small Area Population. The City Centre Zone does not conform fully to ED or SAP boundaries. These calculations also refer only to residential data, so cannot be definitively mapped to Use Cases, but have been used as a guide:

Table 1. Analysis of CSO 2016 figures on building age of residential housing in SAPs within or adjacent to the City Centre Zone.

Residential Housing Age	Number	Percentage	Number excl. date not stated	Percentage excl. date not stated
Pre 1919	872	15%	872	20%
1919-1945	454	8%	454	10%

Residential Housing Age	Number	Percentage	Number excl. date not stated	Percentage excl. date not stated
1946-1960	457	8%	457	10%
1961-1970	262	4.50%	262	6%
1971-1980	179	3%	179	4%
1981-1990	314	5.5%	314	7%
1991-2000	739	13%	739	17%
2001-2010	1015	17.5%	1015	23%
2011 or later	111	2%	111	3%
Date not Stated	1381	24%		
Total	5784		4403	

On reflection and input from partners, it was decided to use a more analytical frame to identify project age bands for Use Case buildings. The CSO data is linked to the most comprehensive survey of Limerick buildings (residential only), but the categorisation of that data into ten-year periods (post 1945) is not as rich a source of insight. As the work of SMARTLAB Use Cases is based on building an accurate picture of building stock in a contemporary Irish city, partners agreed to cluster date categories based on different eras of building in Irish history. The categories therefore include those listed in the table below, including an analysis of CSO data regarding their occurrence within the City Centre Zone (CCZ):

Table 2. SMARTLAB building age categories and their occurrence in the City Centre Zone.

Date Category	Occurrence in CCZ	Description
Heritage Buildings pre 1940	30%	Includes Georgian, a foundational building stock in the Limerick context. SMARTLAB is committed to including at least 30% heritage buildings in its study, and this will be reflected in Use Cases
1941-75	~17%	Reflecting the post-war building boom, particularly in social housing. Often hollow-block housing, with significant challenges for retrofit.
1976-91	~10%	Post oil-crisis with new building regulations resulting in gradually improving building conditions
1992-2007	~35%	The "Celtic Tiger" building boom, high construction levels with mixed regulation standards.

2008-present	~8%	Within the SMARTLAB boundary, this period will be predominantly represented by apartment buildings.
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2.2.2 Category 2: Building Use

Building Use as a category refers to the current use of the building, which may or may not be related to its original purpose when built. In the case of certain Georgian Use Cases, buildings which are now either mixed use or commercial would originally have been designed as single-family homes. In the majority of Use Cases, however, residential buildings are in still use as designed.

CSO categories were less useful to the project team in this category. Their categorisation refers only to residential buildings, and SMARTLAB will focus on all kinds of building uses in Limerick city centre. The CSO's categories are also focused on building use history, as reflected in their categories:

1. Bedsitter.
2. Apartment/Flat - converted.
3. Apartment/Flat - custom built large block.
4. Apartment/Flat - custom built small block.
5. House - detached.
6. House - semi-detached/terraced.
7. Other.

SMARTLAB, however, is focused primarily on the current use of buildings. Also, although inhabitant behaviour is important within the project, the team will not be performing the kind of socioeconomic analysis carried out by the CSO. It was thus decided to streamline SMARTLAB use categories into the following (Table 3), reflecting partner priorities:

Table 3. SMARTLAB building use categories and their resulting occurrence in Use Cases.

TYPE	Commercial	Mixed Use	Institutional	Residential - apartment	Residential - house
USE CASE occurrences	1	1	1	1	5

2.2.3 Category 3: Building Smartness

In order to produce actionable analysis on the potential of Limerick buildings to adopt the Smart Readiness Indicator and improve their smart potential, a baseline understanding of the current smartness of these buildings is needed. As noted in **WP3-D2 Review of the SRI and other appropriate systems for measuring the 'smartness' of a building and requirements for data monitoring and DIY toolkits as a result**, "Although the building smartness covers a broad range of criteria, particularly occupant health and well-being, the overall goal of the SRI is to improve building energy performance which ultimately biases result towards energy efficient solutions" (17). CSO data provided insight into the kind of energy systems in use in Limerick buildings, but it was decided that the project

would use the existing SRI ratings system to categorise SMARTLAB building smartness levels (Table 4). As with the BER system, these ratings range from A (best scoring building) to G (worst scoring building), but the scores will be based on more wide-ranging criteria ranging across three key functionalities, seven impact criteria, and nine technical domains. Using expert advice from project partner IES, it was possible to assess a theoretical analysis of the smartness of Limerick buildings across different buildings by age, resulting in the Use Case occurrences outlined below. It is clear that the dispersal of ratings across this category is not an even spread, but based on IES analysis, no significant number of Limerick buildings would be likely to score above an F rating, and therefore should not be represented in SMARTLAB Use Cases.

Table 4. SMARTLAB building smartness categories and their resulting occurrence in Use Cases.

Level of Building Smartness (SRI rating)	G	F	E	D	C	B	A
SMARTLAB Use Case occurrences	7	2	0	0	0	0	0

The following section outlines the SMARTLAB Use Cases as agreed by project partners based on the analysis in the above three categories.

3 SMARTLAB Use Cases

SMARTLAB Use Case typologies as agreed by partners are outlined below in relation to each of the three core categories – period of construction, current use of the building, and estimated smartness level. These Use cases draw on available statistics and data sources, but the team has not attempted to exactly replicate particular quotas within Use Cases. The greater range of buildings within Use Cases is also reflective of the partner expertise in determining which building types (age, use, smartness) are most valuable for research purposes. The below Table 5 gives a resume of SMARTLAB Use Cases within each category:

Table 5. SMARTLAB Use Cases by date, use, and smartness level.

Use Case #	Date	Use Type	Smartness
1	Pre-1940 Heritage Buildings	Mixed Use	G
2		Residential – House	G
3		Residential – house	G
4	1941-75 Post-war building	Residential – house	G
5	1976-91 Oil Crisis	Residential - house	G
6	1992-2007 Celtic tiger building	Institutional	G
7		Commercial / Mixed Use	F
8		Residential	G
9	2008-present	Residential – apartment	F

More detail on each of the Use Case typologies is given below (Tables 6-14). In each case, a Limerick location is identified as an example of each typology – these are not specific locations related to the study, but rather a visual example of a type. Sample images are drawn from Google Maps. Further information on residential building Use Cases is provided about building type and the expected building fabric, drawn from the Tabula Building Typology Brochure (2014) where appropriate.

Table 6. Use Case 1.

	Period	Pre-1940 Heritage Buildings
	Use Type	Mixed Use
	Smartness	G
	Typology	Terraced house, solid brick wall, Pre 1900. Georgian brick terrace house found in Dublin, Cork, Limerick etc from late 1700s up to mid-1800s. These 3 storey dwellings often have a parapet wall to the front which disguises the pitched roofs behind. In order to retain the aesthetic of the streetscape ¹ . Tabula comments that "an internal insulation solution would be ideal" (22)
	Sample Limerick Address	Glentworth Street. Georgian building, apartments over commercial unit.

¹ Tabula typologies do not cover Georgian buildings, so the description in Georgian period Use Cases is amended for accuracy.

Table 7. Use Case 2.


	Period	Pre-1940 Heritage Buildings
	Use Type	Residential
	Smartness	G
	Typology	Terraced house, solid brick wall, Pre 1900. Georgian brick terrace house found in Dublin, Cork, Limerick etc from late 1700s up to mid-1800s. These 3 storey dwellings often have a parapet wall to the front which disguises the pitched roofs behind. In order to retain the aesthetic of the streetscape. Tabula comments that "an internal insulation solution would be ideal" (22)
	Sample Limerick Address	Catherine Street – Georgian building, single family home.

Table 8. Use Case 3.


	Period	Pre-1940 Heritage Buildings
	Use Type	Residential
	Smartness	G
	TABULA typology	Terraced house, solid brick wall. "Typical redbrick house found in Dublin, Cork, Limerick etc from late 1800s up to 1930s. Often includes a flat roof extension to rear. Suited to a mix of internal and external wall insulation. Suspended timber floors are common that can be retrofitted with insulation" (30).
	Sample Limerick Address	Joseph Street. Built 1901. Single family home.

Table 9. Use Case 4.


	Period	1941-75 Post-war buildings
	Use Type	Residential
	Smartness	G
	TABULA typology	Terraced house, hollow block walls. "Mid terrace house with half brick front. Very common in Dublin in 1950s and 1960s. Small 50mm cavity behind brick wall with 9 inch (225mm) hollow block walls elsewhere. Un-insulated exposed floor above the garage. Suspended timber floors" (40)
	Sample Limerick Address	Belfield Park. Built 1950s. Single family home.

Table 10. Use Case 5.


	Period	1976-91 Oil Crisis Era Buildings
	Use Type	Residential
	Smartness	G
	TABULA typology	Semi-detached house, cavity walls. "Semi-detached house with part-filled cavity walls and solid floors. The part-filled cavity can be full-filled by pumping in additional insulation beads. This house type is common throughout Ireland during the 1980s" (58).
	Sample Limerick Address	Fernhill Estate. Built 1980s. Single family home.

Table 11. Use Case 6.


	Period	1992-2007 Celtic Tiger Era Buildings
	Use Type	Institutional
	Smartness	G
	TABULA typology	No TABULA typology for commercial buildings.
	Sample Limerick Address	Barrow House. Built early 2000s. Library, formerly commercial.

Table 12. Use Case 7.


	Period	1992-2007 Celtic Tiger Era Buildings
	Use Type	Commercial Mixed Use
	Smartness	F
	TABULA typology	No TABULA typology for commercial buildings.
	Sample Limerick Address	Riverpoint Buildings. Built early 2000s. Commercial-led Mixed Use.

Table 13. Use Case 8.



	Period	1992-2007 Celtic Tiger Era Buildings
	Use Type	Residential
	Smartness	G
	TABULA typology	Terraced house, timber frame. "Timber frame construction started to become increasingly popular in the late 1990s and has made up more than 10% of the market from 2000 onwards. Apart from adding additional roof insulation, the focus for retrofit would be on upgrading the space & water heating systems" (70).
	Sample Limerick Address	Pennywell Gardens. Built 1990s. Single family home.

Table 14. Use Case 9.

	Period	2008 – present
	Use Type	Residential
	Smartness	F
	TABULA typology	No Tabula typology for apartment buildings
	Sample Limerick Address	Lower Mallow Street. Custom built large apartment block.

References

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