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Green Building Passports: a review for Scotland

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January 2022

DOI: http://dx.doi.org/10.7488/era/2075

1 Executive summary

Aims

Scaling up the reduction of carbon emissions from homes and buildings is one of Scotland's key priorities towards meeting climate change targets. The Climate Change Committee (CCC) recommends the inclusion of digital Green Building Passports (GBPs) in the UK's heat and buildings strategies.[1] This report aims to provide policy makers with an understanding of the purpose, structure and use of Green Building Passports, along with the main barriers and opportunities when considering their possible introduction in Scotland. This work is important to inform development of approaches to help property owners access information about the energy efficiency of their properties and to draw on this to improve energy efficiency and install zero-emissions heating.

The research comprises:

- a review of the definition of Green Building Passports (GBPs) and associated terminology.
- a review of positions taken by UK stakeholders and associated recommendations linked to what GBPs are, what they should contain and approaches to implementation.
- a review of GBPs or similar frameworks and initiatives across Europe, and internationally, and a comparison of these approaches with recommendations developed for a UK approach.
- an appraisal of the barriers and opportunities of developing GBPs and log books in Scotland and the potential content of GBPs in Scotland.
- an appraisal of where the information potentially collected as part of a GBP and log book approach in Scotland may link or overlap with information already collected.

[1] CCC (2020) Climate Change Committee's Sixth Carbon Budget: Buildings

Key findings

GBPs and log books: direction and experience

The adoption of Green Building Passports (GBPs) in the UK has been recommended by the UK Climate Change Committee and House of Commons Environmental Audit Committee.

It is possible to draw on research, development and implementation experience of a variety of schemes in the UK, Europe and internationally to understand more about what GBPs are, and what they can offer. Information available relates to developing frameworks for unified approaches; delivery of pilot projects; management of mandatory and voluntary government-led digital platforms; and delivery of government-supported, industry-led 'one-stop-shop' models.

GBPs are more commonly referred to as Building Renovation Plans (BRPs) or Building Renovation Passports. For the purposes of this report, we have interpreted both GBPs and BRPs as comprising the following three elements, described by the Green Finance Institute (GFI), and used the terms BRP and GBP interchangeably:

(i) comprehensive building information (logbook),
(ii) bespoke and staged renovation guidance (renovation roadmap), and
(iii) enabling links/connections for energy efficiency improvement (such as available loans/subsidies).

We note that some definitions refer to a BRP as comprising solely the renovation plan element and that this can be linked to a digital passport or logbook with data from a logbook feeding directly into the development of any renovation roadmap.

The introduction of GBPs is primarily driven by a need to provide property owners with high quality, comprehensive and user-friendly information on energy efficiency and appropriate renovation guidance. For some properties, detailed renovation guidance will be needed; this is considered especially important when improvements are likely to require a transition from relatively simple energy efficiency measures to requiring more complex measures. This research includes considerations linked to the provision of such renovation guidance.

There is a significant aspiration (based on extensive stakeholder engagement, development and testing) that this enhanced building data availability (and its transparency for relevant stakeholders) will have a major impact on scaling up retrofit activity. While feedback from current initiatives and/or pilots has been generally positive, there is a lack of robust evidence connecting existing BRP initiatives with increased retrofit activity due to many projects being in early phases.

Scope for development in Scotland

Logbook

- For the UK, the GFI has recommended log book data inputs (minimum and advanced) that generally align with data input frameworks proposed in the EU work undertaken on Building Renovation Passports.
- Most of the minimum data inputs recommended by GFI are already collected and managed through various Scottish Government initiatives.
- Data already collected as part of the Energy Performance Certificate (EPC) approach would make a particularly important contribution. Enabling software and guidance could be incorporated for efficient integration of data from EPC data models.

- Data inputs that are considered an 'advanced' element of a log book (such as energy consumption, circularity considerations and indoor comfort) is typically held by other stakeholders. These inputs could help with whole lifecycle carbon monitoring and provide guidance to households based on occupant behaviour.

Renovation roadmap

- The research suggests that renovation guidance should outline a long-term (around 20 years) step-by-step roadmap to achieve deep renovation.
- Stakeholders across the various GBP or BRP initiatives have also recommended that renovation guidance should be based on a specialist survey by a qualified professional. For the UK, PAS 2035:2019 introduced overarching guidance for longer term retrofit planning and stakeholders are continuing to work on more detailed guidance and formal standards. The renovation roadmap could be a key area for further attention given its significant potential to support decarbonisation of built environment assets. Independent and trusted retrofit advisors may be able to expand the market, especially for able-to-pay householders.

Enabling connections

- All stakeholders have indicated that it is critical to work on property owner awareness-raising and education to help increase the uptake of interest in BRPs.
- The provision of key supporting information also enables property owners to easily access trusted stakeholders and identify available funding for retrofit works. In Scotland, Home Energy Scotland provides general advice on energy in the home and suitable financing options.
- Feedback from BRP initiatives found that working with larger commercial partners could help drive significant consumer change. Collaborations with academia and research institutes could also be beneficial.

Potential implementation, costs and wider support

- BRPs have not yet reached maturity and many challenges have been encountered with implementation. There are complexities with integrating data from various sources that could potentially take significant time and resource to overcome.
- Most initiatives include free on-site audits and digital platforms for lodging information. Ireland's pilot BRP initiative projected that the cost to develop a BRP is €600 - €750/dwelling. Similarly, France is considering a maximum fee of €400 for on-site audits for their energy efficiency passport (currently free). Germany subsidises up to 60% of onsite audits to a maximum of €800 for single and two-family buildings. Models, such as recovering audit costs via financing, and tiered costs for different dwelling sizes, are still being explored.
- All stakeholders highlighted that clear distinction is needed between who owns and who should have access to building data (i.e. personal data vs property data). UK stakeholders have published recommendations for data governance good practice. Suitable pathways for data to be shared or made publicly available are also still being investigated in various initiatives.

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Acknowledgements

BRE would like to thank ClimateXChange, Scottish Government and all individuals who participated in expert interviews and discussions for their time and input.

2 Introduction

2.1 Context

The Climate Change Committee (CCC) recommends the inclusion of digital Green Building Passports in the UK's heat and buildings strategies.[2]

This report aims to support policy makers with understanding the purpose, structure and use of Green Building Passports and associated log books, along with the main barriers and opportunities when considering their possible introduction in Scotland. The research comprises:

- a review of the definition of Green Building Passports (GBPs) and associated terminology;
- a review of positions taken by UK stakeholders and associated recommendations linked to what GBPs are, what they should contain and approaches to implementation;
- a review of GBPs or similar frameworks and initiatives across Europe, and internationally, and a comparison of these approaches with recommendations developed for a UK approach;
- an appraisal of the barriers and opportunities of developing and introducing GBPs in Scotland and the potential content of a GBP; and
- an appraisal of where the information potentially collected as part of a GBP and log book approach in Scotland may link or overlap with information already collected.

2.2 Definitions

The CCC describes a GBP as "a digital passport providing detailed guidance on the actions required – and already undertaken – to improve a building's energy efficiency and comfort, based on building fabric and operational data". It goes on to note that it sees a role for these passports to "include recommendations on low-carbon heat alongside this, and for the platform to be expanded to cover issues such as indoor air quality, flood resilience, water efficiency and overheating. In doing so, passports would set out a customised and holistic retrofit roadmap for each home. Passports would be transferable between building owners and help to maintain sight of long-term decarbonisation / resilience goals. They would capture EPC data digitally and augment it with other data over time".[3]

The CCC reference work undertaken by the Green Finance Institute (GFI) – which refers to these documents as Building Renovation Plans (BRPs) rather than Green Building Passports. The GFI notes that these BRPs are also known as Building Renovation Passports. GFI defines these as a toolkit which contains:

"*1. A **status of qualified information** about the property's current and historic characteristics, performance, governance and relevant maintenance activity, with activity such as servicing and safety checks logged;*

[2] CCC (2020) Climate Change Committee's Sixth Carbon Budget: Buildings
[3] COVID-19 can be an historic turning point in tackling the global climate crisis - Climate Change Committee (theccc.org.uk)

*2. A **retrofit plan** of sequenced measures the property-owner can take to improve their home and significantly and measurably reduce its emissions towards net zero, in line with PAS 2035 standards or equivalent;*

*3. Enabling **links and connections** to supply chains, financial support, and sources of information and trusted advice to support the necessary changes."*[4]

Although other terms and descriptions can be found that refer to similar concepts (further explained in Section 4), there is consensus that property owners should be provided with information on the current and potential future status of the building, bespoke and staged renovation guidance, and enabling links/connections, such as financial information on energy costs and available loans/subsidies.

In 2018, the European Commission published a technical study on the possible introduction of BRPs and defined the BRP as a "…*long-term, tailored renovation roadmap for a specific building, following a calculation based on available data and/or an on-site audit by an energy expert…The instrument can be complementary to energy performance certificates and/or combined with digital logbooks*".[5] At the end of 2021, the Commission proposed a revision of the Energy Performance of Buildings Directive (EPBD) and this similarly defines 'renovation passports' and 'staged deep renovation', including a plan to establish a common European framework for renovation passports by the end of 2024.[6]

This latter definition distinguishes the renovation roadmap/passport element from the digital logbook element. The Buildings Performance Institute Europe (BPIE) also make this distinction noting that a BRP can link to a log book:

"The Renovation Roadmap/Passport presents renovation as a home-improvement plan, not just as a technical intervention. It is based on the occupant's needs and specific situations (e.g. age, financial situation, composition of the household, etc.) and outlines each step and links proposed measures….The BRP can also link to a logbook, a (digital) repository where the building's information can be stored and updated. The type of information stored can evolve overtime and could range from available financing options for renovation projects (e.g. green loans, incentives, tax credits) to energy bills, smart meter data, equipment maintenance requirements as well as insurance and property plans and obligations. All this information could be made available to property owners and, under specific conditions, to other relevant users (e.g. public authorities)."[7]

For the purposes of this report we have interpreted both GBPs and BRPs as comprising all three elements described by GFI rather than solely a renovation plan.

2.3 Development and application of GBPs in the UK

The CCC's Sixth Carbon Budget buildings sector policy report states that EPCs have been a useful source of basic comparable information but they have extensive issues and require reform to ensure they are fit to support near-term progress. As a next stage, home retrofit plans are identified as a tailored approach to incorporating wider dimensions of comfort, aesthetics and affordability as well as adaptation needs. The CCC further states that "*combining these with the opportunity of smart meter data in a*

[4] GFI (2021) Building Renovation Passports: Creating the pathway to zero carbon homes p.4
[5] European Commission (2020) Technical study on the possible introduction of optional building renovation passports
[6] European Commission (2021) Proposal for a Directive of The European Parliament and of The Council on the energy performance of buildings COM/2021/802 final
[7] BPIE (2017) Factsheet_D-170918_Final-2.pdf (bpie.eu)

digital Green Building Passport could unlock green finance at scale by providing a robust, quality source of information to raise finance against, track progress and help make standards enforceable"(Figure 1).[8]

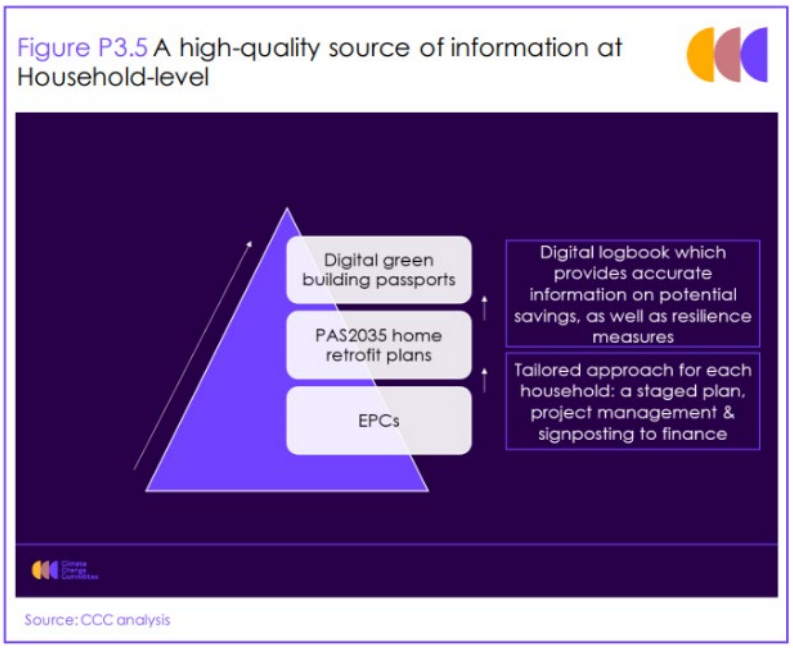

Figure 1 – CCC's view of the transition to digital Green Building Passports[1]

The CCC reference work, undertaken by the GFI [9], highlights the significant role that GBPs could play, including in relation to raising finance to support investment in energy efficiency improvements[10]. At the end of 2019, GFI established the Coalition of Energy Efficiency in Buildings (CEEB) to support market development for financing a net-zero carbon and climate-resilient built environment in the UK. To help scale up retrofit (most notably domestic retrofit), one of CEEB's first projects investigated Building Renovation Passports. In 2021, the GFI published recommendations for a UK BRP framework.

Figure 2 provides an overview from GFI's CEEB, highlighting potential benefits associated with introducing BRPs.[11] These include:

- Helping property owners make informed decisions, find funding, and connect with suppliers and service providers to make the retrofit process simpler.
- Supporting private landlords to comply with energy efficiency standards and benefit from offering energy-efficient properties that are attractive to tenants.
- Lenders may better assess risks to their portfolios and provide tailored products to customers, while accessing the data needed to develop new products and services. Local authorities and affordable housing providers may build a better understanding of local housing stock, enabling implementation of effective retrofit programmes at local level to meet climate and fuel poverty targets.

[8] CCC (2020) Climate Change Committee's Sixth Carbon Budget: Buildings pp.72-73
[9] BEIS (2019) Green Finance
[10] CCC (2020) Sixth Carbon Budget – buildings
[11] GFI (2021) Building Renovation Passports - Creating the pathway to zero carbon homes

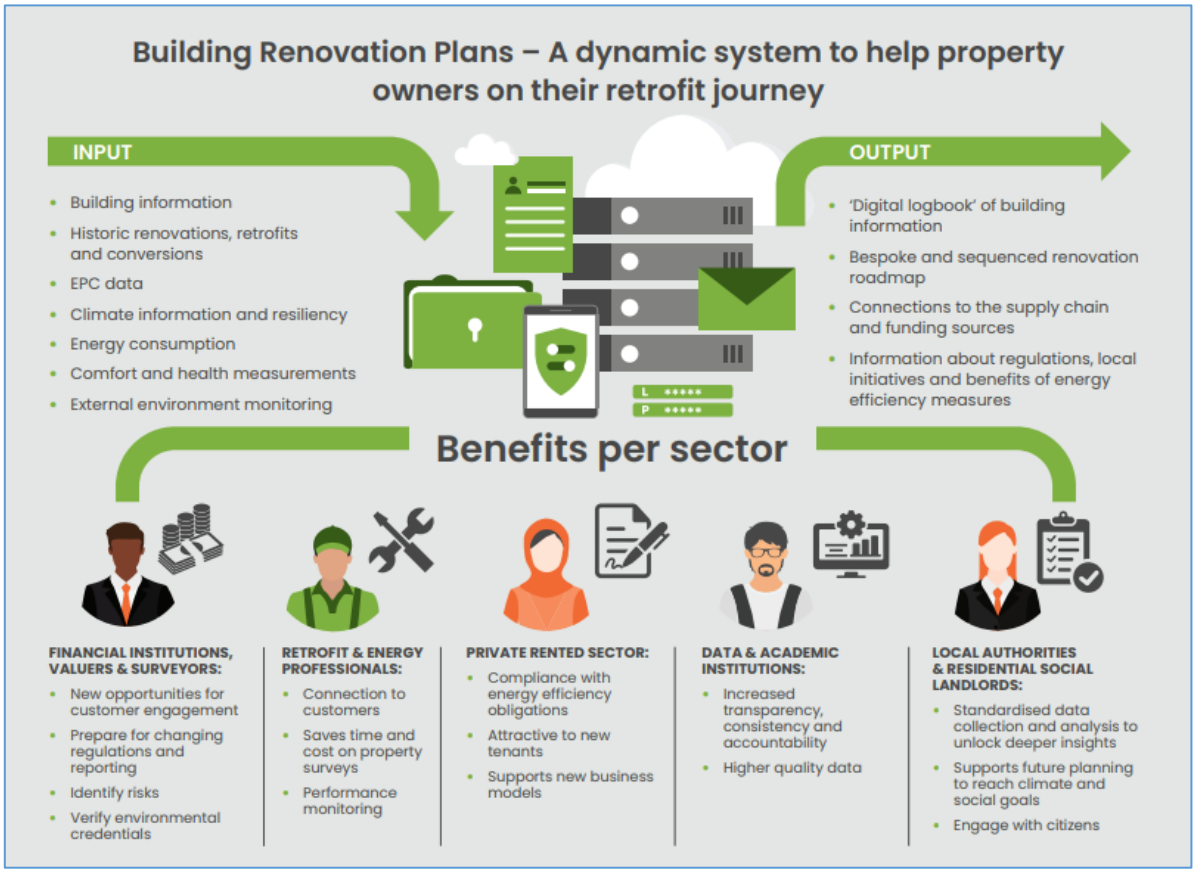

Figure 2 – GFI CEEB recommendations on data inputs and outputs of a BRP and the benefits such a system could present to different sectors[12]

The introduction of BRPs is also supported in the House of Commons Environmental Audit Committee 2021 report on the energy efficiency of existing homes[13]. In its report the Committee suggests that:

"Building renovation passports have the potential to provide much more accurate data on energy usage and could be used to unlock green finance. They provide homeowners with long-term renovation strategies which can minimise disruption to their properties and thereby encourage more extensive retrofitting of energy efficiency measures."

The Committee recommends that "*the Government develop an approved, standardised methodology and data framework for Building Renovation Passports and supports their roll-out, with a view to the eventual replacement of Energy Performance Certificates".*

As part of its Optimised Retrofit Programme (ORP) the Welsh Government is testing the practical application of BRPs and longer term retrofit planning across social housing via two trials; one that is be delivered in accordance with PAS 2035[14], and another trial based on their own survey methodology (that is being developed and tested within the programme, building on key principles related to PAS 2035). Further details are provided in Annex 1.

[12] GFI (2021) Building Renovation Plans: An information requirements framework p.4
[13] UK Government (2021) House of Commons Environmental Audit Committee Fourth Report - Energy Efficiency of Existing Homes
[14] *PAS 2035:2019 provides overarching guidance in the UK on longer term retrofit planning.*

2.4 Methodology

A wide variety of primary and secondary sources have been utilised such as industry reports, research programmes, academic papers and policy documents. Twelve interviews were conducted with Scottish, UK and international stakeholders.

3 UK frameworks and initiatives

There is consensus that property owners should be provided with information on the current and potential future status of the building, bespoke and staged renovation guidance, and enabling links/connections such as financial information on energy costs and available loans/subsidies.

The UK BRP framework recommended by GFI aims to support a transparent, consistent and coherent approach across the UK. The building and construction sector is very fragmented with different stakeholders generating relevant building information in different ways at each stage of the construction lifecycle. The fragmentation limits the availability of consolidated building information, which can hinder more holistic and effective decision making about buildings, especially towards improving energy efficiency. The key suggested BRP outputs are:

1. Logbook: practical building information
2. Retrofit plan: long term renovation roadmap towards net zero
3. Enabling connections: key information to support property owners with energy/retrofit decision making:
    a. Connections to qualified supply chains and other service providers
    b. Connections to funding sources
    c. Education and/or other information regarding relevant central and local government regulations and initiatives.

Logbook

The logbook is a summary of current and historic information on building characteristics and performance such as building type, fabric, services, energy consumption and climate resiliency. The logbook provides a standardised repository of information that assists energy and building professionals such as by providing data for energy performance calculations and retrofit assessments. For the UK, GFI has recommended data inputs based upon nine **core input components** with ‘minimum’ and ‘advanced’ (secondary) sub-components proposed. (Figure 3). GFI indicated that inputs have been recommended based on effectiveness and reliability, while considering practical data collection and access limitations.

Recommended Inputs (GFI, 2021)	Minimum	Advanced
Building information	★	★
Building type	★	★
Building ownership & governance	★	★
Building fabric	★	★
Building services	★	★
Energy consumption and household behaviour		★
Information relating to climate resiliency	★	★
Circular economy considerations and enhanced climate information		★
Indoor monitoring systems to measure comfort		★

Figure 3 – Potential BRP data inputs (adapted from GFI's report recommendations[15])

Most of the minimum data inputs recommended by GFI are already collected via various Scottish Government initiatives. 'Energy consumption and household behaviour' refers to actual energy use and how occupant actions impact the overall use of energy. The logbook is further explored in Section 0 and sub-components are listed in Annex 2.

Retrofit plan

The **retrofit plan** or renovation guidance is an independent and bespoke step-by-step plan of property improvements towards net zero (even if only limited improvements can be undertaken in the short term). The step-by step plan is important as property owners transition from relatively simple energy efficiency measures to more complex measures that may introduce unintended consequences if executed out of sequence. Given the complexity, it is also recommended that at minimum, retrofit plans consider conforming to quality standards such as PAS 2035.

Key supporting information

Key supporting information on qualified supply chains and funding sources, enables property owners to easily access trusted stakeholders and identify available funding for retrofit works. BRPs could also aim to educate and build awareness by providing information about changes to standards (e.g. Minimum Energy Efficiency Standards (MEES), Zero Emissions Homes or similar) and relevant local and national initiatives.

4 European and international frameworks and initiatives

This section explores BRPs or similar frameworks and initiatives across Europe and internationally to extract practical experiences for comparative analysis and to further investigate considerations for Scotland. Annexes 3 and 4 summarise a variety of Government and/or industry led BRPs or similar examples. The information provides an overview of implementation approaches, costs, management, uptake, and learnings where data was available. Data was gathered from existing publications and stakeholder interviews.

[15] GFI (2021) Building Renovation Plans: An information requirements framework

4.1 European research projects

4.1.1 iBRoad

The iBRoad was a European research project that developed and tested a building renovation roadmap and building logbook for single-family homes in multiple countries. The roadmap provides a customised renovation plan over a long-term period (10 to 20 years). It considered the occupants' needs and specific situations (age, financial situation, composition and expected evolution of the household, etc.). It avoids the risk of 'locking out' future renovation solutions due to a lack of foresight by addressing the complexity of renovation works and ensuring coordination over different stages. The logbook stores building related information. Software was created, referred to as the 'roadmap assistant', for more efficient and standardised data collection and calculations by auditors and automated data centralisation. The iBRoad framework was also analysed for multi-family homes and non-residential buildings to recommend specific adaptation considerations.[16]

4.1.2 ALDREN

The ALDREN European research project, primarily for offices and hotels, proposes a common EU wide assessment framework to trigger more ambitious renovation projects. Similar to iBRoad, ALDREN's framework produces a 'building renovation passport' that includes a logbook and renovation roadmap. The logbook contains data to better inform property owners and managers about the current technical energy, Indoor Environmental Quality (IEQ), and financial performance status of their building. The tailored renovation roadmap or 'RenoMap' contains steps to reach high energy performance in the medium to long term.[17] The ALDREN framework also goes further to incorporate the 'European Voluntary Certificate' (EVC), as a key project aim is also the inclusion of improved sustainability metrics in certifications. This is in support of the implementation of a European Voluntary Certification Scheme (EVCS) introduced in Article 11(9) of the European Energy Performance of Buildings Directive (EPBD).[18]

Several initiatives have built on, and continue to build on, the work developed in the iBRoad and ALDREN research projects.

4.2 European and international examples

4.2.1 Approaches

The Flemish Government has implemented BRPs through a mandatory Government-led online platform and the new Flemish EPC (updated in 2019) includes staged renovation guidance and estimated costs.[19] France implemented an energy efficiency passport (logbook and renovation roadmap) system, which is part of a digital platform for housing and is required by law. The scheme was made mandatory for new buildings from January 2020 and will become mandatory for renovations from 2025.[20] The Sustainable Energy Authority of Ireland (SEAI) BRP activity includes pilot testing the iBRoad framework[21] and supporting the deep renovation one-stop-shop model run by private

[16] Institute for Energy and Environmental Research (2020) Beyond the single-family house – potential extension of iBRoad to other building types
[17] ALDREN (2021) ALDREN Building Renovation Passport
[18] ALDREN (2021) ALDREN - European Voluntary Certificate (EVC)
[19] Flemish Energy and Climate Agency (2021) The Flemish Building Renovation Passport – Moving Forward Together!
[20] The Shift Project (2020). Passeport Efficacité Énergétique (P2E)
[21] Irish Green Building Council (2020) Introducing Building Renovation Passports in Ireland

organisations.[22] Portugal[23] and Denmark's[24] EPC schemes along with Germany's energy audit scheme[25], include tailored renovation advice. Australia has piloted an electronic building passport approach that comprises a digital platform for building information and tailored renovation advice.[26]

4.2.2 Costs

Most initiatives include free on-site audits and digital platforms for lodging information. Ireland's pilot BRP initiative projected that the cost to develop a BRP is €600 - €750/dwelling. Similarly, France is considering a maximum fee of €400 for on-site audits for their energy efficiency passport (currently free). Germany subsidises up to 60% of onsite audits to a maximum of €800 for single and two-family buildings. Models such as recovering audit costs via financing, and tiered costs for different dwelling sizes, are still being explored. In the Canadian Renoclimat scheme 50% of the energy audit costs are covered.

4.3 Comparative commentary and further applications

Recommendations from the UK's GFI BRP framework about information that should be captured in the logbook closely align with those identified in iBRoad and ALDREN projects and cover areas on:

- ownership and governance,
- building information and type,
- building services and fabric,
- energy consumption and use behaviour,
- indoor comfort,
- circular economy and enhanced climate, and
- climate resiliency.

There is noticeable variation in sub-groupings that creates some initial difficulty with content mapping but on reviewing the most granular levels, the majority of content overlaps.

4.3.1 Finance

There is an explicit logbook module on 'cost value risk' that is found in ALDREN but missing from the GFI and iBRoad input frameworks. This module gathers information on financial value and risk specific to the building and draws on data from other modules and the 'RenoMap' (renovation roadmap). This is shared with financial valuation experts to compare the financial impacts associated with various renovation scenarios. The explicit inclusion for ALDREN aims to support more consistent and detailed information sharing between energy and environmental professionals and financial experts towards improved market financing conditions.[27] The frameworks that focused on domestic properties (GFI, iBRoad) incorporate financial considerations within the retrofit plan/renovation guidance (i.e. estimated range of costs associated with making improvements, as well as the savings that might be accrued by different measures) and by providing links to loans, incentives, etc.

[22] Tipperary Energy Agency (2021) Superhomes 2030 Overview
[23] ADENE (2021) Portugal Energy Certification of Buildings
[24] Renovate Europe (2021) BetterHome - Denmark
[25] Federal Government of Germany (2021) Individual Renovation Roadmap (Individueller Sanierungsfahrplan – iSFP)
[26] Queensland University of Technology (2015) Pilot Electronic Building Passport – Final Report
[27] ALDREN (2021) ALDREN - Cost, value, and risk

The extent of collected data, and the extent of evaluation, may vary depending on the local market and to reflect issues of tenure, project size and procurement rules. Where there is sufficiently accurate data for metric calculations (e.g. perhaps for larger developments/multi-family buildings) and a need for more in-depth financial evaluation, aspects of ALDREN's cost value risk module could be adapted.

4.3.2 'Smart' data

All of the frameworks incorporate smart information, with the European iBRoad and ALDREN projects explicitly referring to the 'Smart Readiness Indicator' (which is the EU's optional common scheme for rating the smart readiness of buildings). The indicator considers the capability of buildings to provide information on dwelling performance and environmental conditions to users, have smart controls that can adapt operation to the needs of the occupant, optimising energy efficiency and overall performance, and to adapt operation in reaction to signals from the electricity grid.[28]

4.3.3 Digital logbooks

An EU framework for a digital unification tool, Digital Building Logbooks (DBL), has been proposed for 2023 due to the existing range of approaches to building logbooks. The aim being to cover the entire lifecycle and include all relevant building information that could increase learning and enable synergies, interoperability, data consistency and information exchange.[29] The Royal Institute of Chartered Surveyors (RICS) co-chairs a working group in the Global Alliance for Buildings and Construction (GABC) that is developing guidelines for 'building passport' schemes across the world. The purpose is to provide a harmonized system that supports buildings and construction policy and investment with Measurable, Reportable and Verifiable (MRV) Data. [30] GABC's proposed building passport (sometimes referred to as a Digital Building Logbook or (Electronic) Building File) is a whole life cycle repository of building information. It covers a building's administrative documentation as well as data regarding its plot and location, its technical and functional characteristics, and its environmental, social and financial performance (an overview of its suggested benefits is shown in Figure 4).[31]

[28] EU (2018) EU Smart Readiness Indicator for Buildings
[29] European Commission (2020) Report 1 of the study on the development of a European Union framework for buildings' digital logbook
[30] RICS (2020) A building passport for life
[31] GABC (2021) The Building Passport Practical Guidelines

Figure 4 - GABC's mapping of building passport wider benefits with individual beneficiaries[32]

4.3.4 Wider conclusions

The research, development and implementation approaches to BRPs in the UK, Europe and internationally share many common motivations and objectives. BRPs offer the potential to gather and present accurate, current and granular information about all aspects of a property's energy use, and its roadmap to net zero, in one place along with additional information to support householders and property professionals. There is significant aspiration (based on extensive stakeholder engagement, development and testing) that this enhanced building data availability, and its transparency for relevant stakeholders, will have a major impact on scaling up renovation activity. However, while stakeholder feedback from current initiatives and/or pilots has been generally positive, there is a lack of robust evidence connecting BRPs with increased retrofit activity due to many projects being in early phases.

[32] GABC (2021) The Building Passport Practical Guidelines p.19

5 Considerations in the Scottish context

This section explores the possible content and purpose of BRPs in relation to building information that is already collected or being provided to householders in Scotland. The structure of this section reflects the BRP framework that has been proposed by GFI given its similarity to the other initiatives that have been investigated. There has also already been a wide range of UK stakeholder engagement to create the framework and as such, this approach provides additional context for further national level development.

5.1 Logbook: digital current and historic building information

For the UK, GFI has recommended nine input components for the logbook (Table 1), with ‘minimum’ and ‘advanced’ sub-components (the complete list is presented in Annex 4). Most of the minimum recommended data inputs are already collected via various Scottish Government initiatives as further outlined in this section.

Table 1 - GFI recommendations on BRP minimum and advanced data inputs, how they contribute to improved energy efficiency and zero emissions, and how data is captured and managed

Input	Min.	Adv.	Contribution to net zero	Data capture & management
Building information	★	★	Assist energy and building professionals by providing centralised and more reliable data for energy performance calculations, retrofit planning, etc. Provide reliable and trustworthy information to facilitate buying, selling, insurance, renting and renovation. Enable synergies that may foster new business models. Facilitate building stock monitoring and reporting.	Most data publicly available from Government owned and managed databases such as the EPC register and Land Registry. For new builds, there is electronic lodgement of various information via the 'eBuildingStandards' portal. Council based databases for planning consent or other purposes also store building information, but may not all be in machine readable format.
Building type	★	★		
Building ownership & governance	★	★		
Building fabric	★	★		
Building services	★	★	(In addition to above) Insights on whether existing systems are reasonably efficient (energy, cost and/or carbon) or have potential for improvement	Most data could be extracted from EPC data models, if accessible. Home Analytics (Scotland) already aggregates a variety of relevant data inputs.
Energy consumption and household behaviour		★	Recommend actions/lifestyle improvements tailored to the behaviours of the household. Potentially enable services such as demand response and dynamic pricing.	Typically owned by energy provider with customer privacy obligations. EST has engaged DCC to access smart meter data with householder's permission (ongoing process).
Information relating to climate resiliency	★	★	Help identify long-term weaknesses of a building with respect to natural disasters and other harder to foresee effects of climate change.	Most data publicly available from Government owned and managed databases such as flooding, coastal erosion and subsidence risk from SEPA.
Circular economy considerations and enhanced climate information		★	Monitor whole lifecycle carbon. Help inform policy making and/or stakeholder choices on building, product, and material reuse and recycling.	Typically held by various stakeholders (manufacturers, designers, contractors, etc.) such as Environmental Product Declarations (EPDs).
Indoor monitoring systems to measure comfort		★	Encourage more interest in improving energy efficiency by incorporating aspects that are of interest to householders.	No clear guidance on measurement. Various initiatives exploring technical and/or subjective solutions.

5.1.1 Links to EPC

For EPCs, data contained in raw EPC data and/or models capture a variety of inputs but may be privately held by assessors, or by the property owner, or by energy companies. This data could therefore be gathered from property owners, assessors and existing Government databases to provide added value. Energy assessors are already familiar

with lodging energy assessment data onto the **EPC Register** in a required format after being created via 'approved software'. Currently, the information that is publicly available is limited to the EPC software 'outputs' only. While the EPC model input data is currently lodged this is not currently utilised or made available; however this data would provide significant value to the BRP process – reducing effort and costs for gathering data inputs via separate processes. Figure 6 shows the relationship between BRP components and processes and EPC data and processes.[33]

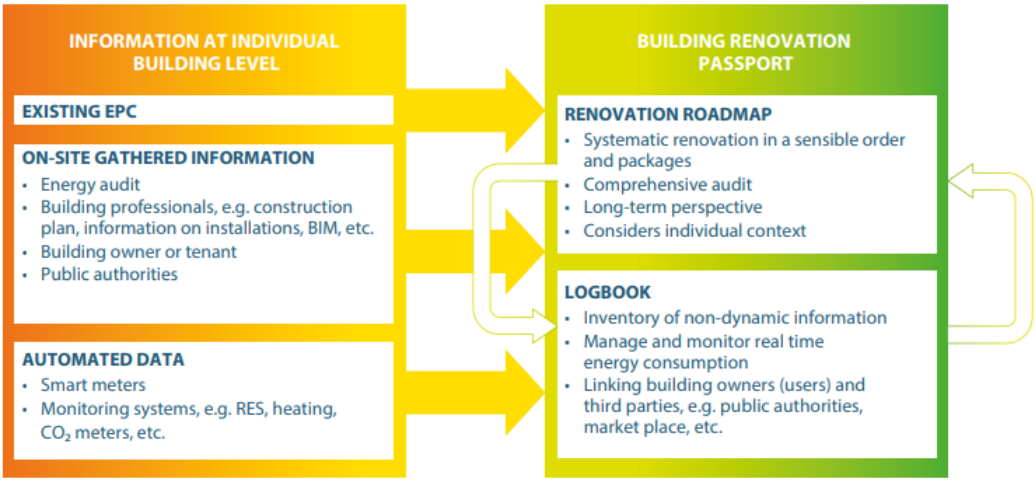

Figure 6 - Overview of EPC components and processes feeding into BRP data and processes[34]

5.2 Bespoke and staged renovation guidance

5.2.1 Renovation guidance in Scotland

CCC's transition pathway to BRPs recommends the establishment of home retrofit plans as a tailored approach to enable wider dimensions of comfort, aesthetics and affordability while meeting adaptation needs. There are various levels of energy efficiency and renovation advice being provided in Scotland. Dwellings on sale are required to have a **Home Report**[35] which includes a single survey and valuation, property questionnaire and energy report (EPC). The survey is a visual inspection by a chartered surveyor to describe the home, its condition, accessibility, and potential remedial action/ repairs by level of urgency. The questionnaire includes information such as historic issues (fire damage, asbestos, etc.), previous alterations, and details of specialist work. **Home Energy Scotland** (HES) advisors access various sets of data and models to provide bespoke advice to householders. For vulnerable households, specialists ('energy carers') conduct in-person surveys to help gather information. In-person surveys are also conducted for renewable energy assessments. Surveys typically gather aspects of similar information that would be required for an EPC assessment along with additional data to assess the measure's suitability for the home. Further support is provided to households eligible for the **Warmer Homes Scotland** programme[36], guiding householders from initial advice to funding and project delivery via Warmworks[37] (managing agent). Data from these interventions would be reported to

[33] BPIE (2017) Building renovation passports: consumer's journey to a better home
[34] BPIE (2017) Building renovation passports: consumer's journey to a better home p.2
[35] Scottish Government (2020) Home Report
[36] Home Energy Scotland Warmer Homes Scotland: in detail
[37] Warmworks Scotland

Scottish Government and so these could provide useful updated building information input data for BRPs.

BRP retrofit planning aims to improve and standardise retrofit approaches by providing deeper, whole house retrofit in place of shallow, measure-based installs. Deep renovation is a complex process that involves a complete overhaul of the energy performance of a building. BRPs therefore require bespoke and accurate guidance based on a specialist survey. Relevant industry guidance and specifications (i.e. PAS 2035: 2019) have been developed to support successful retrofit coordination and risk management based on core principles (7). PAS 2035: 2019 requires the retrofit process to be overseen by an accredited professional, referred to as a 'Retrofit Coordinator' and the Retrofit Coordinator should be responsible for producing a site-specific medium-term improvement plan.

Figure 7 - The core principles that underpin PAS 2035[38]

Several UK Government linked energy retrofit schemes include requirements for PAS2035:2019 to be followed e.g. The Social Housing Decarbonisation Fund (SHDF), Green Homes Grant Local Authority Delivery Scheme, and ECO3.

The analysis of current approaches also highlights a major gap in the 'able-to-pay' market. HES essentially operates a one-stop-shop service (several overlapping characteristics with BRPs) that provides initial advice and signposts eligibility for financial support. More vulnerable households are referred on to Warmworks who provide a more tailored approach and manage and fund a complete process including survey, installation and inspection. In-person surveys can be costly, especially due to geographical challenges across Scotland that could cause some householders to be disadvantaged. For example, the Highlands and Islands covers a large geographical area with smaller scattered communities. Independent and trusted retrofit advisors may be able to expand the market, especially for able-to-pay householders. Stakeholders view trust as a critical requirement for scale up.

6 Main barriers and opportunities

The Scottish Government already has digital access to a variety of building information that is recommended for the log book element of a GBP or BRP, particularly those elements that the GFI propose as minimum requirements. Much of this data relates to

[38] Retrofit Academy (2019) The PAS 2035 compliance process map. p.4

information produced as part of the EPC process. This section outlines key considerations, drawing on examples and stakeholder interviews, linked to the potential development of any GBP or BRP system in Scotland.

6.1 Economic considerations

The introduction of BRPs, or similar, requires consideration of how to finance the 'system' in whatever shape or form that may take depending upon the political strategy. This would typically include aspects of:

- design and development of system functionality;
- integrating data from existing databases and sources;
- operation and hosting (servers for backup and storage);
- support (for user queries, general communication);
- maintenance (licences, technical support); and
- evaluation (reporting).

Budgeting is also required for business model development, technical software (calculations and simulations), and training.

6.2 Homeowner awareness-raising and education

All stakeholder discussions highlighted that awareness-raising on the importance of retrofit is a critical area that still requires development to help increase BRP development and/or uptake. Previous EU EPBD policy reviews have already established that a key energy efficiency challenge is the difficulty for end-users to understand and measure energy savings from renovations. In Flanders, there were some initial misunderstandings by users due to the technical wording used on the BRP digital platform. Whilst the BRP concept generally attempts to tackle these challenges by providing bespoke guidance, further user-friendly consideration surrounds understanding which information is valuable and to whom.

6.3 Integration of approaches and data

GFI's CEEB recommended that the UK Government should develop an approved, standardised methodology and data framework for BRPs – essentially a cohesive approach to collecting building information and creating renovation guidance. There are already supportive initiatives in the UK market such as TrustMark which has developed a Data Warehouse, Property Hub and lodgement dictionary. Established sustainability assessment methodologies for buildings, such as BREEAM, operate online platforms that incorporate calculations and produce reports.[39]

The EU example projects that have been reviewed have typically encountered technical challenges with centralising and analysing BRP data. In relation to EPC data this requires considering the availability and accessibility of the EPC database and the ability to import data from the EPC calculation software or its exported outputs. Semi-automated procedures could also be used to simplify entering information in different applications. For example, the iBRoad project created software to be used by the auditor to produce roadmap documents. The Welsh Government's ORP is similarly exploring digital tools and automation to reduce burden.

[39] BRE (2021) BREEAM - Sustainability Assessment Method

6.4 Legalities of data exchange and protection

Another common theme from all stakeholders is that clear distinction is needed between who owns, and who should have access to, building data (i.e. personal data vs property data). Some countries/regions have set specific laws (Flanders, France) and some Governments have declared that data protection has been adhered to for public good (Wales). Under Article 6(1)(e) of the UK General Data Protection Regulations (GDPR), data controllers can legally process personal data for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller.

Considering the safety of gathering different data sources hosted by different entities, the Flemish Government developed services to ensure that data from authentic sources can be retrieved in a safe and secure manner. Every data-related process in the Woningpas is also checked to adhere to the General Data Protection Regulation (GDPR), the Data Protection Law Enforcement Directive and other rules concerning the protection of personal data. The GFI recommend that a governance board should control access to relevant data sources, with a code of practice developed to govern the use of data in line with requirements.

6.5 Willingness to pay

A survey study of 1,502 households from three countries where the iBRoad was tested (Bulgaria, Poland, Portugal) found that most respondents would be interested in receiving a BRP, but only around a quarter would be interested plus willing to pay. The BRP pilot in Ireland found a gap between what homeowners were expected to pay and how much they were willing to pay for the BRP.[40] In 2021, Santander UK launched a free home energy report, 'EnergyFact report', in partnership with Countrywide Surveying Services.[41] Out of all eligible customers, only around 20% used the EnergyFact report service. Uptake has been below what was expected but once a borrower agreed to receiving a report, the completion rate of implementing measures has been around 80%.[42] BRPs have been presented as a solution to raising finance (by providing more accurate and trusted building information to lenders); therefore, initiatives such as Santander's, which can lever private finance, could be trialled and monitored to evaluate outcomes when free guidance is subsidised by the private sector.

7 Findings

7.1 GBPs and log books: direction and experience

The adoption of Green Building Passports (GBPs) in the UK has been recommended by the UK Climate Change Committee and House of Commons Environmental Audit Committee. GBPs are more commonly referred to as Building Renovation Plans (BRPs) or Building Renovation Passports.

The introduction of GBPs is primarily driven by a need to provide property owners with high quality, comprehensive and user-friendly information on energy efficiency and appropriate renovation guidance. The latter is considered especially important where

[40] Institute for Energy and Environmental Research (2019) Test driving the Individual Building Renovation Roadmap and Logbook
[41] Santander UK (2021) EnergyFact
[42] Santander UK, personal communication, October 13th, 2021

improvements are likely to require a transition from relatively simple energy efficiency measures to requiring more complex measures. There is consensus that a GBP or BRP should contain 3 key elements:

(i) comprehensive building information (logbook),
(ii) bespoke and staged renovation guidance (renovation roadmap), and
(iii) enabling links/connections for energy efficiency improvement (such as available loans/subsidies).

There is significant hope (based on extensive stakeholder engagement, development and testing) that this enhanced building data availability (and its transparency for relevant stakeholders) will have a major impact on scaling up retrofit activity. While feedback from current initiatives and/or pilots has been generally positive, there is a lack of robust evidence connecting existing BRP initiatives with increased retrofit activity due to many projects being in early phases.

7.2 Scope for development in Scotland

7.2.1 Logbook

- For the UK, the Green Finance Institute (GFI) has recommended log book data inputs (minimum and advanced) that generally align with data input frameworks proposed in the EU work undertaken on Building Renovation Passports.
- Most of the minimum data inputs recommended by GFI are already collected and managed through various Scottish Government initiatives.
- Data already collected as part of the Energy Performance Certificate (EPC) approach would make a particularly important contribution. Enabling software and guidance could be incorporated for efficient integration of data from EPC data models. In Scotland, the EST Home Analytics Scotland team has made some advancements with modelling and integration that could potentially be learnt from and built on to support the development of a logbook.
- Data inputs that are considered an 'advanced' element of a log book (such as energy consumption, circularity considerations and indoor comfort) are typically held by other stakeholders. These inputs could help with whole lifecycle carbon monitoring and provide guidance to households based on occupant behaviour.

7.2.2 Renovation roadmap

- The research suggests that renovation guidance should outline a long-term (around 20 years) step-by-step roadmap to achieve deep renovation.
- Stakeholders across the various GBP or BRP initiatives have also recommended that renovation guidance should be based on a specialist survey by a qualified professional. For the UK, PAS 2035:2019 introduced overarching guidance for longer term retrofit planning and stakeholders are continuing to work on more detailed guidance and formal standards.

7.2.3 Enabling connections

- All stakeholders have indicated that it is critical to work on property owner awareness-raising and education to help increase the uptake of interest in BRPs.
- The provision of key supporting information also enables property owners to easily access trusted stakeholders and identify available funding for retrofit works. In Scotland, Home Energy Scotland provides general advice on energy in the home and suitable financing options.

- Feedback from BRP initiatives found that working with larger commercial partners could help drive significant consumer change.
- Collaborations with academia and research institutes could also be beneficial. As an example the current Wales ORP initiative includes working with universities to trial consumer engagement approaches.

7.3 Potential implementation, costs and wider support

- BRPs have not yet reached maturity and many challenges have been encountered with implementation. There are complexities with integrating data from various sources that could potentially take significant time and resource to overcome.
- Most initiatives include free on-site audits and digital platforms for lodging information. Ireland's pilot BRP initiative projected that the cost to develop a BRP is €600 - €750/dwelling. Similarly, France is considering a maximum fee of €400 for on-site audits for their energy efficiency passport (currently free). Germany subsidises up to 60% of onsite audits to a maximum of €800 for single and two-family buildings. Models such as recovering audit costs via financing, and tiered costs for different dwelling sizes, are still being explored.
- All stakeholders highlighted that clear distinction is needed between who owns and who should have access to building data (i.e. personal data vs property data). UK stakeholders have published recommendations for data governance good practice. Suitable pathways for data to be shared or made publicly available are also still being investigated in various initiatives.

8 Annexes

Annex 1: Wales initiative: Optimised Retrofit Programme (ORP)

The Welsh Government aims to decarbonise all Welsh homes by 2050 and has a target that social homes must achieve a minimum EPC rating of A by 2033[43]. The BRP concept is incorporated with a key part of the decarbonisation plan, which is the Optimised Retrofit Programme (ORP) that was launched in 2020. The ORP and net zero performance targets are based on research with the Welsh School of Architecture and the recommendations in 'Better Homes, Better Wales, Better World' published in 2019[44]. The main aims are to learn how to upgrade social homes well at an optimised cost, help tenants reduce the amount of carbon produced in powering and heating homes, tackle concerns about the quality of retrofit work, support supply chains and facilitate the overall development of the retrofit industry (potentially leading to as many as 15,000 jobs in Wales). The ORP will help set the Wales standard for retrofit schemes and is hoped that it will provide learning to other, non-social housing, programmes such as the Welsh Housing Quality Standard (WHQS) and Warm Homes Programme, with potentially 300,000 social and fuel poor homes over the next 10 years.

The ORP adopts a whole house approach to decarbonising existing homes considering the building fabric, heating and renewables/energy storage, and energy supply. An audit is conducted to create a retrofit plan within a digital passport, setting out when work will

[43] Welsh Government (2021) Net Zero Wales plan, carbon budget and sustainability appraisal
[44] Decarbonisation of Homes in Wales Advisory Group (2019) Independent review on decarbonising Welsh homes

be done. PAS 2035 has been adopted for one of the trials with the other exploring the development, testing and use of a bespoke detailed survey methodology. The programme will explore the creation of software that can automatically generate retrofit plans based on various inputs, somewhat like the process for EPC recommendations. Overall, the project aims to trial and refine digital tools and new approaches, which enables comparison with and further development of existing guidance. The programme will also help build relevant foundational skills and training. The Welsh Government is working with the further education sector to support development. Welsh colleges have begun to prepare by developing retrofit academies and the Construction Industry Training Board (CITB) has begun to develop accredited standards for the training. Multiple stakeholder groups, such as the Federation of Master Builders and the Builders Merchants Federation, are also involved to promote the opportunities that will be created for SMEs. Community involvement to find the right solutions for the home and the resident is also considered vital to success[45].

Social landlords were invited to apply for funding of up to £0.5 million for research and innovation projects that address a range of challenges from consumer acceptance to improving the impact of retrofit. Although the focus is on social housing sector, the hope is that establishing a long-term retrofit industry will enable retrofit of the private housing sector. The 2020-21 budget was **£19.5m** (£17m from Homes & Places; £2m Economic Development Funding; and £500k Innovation funding)[46]. Work has commenced in over 1,700 homes. Off gas grid properties which can be difficult and expensive to heat are a focus of the programme and some of the trials will include heat pumps, intelligent energy systems (IES)[47] and solar panels. At the beginning of November 2021, Welsh ministers announced the allocation of an additional **£150m** to the ORP.[48] There are no programme results as the first set of monitoring will occur during the 2021/22 winter season. The supply of microchips that are an essential part of controlling the IES systems has also been impacted by global supply chain challenges, and this may cause some delay, but results will be publicly shared when available.

[45] Welsh Government (2021) Written Statement: The Optimised Retrofit Programme 2020-21
[46] Innovative Housing Programme Optimised Retrofit presentation
[47] The IES is intended to be a long-term installation within the home, capable of being expanded to incorporate new technologies (open source and future proof). It monitors energy usage to demonstrate current performance, impact of physical measures and changes in occupant behaviour. It controls energy usage to optimise cost and carbon benefits.
[48] Welsh Government announces additional £150m to retrofit social housing

Annex 2: Example BRP framework data inputs

UK GFI's recommended BRP building logbook data inputs

Table 2 – Data inputs from UK GFI's recommended building renovation passport/plan framework

Component	Minimum & Advanced data inputs
Ownership & governance	Tenure (Freehold/ leasehold/ commonhold)
	Owner occupied or rented
	Owner's details
	Managing agent details (if applicable)
	Occupier details (if different to owner)
	Obligations or restrictions on works and upkeep specified in the lease, title deeds, restrictive covenants or elsewhere
	Restrictive covenants
	Current and historic valuations
	Copy of lease/title deeds or commonhold as appropriate
Building information	Unique Property Reference Numbers (UPRNs), which include Unique Street Reference Numbers (USRNs), Address, Latitude, longitude, and azimuth
	Age and/ or era
	Topographic Identifier (TOID)
	Planning permission (and building warrants in Scotland); certificates of lawful development and building regulation approvals
	Conservation area; listed building status; identified radon area
	Title number
	MPRN/MPAN numbers
	Area around the property (i.e. for installing equipment such as air source heat pumps)
Building type	Building typology
	Number and arrangement of floors
	Floor plan
	Floor area and building volume
	Number of bedrooms
	Number of bathrooms
	Layout of whole building for multi-unit properties (i.e. block of flats, terrace housing)
	Presence of/suitability for EV charger
	Roof area/usable roof area
	3D representation of building identifying massing, features, glazing areas, materials, surrounding features.
	Typical extensions routes for building type (based on surrounding works)
	Street parking
Building Services	Energy supply and storage (i.e. mains electricity, fossil gas, heat network, oil, on-site generated solar thermal, etc)
	Heating system
	Ventilation provisions
	Fire safety measures
	For multi-unit properties (i.e., block of flats), information on communal features and services
	EV charging station (including communal access)
	Maintenance records and information (i.e. commissioning and/ or servicing reports)
	Access to private energy source (e.g. district heat)
	Air conditioning system (if applicable)
	Energy network constraints (i.e. capacity constraints, 3-phase supply limitations etc)
	Local Energy network flexibility value streams (DNOs & Energy Management Aggregators)
	Any existing and planned local energy schemes (district heat, Energy Service Companies, community energy schemes)

Component	Minimum & Advanced data inputs
Building Fabric	
	Construction Type
	Materials Used
	EPC rating and data contained within certificate (EER, EIR and RdSAP)
	Recent renovations and/or retrofits including year, size, description etc
	warrantees (eg for heating system)
	Certification records
	Defects and location (eg construction, structural, leaks, condensation, mould)
	Materials records
	Rapid testing solutions such as HTC Smeter and PULSE air pressure tests (pre-retrofit survey)
	Maintenance Info (ie for heating installations)
	Technical specs (ie for heating installations)
	Building Features
Energy consumption & use behaviour	Total annual electricity use kWh
	Total annual fossil gas use kWh
	Total annual kWh/m^2, per fuel
	Total annual CO_2/m^2
	Total annual GBP on energy / m^2
	Tariff(s)
	Smart meter data
	Any other smart devices and credentials
	Number / area of heated rooms
	Metered energy savings
	Real-time data on performance
	Heat demand
	Thermal imagery/3D scanning (relative material vs thermal performance, visual/visible texture mapping)
Indoor comfort monitoring	Indoor air quality (humidity; particulate matter (i.e., PM10, PM2.5))
	CO_2 monitoring
	Indoor room temperature
	Daylight
	Air change rates
Circular economy considerations & enhanced climate information	Environmental Product Declarations (EPD) for retrofit materials and systems
	Construction details
	Sustainable material use
	Toxicity considerations
	Capacity for deconstruction
	Component change/reuse
	Embodied carbon (likely derived from other inputs and sources)
	Energy carbon intensity
Climate resiliency	Flooding risk
	Coastal erosion
	Subsidence risk
	Overheating risks (i.e. CIBSE TM59 assessments)
	Measures taken to mitigate risks
	Green space
	Tree canopy cover

European iBRoad logbook data structure

Table 3 - Data inputs from European iBRoad logbook

Level 0	Level 1	Level 2 Core & Complimentary data inputs
General and Administrative Information	Building ID	1. National code
		2. Inspire ID
		3. Energy suppliers ID
	Address	1. Geo Coordinates
		2. Address data
	Property ID	1. Legal registration
		2. Fiscal registration
	Building general features	1. Building
		2. Building Unit
	Licenses and Plans	1. Urban Licenses
		2. Design Plans and Designers
	Conservation Stats	6. Conservation Status 1. Evaluation of the conservation status
	Building User	1. Building user information
		2. User profile
	Other Building Information	1. Governmental taxes and incentives
		2. Financial Programs
		3. Real estate information
		4. Energy and Construction market
Building Construction Information	Technical Building Systems	1. Ventilation systems
		2. Heating systems
		3. Cooling systems
		4. DHW systems
		5. Lighting systems
		6. Building automation & control (BAC)
	Envelope	1. Walls
		2. Roofs
		3. Floors
		4. Thermal bridges
		5. Doors
		6. Windows
Building Energy Performance	EPC General information	1. Expert name
		2. Expert ID
		3. Type of EPC
		4. EPC Number
		5. Energy label
		6. Issue date
		7. Term date
		8. Photograph report
		9. EPC support documentation
	Audit General Information	1. Expert name
		2. Professional order

		3. Audit date
		4. Energy label
		5. Photograph report
		6. Energy audit support documentation
	Energy and other Indicators	1. Energy use
		2. Delivered energy
		3. Primary energy
		4. Environmental and energy indicators
		5. Other indicators
		6. Comfort level
	Recommendations	1. Individual impact
		2. Collective impact
Building Operation and Use	Energy Consumption	1. Energy source
		2. Metering system information
	Energy generation	1. Renewable energy source
		2. Metering system information
	Energy Suppliers	1. Energy source
		2. Metering system information
	Inspections	1. Building element
		2. Inspection information
	Maintenance	1. Building element
		2. Maintenance information
	Climate Data	1. Weather Data
Smart Information	Smart Indicator	1. SRI - Smart Readiness Indicator
		2. Other smart indicators
	E Mobility	1. EV charging points
	Smart District	2. Smart district indicators

European ALDREN BuildLog modules

Table 4 - EU ALDREN BuildLog modules

Module	Description
Documentation	Overall indicators related to the existing materials for different issues to check the availability and format of all the information. This includes components like building address, building alititude, local climate, building volume, number of rooms, etc.
Building Picture	Indicators that outline the current state of the building in terms of geometry data, location, documentation, certification, technical components, general information of ownership (high level examples below).
	Building features
	Location data
	Weather data
	Building geometry
	Envelope: wall; windows; floor; roof
	Technical Building System: space heating; space cooling; domestic hot water; ventilation; renewable energy; metering; EV charging
Energy Rating and Target	A consistent, harmonized, unique European energy performance rating, based on ISO/CEN standards, offering comparability and transparency across the EU to provide a common metrics and highlight the quality for financial instruments connected with renovation. A rating scale with classes from A-G has been defined to compare and identify in priority the buildings fitting best for deep renovation and to evaluate the impact of renovation actions on energy performance
Energy Verification	An energy Performance verification framework allowing actual (measured) performance to be compared with simulated (predicted) performance. It encompasses a “Design for Performance” protocol that sets out and tracks the actions required during the deep renovation process. It also includes a “Performance Verification Tool” (PVT) to compare predicted and actual performance at different levels of granularity
Comfort and Wellbeing	A health and well-being assessment protocol. It is based on an index called ALDREN-TAIL to rate the Indoor Environment Quality (IEQ) of buildings undergoing deep renovation, focusing on 4 key components: Thermal environment (T), Acoustic environment (A), Indoor air quality (I), Luminous environment (L). TAIL ratings can and should be evaluated before and after renovation.
Cost Value Risk	A protocol to evaluate impacts of energy and non-energy benefits associated with deep renovation on the financial value and risks of office and hotel buildings. The information and sustainability metrics provided by the 3 previous modules and the Renovation Roadmap of the ALDREN BRP (see below) is shared with financial valuation experts who compare the financial impacts – costs, risks and value – associated with different renovation scenarios

Building Passport (Global Alliance for Building and Construction)

GABC's building passport is a tool for capturing and managing whole lifecycle data and information in construction and real estate. It is flexible and modular to enable data and information categories to be added and updated over time. Options for Building Passport data categories are shown in Figure 2 and Table .

Figure 2 - GABC Building Passport options for data categories[49]

Table 5 - GABC Building Passport category options

A1	Identification of plot and plotrelated characteristics (including tenure)
B1	Identification of building
B2	Design documents
B3	Contracts (including any responsible procurement provisions, documentation related to workers conditions and equity)
B4	Certificates (e.g., building report / certificate / documentation related to processes of community engagement prior to construction)
B5	Energy Performance Certificate / sustainability label
C1	Material inventory (including, where obtainable, documentation of source, e.g., environmental product declaration and / or assessment of risk of labour abuses)
D1	Surfaces, cubatures
D2	Building description
D3	Technical features and characteristics
D4	Dismantling and recycling strategy (including workers safety)
E1	Use and operation data / consumption
E2	Maintenance manuals
E3	Proof of maintenance (including contracts / documentation in regarding working conditions - also for subcontractors)
F1	Environmental performance and carbon footprint
F2	Impact on occupant health (e.g. indoor air quality, access to natural daylight) and local environment
F3	Results of user satisfaction surveys
F4	Operational cost

[49] GABC (2021) The Building Passport Practical Guidelines p.24

Annex 3 Summary table of building renovation passport schemes or similar in other countries

Table 6 - Examples of building renovation passport schemes or similar, such as one stop shop models

Name	Data Manager	Approach	Timeline & costs	Uptake & limitations	Other notes
Europe **Individual building renovation roadmap (iBRoad)**	EU H2020 programme with partners from Belgium, Germany, Austria, Greece, Portugal, Poland, Bulgaria, Sweden, and Romania	Government and industry research project; digital logbook and renovation roadmap (iBRoad); software for auditors ('roadmap assistant')	2017-2020 Project budget €1,957,095	15 to 20 pilots per country with local certified energy auditors; 10 auditors trained in each pilot country; positive auditor and user feedback on roadmap and logbook.	Most important aspects that respondents wanted were the estimated costs of each renovation step, the expected benefits of reduced heating consumption/bills and technical information to help avoid mistakes. The iBRoad has also been analysed for multi-family homes and non-residential buildings to recommend specific adaptation considerations.
Europe **ALliance for Deep RENovation in buildings (ALDREN)**	EU H2020 programme with partners from France, Slovakia, Spain, Belgium, Italy, and UK	Government and industry research project; digital platform; logbook and renovation roadmap ('RenoMap'); financial risk evaluation; incorporation of EPBD European Voluntary Certification (EVC) scheme	2017-2020 Project budget €1,982,206 At least 60% energy savings between before and after renovation	17 deep renovation pilots (offices and hotels) in France, Slovenia, UK, Spain, each >10000 m² where possible.	For non-residential buildings, particularly office and hotel typologies. Structure also suitable for residential. ALDREN Alliance established to better specify stakeholder needs and reflect in further protocol development.
Belgium **Flemish Building Renovation Passport (Woningpas)**	Flemish Government: Flemish Energy and Climate Agency, Flemish Agency on Housing, Public Waste Agency of Flanders, and Flemish Department of Environment	Mandatory government-led digital platform; logbook and renovation roadmap (iBRoad); insurance and property obligations; financing options; digital tools (calculate indicative EPC, housing quality test); decorbonisation monitor	2018 decree issued for digital passport; free platform Initial investment: €1.5 million for platform design, technical analysis (information architecture), proof of concept, hosting the infrastructure, license fees, overall tool development Annual cost: €400,000 for correctional maintenance, license fees, hosting, processing of questions, hiring specific roles	Over 3 million dwellings in 2021; high user interest during buying, selling or renting; positive feedback on EPC and housing quality tools. Key challenges: information exchange, lack of EPC data.	Central role in Flemish 2050 long-term renovation strategy. Primary focus on user experience. New Flemish EPC (2019) includes staged renovation guidance and estimated costs. Expansion: €400,000/annum for platform design, analysis and development of common functionalities and thematic additions. Analysis and development costs carried by the responsible organisation for data.

Name	Data Manager	Approach	Timeline & costs	Uptake & limitations	Other notes
Ireland **Sustainable Energy Authority of Ireland (SEAI) BRP pilot**	Sustainable Energy Authority of Ireland (SEAI); delivered by Ireland Green Building Council (IGBC) and Limerick Institute of Technology (LIT).	Government and industry research project; digital logbook and renovation roadmap (iBRoad); training from iBRoad specialist.	2019-2020 Project budget €115,000 Assessor budget in project €500/property Projected cost to develop BRP is €600 - €750/dwelling. Costs may be reduced with access to EPC data (input data and not just EPC reports).	20 single-family households; 10 assessors trained from various backgrounds such as architects, engineers, and EPC assessors; feedback highlighted a gap between what householders were expected to pay and willing to pay.	Key stakeholders included the DCCAE due to their responsibility for the management of renovation plans and housing standards. Improvements were consequently made to the EPC / Building Energy Rating (BER) advisory report and a one-stop-model run by private organisations has been recommended to help market development (see below).
Ireland **Superhomes Ireland**	SEAI, the Electricity Supply Board (ESB), and Limerick Institute of Technology (LIT); co-funded by EU H2020 programme; delivered by Tipperary Energy Agency (TEA).	Government (EU and Irish) supported deep renovation one-stop-shop model; technological and financial support to householders; on-site audit; subsidies up to 50% of renovation cost to bring pre-2011 buildings to BER rating A3 (new build requirements), or as close as financially and technically feasible.	2019+ Of proposed renovation packages, 33% were accepted and the average cost was €33,000. User feedback found that 80% were happy with a payback period of 5-7.5 years, while 60% were happy with up to 10 years.	80 deep renovations in 2019 with average primary energy saving of 71% and average annual energy cost reduction of €1,800. Of homeowners who did not renovate, barriers include cost and a lack of understanding what and how to make improve improvements.	The main aim is to demonstrate and test the decarbonisation pathway using independent, expert led, renovation focussed on insulation, air-tightness, ventilation, solar and heart pumps. Expanded and improved 'Superhomes 2030' scheme aims to rapidly scale up the model by developing four regional one-stop-shops (with finance solutions independent of public finances). Electric Ireland Superhomes has already been established.
France **Energy Efficiency Passport (Passeport Efficacite Energetique)**	Experience P2E (Shift Project, Cercle Promodul, EdF, Saint-Gobain, Schneider Electric).	Digital platform; logbook and renovation roadmap; part of the digital notebook for monitoring and maintenance of housing (Article 11 of the TECV law).	Onsite assessment currently free. Future considerations - introducing a maximum fee of €400 or recovering costs via financing programmes. If fee introduced, exceptions for low-income households.	Mandatory for new buildings from January 2020 and will be for buildings undergoing a change from January 2025.	French Shift Project indicates that building owners are on average willing to pay around €105 and most stakeholders thought €200-€500 was a reasonable cost for a single-family house, followed by €50-€200 (22%) and €500-€1000 (19%).
Germany **HeizCheck**	Private non-profit	automated renovation advice; data registry.		1,600 HeizChecks issued weekly; over 1 million users.	

Name	Data Manager	Approach	Timeline & costs	Uptake & limitations	Other notes
Germany **Individual Renovation Roadmap – iSFP & Sanierungsfahrplan BW)**	Government (Economics, Energy)	Government led programme; renovation roadmap; tailored renovation advice, on-site audit, integrated with other instruments and policies.	A grant subsidises up to 60% of an onsite audit to a maximum of €800 for single and two-family buildings, or €1100 or more for dwellings with three or more families.	2015 pilot, now adapted across the country.	Does not foresee the introduction of a digital logbook associated with the renovation roadmap.
Denmark **BetterHome**	Danfoss, Grundfos, the ROCKWOOL, and VELUX Groups	Private organisations; digital platform; tailored renovation advice; on-site check; smart data solution; energy savings range from 30-70%.	First inspection is free. Deep renovation projects circa €70,000 financed by owner companies.	200 projects/year (2016).	User-centric with a focus on deep renovations, adapting the role of installers, offering multiple benefits and innovative technologies.
France **Picardie Pass Rénovation**	Government	tailored renovation advice; on-site audit, integrates financial options.	Free on-site audit; 3rd party financing with grants from ADEME, ELENA and FEDER, loan from European investment bank.	By 2018 - 7,288 single-family houses had had first contact - 2,758 energy audits and 868 renovations were planned/completed; 24 condominiums (2,606 dwellings) had first contact - 14 (1,207) energy audits and 7 (863) renovations planned/completed.	
Portugal **CASA+**	ADENE (National Energy Agency)	Digital platform; renovation advice.	Free to use	Since September 2020, 27 companies signed up.	
Australia **Electronic Building Passport**	Queensland University of Technology, Pitt & Sherry	Digital platform; renovation advice.		Pilot tested with 30-50 min phone call to each council to set up functionality.	Voluntary collaboration from many South Australian councils.
Canada **Rénoclimat**	Québec Government	On-site audit; tailored renovation advice; financial options.	2007+. 50% of energy assessment covered. Insulation of external wall ranges from $295 to $2,440 (≈ €196 to €1622) depending on amount being reinforced.	An energy advisor carries an on-site energy assessment before and after the renovation. Assistance is provided for insulation work (airtightness, replacing doors and windows) or installing or replacing mechanical systems (ventilation system, water heater, heat pump, geothermal heating system).	

Annex 4: Example BRP initiatives

Flemish building renovation passport: Woningpas

The Flemish building renovation passport is a mandatory government-led online platform with a primary focus of creating a user experience that encourages householders to learn more about their buildings and comprehend retrofit guidance. The new Flemish EPC (updated in 2019) includes staged renovation guidance and estimated costs.

Flanders (Belgium) has increased their level of ambition from fragmented improvements to deep renovations of all existing houses. A multi-stakeholder partnership was established to create a long-term action plan to 2050 for residential buildings. A key action was the development of a housing passport to monitor and register the evolution of every single home towards the long-term objective. In 2018, a decree was issued for the digital passport to centralise all information about a building and to be accessible online by the owner of the building. The digital passport, the 'Woningpas', is the main repository of building information such as energy performance (evolution), renovation advice, housing quality, equipment maintenance recommendations, insurance and property obligations, and financing options for renovation projects, e.g. incentives, tax credits, green loans. The platform is free to use, and data is gathered from various sources such as certificates from mandatory assessments and/or inspections. There is a 'test your EPC' tool that calculates a building's indicative EPC and compares it to other regions and municipalities. There is also a 'Housing Quality Tool' that tests various parameters such as moisture, stability, etc. The end user, and owner, of the passport is the property owner.[50]

The first released version (the 'light' version) was only accessible by the householder and provided building insights from any available documents. The aim was to start raising awareness and encourage users to become more interested in their building information. Feedback from users was incorporated with the development of an updated version (the 'medium' version) that was launched in 2020. This version enabled users to register renovation work and share the passport with third parties. In 2021, a digital safe was added to facilitate the storage of more documents such as building plans, reports, invoices, etc. The focus of the safe is to share information (excluding personal data) because access will be passed on to the next owner. There is ongoing work to incorporate more data such as personal energy use and to formalise the inclusion of retrofit plans. Flanders introduced an updated EPC in 2019 that outlines sequenced renovation recommendations with impact and estimated costs in alignment with their 2050 target.[51]

The BRP ownership structure, initial investment to develop the systems and tools, and ongoing maintenance and expansion commitments, are outlined in Figure 8.

[50] Flemish Energy and Climate Agency (2021) The Flemish Building Renovation Passport – Moving Forward Together!

[51] Vlaanderen (2021) EPC for a dwelling – Conditions (Sample EPC)

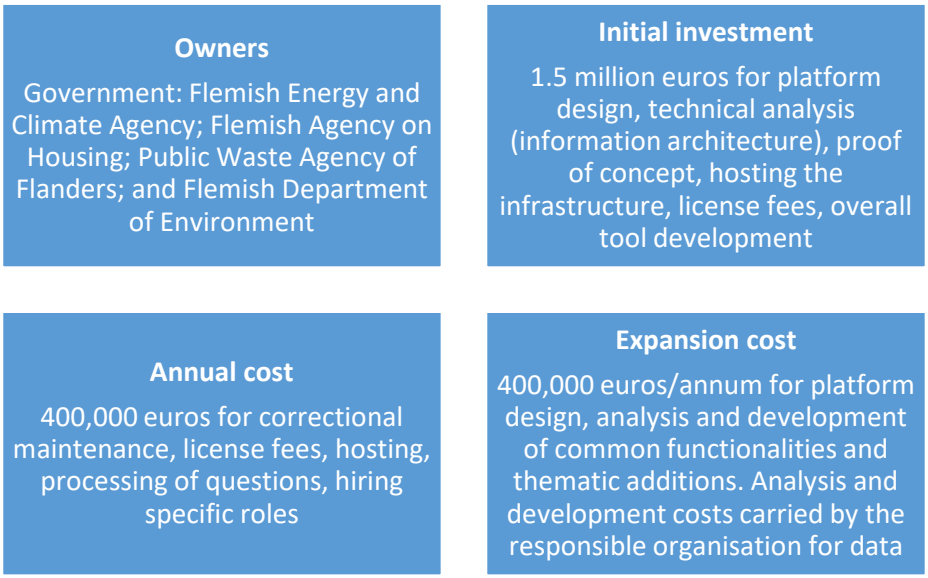

Figure 8 - Flemish BRP overview of ownership, investment and ongoing costs

Feedback from the light version encouraged Flanders to continue development. High interest was especially expressed during the process of buying, selling or renting. There was also positive feedback on the tools that have been incorporated. A key implementation challenge was information exchange (gathering data from various sources into a centralised platform). The passport was therefore started with partners that were able, or willing, to adapt their systems and functionality. Now that the platform is in use and development is progressing, more entities have adapted their systems or expressed interest in the ability to share information. Feedback is still being collected for the medium version, but a highlighted shortcoming so far is Flanders lack of EPC data.

Steps are being taken to increase requirements for EPCs such as direct links to financial support and mandatory requirements to have EPCs by 2026. In 2016, 5-year property tax incentives were introduced for deep renovations with a total amount of combined subsidies for deep renovations ranging between €10,000 and €20,000 per house.[52] A renovation obligation is proposed that requires renovation within 5 years of purchase. To increase usage of the passport platform, more targeted communication will commence in 2022 after more useful content has been incorporated.

EU individual building renovation roadmap (iBRoad)

The iBRoad was a European research project that developed and tested a building renovation roadmap and logbook for single-family homes in multiple countries. Software (roadmap assistant) was created to help assessors to produce roadmap documents.

The individual building renovation roadmap (iBRoad) was an EU Horizon 2020 project from 2017-20 with an overall budget of €1,957,095. Partners were from Belgium, Germany, Austria, Greece, Portugal, Poland, Bulgaria, Sweden and Romania. The main driver was to eliminate barriers to staged deep renovation by developing a renovation roadmap. The roadmap was developed for single-family houses and provides a customised renovation plan over a long-term period (10 to 20 years). It considers the occupants' needs and specific situations (age, financial situation, composition and expected evolution of the household, etc.). It avoids the risk of 'locking out' future renovation solutions due to a lack of foresight by addressing the complexity of renovation works and ensuring coordination over different stages. The roadmap is combined with a building logbook where all building related information can be stored

[52] Flemish Energy Agency (2016) Implementation of the EPBD in Belgium – Flemish Region

and updated. Software was created, referred to as the 'roadmap assistant', for more efficient and standardised data collection and calculations by the auditor and automated data centralisation.

In preparation for iBRoad testing, preliminary market research was conducted. The most important aspects respondents wanted to see in a renovation roadmap were the estimated costs of each renovation step, the expected benefits in terms of reduced heating consumption/bills and technical information to help them avoid mistakes. Pilot testing included 15 to 20 buildings per country with local certified energy auditors. Ten auditors received training in each pilot country. Householder and auditor feedback were very positive about both the roadmap and logbook.[53] The research project has ended; however, project partners have continued to assist with wider development and implementation, such as the EU research project X-tendo (2019-2022).[54] The iBRoad has also been analysed for multi-family homes and non-residential buildings to recommend specific adaptation considerations.[55]

Sustainable Energy Authority of Ireland (SEAI) BRP pilot

The SEAI BRP pilot tested the practical application of the iBRoad framework on 20 single-family households after recruiting and training 10 assessors.

The Irish Green Building Council (IGBC) and the Department of Communications, Climate Action and the Environment (DCCAE) conducted a consultation process in 2017 to codesign a national renovation strategy with close to 200 key stakeholders. One of the key recommendations to facilitate energy renovation was the introduction of building renovation passports. In 2019, the Sustainable Energy Authority of Ireland (SEAI) provided funding (**€115,000**) for the IGBC, along with the Limerick Institute of Technology (LIT), to explore the feasibility of using BRPs in Ireland. Following a literature review on existing approaches, the project team selected the iBRoad approach as approach that was already developed was considered more feasible for the small trial rather than trying to create a new approach.

The iBRoad framework was slightly adapted for the local market and 20 single-family households were recruited. The assessor budget was €500/property and 10 were recruited with various backgrounds such as architects, engineers, and EPC assessors, to create diversity in the selection. An iBRoad specialist provided one day of training and, upon conclusion of the audits, householders and assessors were surveyed on their experience. Other key stakeholders included the DCCAE due to their responsibility for the management of renovation plans and housing standards. The assessors estimated that developing the roadmap and logbook would cost between **€600 - €750** per dwelling and that costs may be reduced if there is access to EPC data (assumed to be the EPC input data and not just the EPC output reports). The study found a gap between what householders were expected to pay and how much they were willing to pay but overall, the majority would recommend the roadmap and logbook if it costs less. The conclusions were that improvements to the EPC / Building Energy Rating (BER) advisory report could be a good first step (and this has now been done), but further elaboration would be needed in the form of a BRP or similar, as it is based on a detailed onsite visit from an assessor who discusses the needs, future plans and financial flexibility of the building owner to develop the roadmap. SEAI's longer-term view was that the logbook, roadmap

[53] Institute for Energy and Environmental Research (2019) Test driving the Individual Building Renovation Roadmap and Logbook
[54] X-tendo aims to support public authorities with improving compliance, reliability and usability of energy performance assessment and certification.
[55] Institute for Energy and Environmental Research (2020) Beyond the single-family house – potential extension of iBRoad to other building types

and dwelling energy assessment procedure (DEAP) file should be connected. As an interim step to give the Government more time to develop the necessary tools for the market, a recommendation was for the BRP to be run by a private organisation for a few years as a one-stop-shop model (see below for more information).[56]

Superhomes Ireland

Superhomes is a deep renovation one-stop-shop model supported by the Irish Government and EU research funding. Superhomes 2030 aims to rapidly scale up the model by developing four regional one-stop-shops.

Superhomes is an Irish one-stop-shop project that has increased the number of deep energy renovations by providing technological and financial support to householders. It was developed through collaboration between SEAI, the Electricity Supply Board (ESB), and Limerick Institute of Technology (LIT), co-funded by the EU H2020 programme and is delivered by the Tipperary Energy Agency (TEA). The main aim is to demonstrate and test the decarbonisation pathway using independent, expert led, renovation focussed on insulation, air-tightness, ventilation, solar and heart pumps.

Superhomes offers subsidies to building owners of up to 50% of the renovation cost for renovation that brings pre-2011 buildings to an BER rating band A3 (which corresponds with requirements for a new building), or as close as financially and technically feasible. Within the project, an on-site audit is conducted that goes beyond the common BER assessment. The complexity of a deep renovation is simplified and presented in a digestible way to the householder, while the recommendations are tailored to the specific building and the incentives of the householder. To receive financial support, the householder is required to upgrade certain parts of the building. There were 80 deep renovations in 2019 with an **average primary energy saving of 71%** and **average annual energy cost reduction of €1,800**. Of the proposed renovation packages, 33% were accepted (mainly through secured debt) and the average cost was **€33,000**. Feedback from a potential user survey found that 80% were happy with a payback period of 5-7.5 years, while 60% were happy with up to 10 years. There were much lower responses for retrofit with over 10 years payback and among homeowners who decided not to renovate, 69% stated the barrier is the cost of the works followed by 38% highlighting a lack of 'understanding of what and how to improve my home specifically'.[57]

Superhomes has demonstrated technical implementation and started to raise awareness but the market still requires further development assistance, with lower reliance on early adopters. The expanded and improved Superhomes 2030 scheme aims to scale up the offer from a model that completes 100 (€6m worth of) retrofits per annum to 500 (€36m) per annum by 2023 and 3,000 (€150m) per annum by 2030 – resulting in 48 GWh savings (2020 to 2023). The ambition is to develop four regional Superhomes one stop shops (Electric Ireland Superhomes has already been established[58]) that: engages 80 high performance contractors; provides capacity building and training for over 200 homeowners, surveyors, contractors and technical staff; delivers over €67m per annum by 2030 of attractive finance solutions independent of public finances via the optimisation of technical analysis and design systems and solutions. It also aims to create **open source energy performance data platforms** that demonstrate the value of undertaking net zero energy building (NZEB) retrofits to the market.[59]

[56] IGBC (2020) Building Renovation Passports
[57] Tipperary Energy Agency Superhomes - Financing Home Renovation
[58] Electric Ireland Superhomes (2021) A 'one stop shop' for your home energy retrofit
[59] Tipperary Energy Agency (2021) Superhomes 2030 Overview

9 Key resources

Table 1 - List of some of the key references used throughout the research

Year	Title	Source	Link
2021	Building Renovation Passports: Creating the pathway to zero carbon homes	Green Finance Institute	https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2021/03/GREEN-FINANCE-BUILDING-RENOVATION-final.pdf
2021	Building Renovation Plans	Green Finance Institute	https://www.greenfinanceinstitute.co.uk/green-finance-institute-launches-uk-framework-for-building-renovation-plans/
2021	Towards a protocol for metered energy savings in UK buildings	Green Finance Institute	https://www.greenfinanceinstitute.co.uk/bringing-buildings-energy-measurement-into-the-21st-century-green-finance-institute-puts-forward-new-protocol/
2021	The Flemish Building Renovation Passport – Moving Forward Together!	Flemish Energy and Climate Agency	https://bereel.be/sites/default/files/atoms/files/E8_210126_Artikel%20Flemish%20Building%20Renovation%20Passport.pdf
2021	The Building Passport	Global Alliance for Building and Construction	https://globalabc.org/news/new-report-building-passport-practical-guidelines
2021	Warmer Homes Scotland Annual Report 2020/21	Warmworks Scotland	https://www.warmworks.co.uk/wp-content/uploads/2022/03/Annual-Report-2020-21.pdf
2020	Sixth Carbon Budget: Buildings	Climate Change Committee	https://www.theccc.org.uk/publication/sixth-carbon-budget/
2020	Financing zero carbon heat: turning up the dial on investment	Green Finance Institute	https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2020/12/Financing-zero-carbon-heat-turning-up-the-dial-on-investment_Green-Finance-Institute.pdf
2020	Digital Building Passports: The Future of Structures?	Design and Build Review	https://designbuild.nridigital.com/design_build_review_apr20/digital_building_passports_future
2020	Introducing Building Renovation Passports in Ireland	Irish Green Building Council	https://www.igbc.ie/wp-content/uploads/2020/09/Introducing-BRP-In-Ireland-Feasibility-Study.pdf
2020	Technical study on the possible introduction of optional building renovation passports	European Commission's Directorate General for Energy	https://op.europa.eu/en/publication-detail/-/publication/a38ea088-aead-11ea-bb7a-01aa75ed71a1/language-en

2020	Beyond the single-family house - Potential extension of iBRoad to other building types	Institute for Energy and Environmental Research	https://ibroad-project.eu/news/beyond-the-single-family-house/
2020	My path towards an energy efficient home - Layman's report	Sympraxis Team	https://ibroad-project.eu/news/my-path-towards-an-energy-efficient-home-laymans-report/
2020	Electronic Building Passport: The role of an Electronic Building Passport for energy efficiency compliance and quality assurance in residential buildings	Department of Energy and Mining, Government of South Australia	https://eprints.qut.edu.au/205841/1/NEEBP32_Electronic_Building_Passport_public_report_final.pdf
2020	The ALDREN Building Renovation Passport for Non-Residential buildings: a modular digital instrument to support the Renovation Wave	REHVA European HVAC Journal 04/2020	https://www.rehva.eu/rehva-journal/chapter/the-aldren-building-renovation-passport-for-non-residential-buildings-a-modular-digital-instrument-to-support-the-renovation-wave
2020	PAS-E Building Passport Spain	Spain's Green Building Council	http://pas-e.es/book/pas-e_en.html
2020	EPC for Buildings Action Plan	MHCLG and BEIS	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922660/EPC_Action_Plan.pdf
2019	UK housing: Fit for the future?	Climate Change Committee	https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf
2019	Stepwise and structured: Surrounding policy instruments to support the iBRoad approach for building renovation take-off	Institute for Energy and Environmental Research	https://ibroad-project.eu/news/stepwise-and-structured/
2019	Test driving the Individual Building Renovation Roadmap and Logbook	Institute for Energy and Environmental Research	https://ibroad-project.eu/news/test-driving-ibroad/
2019	PAS 2035:2019	British Standards Institute	https://standardsdevelopment.bsigroup.com/projects/2020-02768#/section
2019	How can Member States implement iBRoad (individual Building Renovation Roadmap)?	Buildings Performance Institute Europe	https://www.bpie.eu/wp-content/uploads/2020/05/How-can-Member-States-implement-iBRoad.pdf

2019	Better Homes, Better Wales, Better World Decarbonising existing homes in Wales	Decarbonisation of Homes in Wales Advisory Group	https://gov.wales/sites/default/files/publications/2019-07/independent-review-on-decarbonising-welsh-homes-report.pdf
2018	The logbook data quest – Setting up indicators and other requirements for a renovation passport	Buildings Performance Institute Europe	https://ibroad-project.eu/downloads/REPORTD24
2018	Energy Efficient Mortgages Initiative: The Dawn of a New Asset Class?	Energy Efficient Mortgages Action Plan Initiative	https://energyefficientmortgages.eu/energy-efficient-mortgages-initiative-the-dawn-of-a-new-asset-class/
2016	Building Renovation Passports - Customised roadmaps towards deep renovation and better homes	Buildings Performance Institute Europe	https://www.bpie.eu/wp-content/uploads/2017/01/Building-Passport-Report_2nd-edition.pdf
2015	Pilot Electronic Building Passport – Final Report	Queensland University of Technology	https://eprints.qut.edu.au/215287/1/NEEBP-phase-2-project-2-electronic-building-passport-final-report.pdf

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