

Heat in buildings data for digital compliance

Joanne McClelland¹, Aythan Lewes¹, Louis Daillencourt² and Sean Smith³

¹EALA Impacts CIC, ²Novoville and ³University of Edinburgh

February 2024

DOI: <http://dx.doi.org/10.7488/era/4856>

1 Executive summary

The 2023/2024 consultation on the Heat in Buildings (HiB) Bill proposed standards covering heating and energy efficiency that all existing buildings will be required to meet. This report explores the data sources that could be used in future to develop a digital compliance monitoring system for those standards. The standards require:

- In all buildings, including non-domestic premises: non-polluting heating from 2045.
- In owner occupied homes: a minimum energy efficiency standard by the end of 2033.
- In privately rented homes: a minimum energy efficiency standard by the end of 2028.
- Those purchasing a property to comply with the prohibition on polluting heating within a specified amount of time following completion of the sale.
- Providing local authorities and the Scottish Ministers with powers to require buildings within a Heat Network Zone to end their use of polluting heating systems by a certain date and with a minimum notice period.

Compliance with the standards can be met through:

- The presence of a clean heating system, including connection to a heat network.
- Meeting the energy efficiency standard through either installing a list of measures or meeting a fabric energy efficiency rating of 120kWh/m²/year or less.

Compliance with the standard creates a need to check on the progress of Scotland's buildings. This may require a dedicated system. Through desk-based investigation and stakeholder interviews, we identified public and private repositories of information regarding buildings, which could be used to carry out compliance monitoring for domestic and non-domestic properties.

1.1 Findings

We found no digital dataset (or database comprising various datasets) that combines data relevant to the HiB Standard that is highly accurate and with full coverage of all buildings in Scotland. For instance, only 55% of Scottish domestic dwellings have an assessed EPC created following a domestic energy assessment, as opposed to a prediction based on similar nearby properties. As a result, no existing dataset could readily be used for compliance monitoring.

Ultimately, reliable digital compliance monitoring can only be achieved with a high degree of accuracy of the data being inserted and coverage across the whole built environment in Scotland. Our findings include observations around the role of data governance, property identification, professionals and professional indemnity insurance, data consistency, archetype approaches, and data sharing.

1.2 Conclusions

We suggest that an optimal digital solution in terms of coverage and accuracy could be achieved in the near term by combining data from different sources and enriching it with new data. We identify below which datasets are relevant to various aspects of the Standard. This review is on the basis that current update points for EPCs remain the same and that the process is able to adapt and update sufficiently quickly to the new clean heating systems coming onto the market.

Aspect of compliance	Data source	Gap analysis
Heat network zone presence	<ul style="list-style-type: none"> Scotland Heat Map 	<ul style="list-style-type: none"> Local Heat and Energy Efficiency Strategies (LHEES) Heat Network Zones would need to be uploaded to the map by local authorities or the Scottish Government.
Clean heating system	<ul style="list-style-type: none"> EPCs and underlying EPC data 	<ul style="list-style-type: none"> There is a delay of weeks/months between system installation and databases being updated. EPC data in Home Analytics & Non Domestic Analytics is predicted rather than observed for 45% of domestic properties. EPC data is uneven in accuracy.
Various energy efficiency measures applied to building fabric or services controls	<ul style="list-style-type: none"> EPC data PAS2035 data warehouse Single survey Digital building logbook/passports 5-yearly tenement inspections 	<ul style="list-style-type: none"> As above regarding EPC data. PAS2035 is seldom used in Scotland, so the dataset has low coverage. Single Survey data is held privately. Digital building logbooks/passport data is held privately. 5-yearly tenement inspections are not yet mandated by legislation, and it is unclear if they will be digital first.
Fabric based heating demand of 120kWh/m ² /year or less	<ul style="list-style-type: none"> EPCs EPC data 	<ul style="list-style-type: none"> As above regarding EPC data. Uncertain future of the EPC methodology.

Table 1 Existing datasets that could be used to measure compliance

Considering the above, the following options may be considered by the Scottish Government for the establishment of a compliance and monitoring tool. Each option has advantages and drawbacks as well as a set of actions required to enable successful implementation.

Option 1: Use existing data sources in their current locations

- **Option 1a: Homeowner reporting into existing locations – 3 to 6 months to develop**
 - Homeowners are required to self-report into these locations and upload evidence. Government looks individually at these data sources.
 - The responsibility to demonstrate compliance rests with the homeowner, who must generate, gather and upload the relevant information to the data sources to demonstrate compliance to the government.
- **Option 1b: Professional reporting into existing locations (status quo)**
 - Government looks individually at these data sources, which can only be updated by professionals.
 - The responsibility to demonstrate compliance rests with the homeowner, who must pay for generating, gathering and uploading the relevant information to the data sources to demonstrate compliance to the government.

Option 2: Professional reporting from linked databases – 3 to 6 months to develop

- Data sources listed above remain in their current locations.
- Government looks at a single portal, which in turn looks at existing sources that can only be updated by professionals.
- The responsibility to assess compliance rests with the government and the responsibility to demonstrate compliance rests with homeowners or their professional consultants. The government creates a means of collating the data on a per-property basis via a new portal.

Option 3: Professional reporting into a new central database – 12 to 18 months to develop

- Data is moved from existing data sources to a new government-managed platform.
- Government manages a combined dataset that can only be updated by professionals.
- The responsibility to assess compliance rests with the government, and the responsibility to demonstrate compliance rests with homeowners or their professional consultants. The government creates a means of collating the data on a per property basis on this new platform.

1.3 Opportunities

We highlight an opportunity for Scotland to develop a comprehensive central database looking at many aspects related to buildings and property, including building materials, fabric condition, and energy use. While this is out of scope of this project, such a database could bring many benefits, such as increased building safety, simpler conveyancing, smoother statutory consent processes, fewer vacant homes, improved building condition, and more resilient property value. The EU and various member states are legislating on the introduction of property logbooks (also called “green building passports”) to constitute such datasets from the ground up, starting at property level. The list of database tools provided by the private sector in our study is testament to the market’s confidence in their potential to positively impact comfort, affordability, and the environment through the provision of digital logbooks.

Contents

Heat in buildings data for digital compliance	1
1 Executive summary	1
1.1 Findings	1
1.2 Conclusions.....	2
1.3 Opportunities	3
2 Glossary of terms and abbreviations.....	6
3 Background and context.....	8
3.1 Introduction.....	8
3.2 Data in property and construction.....	8
3.3 Heat in Buildings (HiB) Strategy (2021).....	8
3.4 Heat in Buildings Bill consultation.....	9
3.5 A definition of HiB Standard compliance	10
3.6 The opportunity for Scotland	10
4 Mapping the current situation	12
4.1 Buildings	12
4.2 Building data holders	12
4.3 Public databases only.....	13
4.4 Public databases with data analysis tool	14
4.5 Private database or data analysis tool	15
4.6 Information required for HiB monitoring	15
4.7 Data sharing and transferability.....	18
4.8 Summary of existing energy & building data landscape.....	19
5 Observations	20
5.1 Indexing	20
5.2 Heat network zones	20
5.3 EPCs, RdSAP, Home Analytics.....	20
5.4 Non-domestic analytics.....	21
5.5 Public Buildings Standards	21
5.6 PAS2035 and Trustmark.....	21
5.7 Microgeneration Certification Scheme (MCS)	22
5.8 Lead vs lag	22
5.9 Property Logbooks / Building Passports	22
5.10 Modelled vs measured.....	23
5.11 Update points.....	24
5.12 Confidence and risk.....	24
5.13 Energy focus	24
5.14 The future of EPCs.....	25
5.15 Self-certification	25
6 Options to consider	28
6.1 Option 1: Use existing data sources in their current locations.....	28

6.2	Option 2: Professional reporting from linked databases.....	28
6.3	Option 3: Professional reporting into a new central database.....	29
7	Further Key Considerations	30
7.1	Data governance	30
7.2	Identifying and indexing.....	30
7.3	Archetype approaches	30
7.4	Common Scheme Standardisation / nomenclature.....	31
7.5	Data access and data sharing.....	31
7.6	Beyond operational energy.....	31
8	Appendices.....	32
8.1	Question List/Appendix A	32
8.2	Detailed commentary to section 4.3/Appendix B.....	33
8.3	Detailed commentary to section 4.4/Appendix C.....	33
8.4	Detailed commentary to section 4.5/Appendix D	34
8.5	Property Identifier Commentary/Appendix E.....	36
9	References	38

2 Glossary of terms and abbreviations

DEA	Domestic Energy Assessors
EPC	Energy Performance Certificate
EPC Data	The information gathered by a Domestic energy Assessor during a survey which is entered into RdSAP to produce an EPC.
EST	Energy Savings Trust
HiBS	Heat in Building Strategy October 2021.
HiB Bill	Proposals for a Bill by the Scottish Government - the consultation has now closed.
HA	Home Analytics. A database relating only to domestic properties founded on EPC Data and augmented using assumptions and algorithms. Core or foundational to several other databases reviewed.
LHEES	Local Heat and Energy Efficiency Strategy
MCS	The Microgeneration Certification Scheme Service (MCS) creates and maintains standards that allow for the certification of products, installers and their installations where those products produce electricity and heat from renewable sources.
MPRN	Meter Point Reference Number. This is the number that is used to identify the gas service at each property, meaning there is a unique MPRN for every single gas service in every building.
PAS2035	A UK Government standard for domestic retrofit. It sets out the management and coordination of the process, rather than the technical standards required.
PII	Professional Indemnity Insurance
Professional	A consultant with recognised training, qualifications, PII, and code of ethics giving them an obligation to protect the public.
QA	Quality Assurance. The maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of delivery or production.
RdSAP	Reduced Data Standard Assessment Procedure. Software which models the energy efficiency of domestic premises. A simplified version of SAP.
RICS	Royal Institute of Chartered Surveyors.
RLBA	The Residential Logbook Association (RLBA) is the DLUCH supported trade association and self-regulatory body for companies providing digital logbooks for the residential property market.
SG	Scottish Government

SAP	Standard Assessment Procedure. A software tool for modelling the energy performance of buildings.
UPRN	Unique Property Reference Number.

3 Background and context

3.1 Introduction

Following the Scottish Government's Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, new strategies and policies have been published to provide a framework for reducing the emissions from our homes and buildings. One such key document is the 'Heat in Buildings Strategy', which aims to support the decarbonisation and retrofitting of existing buildings. Further to the Strategy, a consultation ran between November 2023 and March 2024 with proposals for a Heat in Buildings (HiB) Bill, designed to provide new regulations for the improvement of energy efficiency and transition to clean heating systems in homes and buildings in Scotland. At local authority level, Local Heat and Energy Efficiency Strategies (LHEES) and Delivery Plans have been published to identify opportunities and target funding for decarbonised heat at local council level.

The Scottish Government wishes to explore a digital system to monitor compliance of existing buildings with the upcoming Heat in Buildings Standard to be established by the proposed Bill. This paper reviews existing digital data sources that the Scottish Government could draw on in developing a future monitoring regime.

3.2 Data in property and construction

The real estate industry started to adopt digital technology, such as spreadsheets and accounting software, throughout the 1980s as personal computing became more common (Reed, 2021). At the same time, it became possible to model building performance using computers, leading the Building Research Establishment (BRE) to develop the Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), based on the BRE Domestic Energy Model (BREDEM) and published by BRE and the Department of the Environment in 1992. It has now been adopted by the UK Government and Scottish Government as the official methodology for calculating the energy performance of dwellings (Scottish Government, 2023).

This approach was drawn into international environmental legislation through the European Union's Energy Performance of Buildings Directive (EPBD), first enacted in 2002, and updated in 2010, 2012, 2018 and 2024. This Directive called for standard assessment procedures to analyse the energy performance of buildings, standard data inputs and outputs, and a means of communicating the findings of this process to the public through what became Energy Performance Certificates (EPCs). EPCs use building energy models to communicate modelled energy efficiency in buildings, from bands A (highest energy efficiency) to band G (lowest energy efficiency). Given the varying definitions of 'energy efficiency', these bands have changed over the years.

3.3 Heat in Buildings (HiB) Strategy (2021)

The HiB Strategy, published by the Scottish Government in October 2021 "provides an update to the 2018 Energy Efficient Scotland Route Map and the 2015 Heat Policy Statement, and brings together [Scottish Government's] ambitions on energy efficiency and heat decarbonisation into a single framework." It calls for all owner-occupied homes to reach EPC C by 2033 and all private rented homes by 2028, although it acknowledges that the more difficult homes in mixed tenure or mixed ownership blocks, and non-domestic premises, may

take until 2045 to achieve it. Public Buildings should have zero emission heating sources as soon as possible, with a backstop of 2038.

The Strategy further acknowledges challenges around these targets, suggesting that “where it is not technically feasible or cost-effective to achieve the equivalent to EPC C rating, (...) a minimum level of fabric energy performance through improvement to walls, roof, floor and windows, as recommended in the EPC, would apply.”

3.4 Heat in Buildings Bill consultation

In December 2023 the Scottish Government published a consultation (Scottish Government, 2023) on the proposed Heat in Buildings Bill.

The consultation included the following proposals:

1. Prohibit the use of polluting heating systems after 2045 across all buildings.
2. Require those purchasing a home or business premises to end their use of polluting heating systems within a fixed period following completion of the sale.
3. Require homeowners to make sure that their homes meet a reasonable minimum energy efficiency standard by 2033 only where no clean heating system has been installed.
4. Require private landlords to meet this minimum energy efficiency standard by 2028 regardless of whether a clean heating system has been installed.
5. Require property owners to connect to a Heat Network when it comes available, or change to another form of clean-heating of their choice

We consider the elements below, present in the consultation, to be of particular relevance to the data requirements for a compliance system.

Section 2 states:

“We propose to set a minimum energy efficiency standard that can be met by installing a straightforward list of measures. This list of measures would be developed to prioritise those that could have the most impact for homes with the lowest amount of cost and disruption. Any homeowner who had installed these measures – or as many of them as are feasible for the type of home they live in – would be considered to have reached a good level of energy efficiency and meet the new standard.

We think this list could be:

- loft insulation
- cavity wall insulation
- draught-proofing
- heating controls
- 80 mm hot water cylinder insulation
- suspended floor insulation”

“Alongside this straightforward list of measures, we propose an alternative option of meeting the standard based on the result of an EPC assessment. We have recently consulted on the addition of a new fabric efficiency metric to EPCs, which could be used to show that a property meets a good level of energy efficiency.”

“Owner occupied homes that have ended their use of polluting heating by 2033 will not be required to meet the minimum energy efficiency standard.”

“Private rented properties would still be required to meet the minimum energy efficiency standard, however, even if a clean heating system had already been installed.”

“We are not proposing to set a minimum energy efficiency standard for non-domestic buildings.”

“While we are also not proposing to apply this Heat in Buildings Standard to the social rented sector, the sector will still be on the same pathway.”

Section 4 states:

“We are proposing that any buildings within a Heat Network Zone will not need to meet the Heat in Buildings Standard following a property purchase.”

Section 5 states:

“This consultation has described five points in time at which we may be asked to meet the Heat in Buildings Standard:

- at the end of a grace period which follows the completion of a property purchase;
- following notice from a local authority to a building owner in a Heat Network Zone that they are required to end their use of polluting heating;
- at the end of 2028, private landlords will need to have met the minimum energy efficiency standard;
- at the end of 2033, owner occupiers will need to have met the minimum energy efficiency standard; and
- at the end of 2045, all building owners will need to have ended their use of polluting heating.”

3.5 A definition of HiB Standard compliance

We used a definition of HiB Standard compliance against which to compare existing digital datasets, databases, and tools.

1. Presence of a clean heating system i.e., a heating system which does not emit CO₂ at point of use.
 - a. This includes connection to a Heat Network.
 - b. Being in a heat network zone means that the property does not need to meet the Heat in Buildings Standard following a property purchase.
2. Installing a list of measures (alterations to the building) or meeting a fabric-based heating demand of 120kWh/m²/year or less (as modelled by approved software).

3.6 The opportunity for Scotland

Scotland’s differentiated legislative, regulatory and policy regime affords it the opportunity to determine its own approach with regards to energy and heat in buildings, though with certain limitations around control over the gas grid or product standards. Furthermore, the Scottish building stock is different to the wider U.K. stock, calling for a specific approach. More people live in flats (National Records of Scotland, 2023), (Office for National Statistics, 2023),

construction is of a lower quality generally (BRE Trust, 2020), it has a larger social housing sector (Serin, et al., 2018), and the climate is more challenging. Furthermore, traditional tenements, post-war non-traditional construction, and the greater prevalence of timber kit construction in the late 20th century (PBC Today, 2022) are all unique features of the Scottish building stock.

The gap between the current state of Scottish housing and the expectations set by the HiB Bill will stimulate economic activity. This positions retrofit as a key area of potential growth in the labour market.

4 Mapping the current situation

4.1 Buildings

The HiB Strategy (Scottish Government, 2021) and Scottish House Condition Survey (Scottish Government) contain statistics about the built environment and the people and communities living in them.

- The total domestic building stock in Scotland comprises around 2.7m homes.
- Following their introduction in 2009, as of 2023 around 1.5 million domestic EPCs currently exist (55% of the building stock).
- Following their introduction in 2009, as of 2023 around 49,000 non-domestic EPCs currently exist (25% of the building stock).
- In 2022-2023 there were 101,055 residential property sales in Scotland (Registers of Scotland, 2023), leading to as many updates to the EPC register.

4.2 Building data holders

We drew up a list of organisations known to be maintaining databases associated with the built environment. Other organisations were added upon suggestion by interviewees.

All organisations were contacted via email with a letter of introduction from the Scottish Government about the research study. A series of standard questions were posed, which are listed in Appendix A.

The array of different datasets and tools for buildings and energy data included within this study can be categorised as follows:

- Public databases - owned, funded or managed on behalf of the government.
- Public data analysis tools - owned, funded or managed on behalf of the government.
- Private datasets and analysis tools – owned and funded by third parties.

A summary of all databases contacted as part of this study is provided in Annex A. The following tables summarise the findings. Where “-” is used, there was no comment given in the interview relating to this category.

4.3 Public databases only

Organisation	Name/Title	Geography	Coverage	HiB compliance data (EPC data and/or presence of measures)	Contains data about energy?	Data ownership
Registers of Scotland	Sasine Register	Scotland	Domestic	NO	NO	Registers of Scotland
Energy Saving Trust	EPC Register	Scotland	Domestic Non-domestic	YES	YES	Scot Govt
National Records of Scotland	Valuation Database	Scotland	Domestic	NO	NO	National Records of Scotland
Scottish Government	Scottish House Condition Survey	Scotland	Domestic	YES	YES	Scot Govt
Registers of Scotland	Scotlis	Scotland	Domestic Non-domestic	NO	NO	Registers of Scotland
BE-ST	Scottish Construction Industry Data Dashboard	Scotland	Industry	NO	NO	Public
Scottish Government	Improvement Service	Scotland	Domestic Non-domestic	YES	YES	Scot Govt; Local Authorities

Table 2 Summary of information in public databases

Detailed commentary on each is in Appendix B.

4.4 Public databases with data analysis tool

Organisation	Name/Title	Geography	Coverage	HiB compliance data (EPC data and/or measures)	Contains data about energy?	Data ownership
Scottish Government	Scotland Heat Map	Scotland	Domestic Non-domestic	YES	YES	Scot Govt
Scottish Energy Officers Network	Public Sector Benchmarking	Scotland	Public Buildings	NO	YES	Scot Govt
Energy Savings Trust	Home Analytics	Scotland	Domestic	YES	YES	Scot Govt
Energy Savings Trust	Non-Domestic Analytics	Scotland	Non-domestic	YES	YES	Scot Govt
IRT Surveys	DREam	U.K.	Domestic	YES	YES	Local Authorities
National Grid ESO	National Grid ESO	U.K.	All	NO	YES	National Grid
DESNZ	National Household Model	U.K.	Domestic	NO	YES	UK Govt

Table 3 Summary of information in public databases with data analysis tools

Detailed commentary on each is in Appendix C.

4.5 Private database or data analysis tool

Organisation	Name/Title	Geography	Coverage	HiB compliance data (EPC data and/or measures)	Contains data about energy?	Data ownership
Kuppa	Kuppa	U.K.	Domestic	YES	-	-
Zoopla	Zoopla	U.K.	Domestic	YES	-	-
RoomAgree Ltd	Shedyt	England	Domestic	-	YES	Developer
The National Deeds Depository	The Property Logbook Company	U.K.	Domestic	NO	YES	Homeowner
Shepherds	Single Survey	Scotland	Domestic	YES	NO	Surveyor
PropEco	PropEco	U.K.	Domestic	YES	YES	Mixed
Chimni	Chimni	U.K.	Domestic	YES	YES	Homeowner
Kamma Data	Kamma Data	U.K.	Domestic	-	YES	Mixed
Novoville	Shared Works	U.K.	Domestic	YES	YES	Mixed
Kestrix	Kestrix	U.K.	Domestic	NO	YES	Developer
Trustmark	PAS2035 Data Warehouse	U.K.	Domestic	YES	YES	Trustmark
Parity Projects	Portfolio / Pathway	U.K.	Domestic	YES	YES	Developer

Table 4 Summary of private databases or data analysis tools

Detailed commentary on each is in Appendix D.

4.6 Information required for HiB monitoring

The compliance criteria noted in section 3.5 are cross-referenced below with the datasets and tools reviewed in Table 5.

We haven't distinguished between data which is assumed, predicted, observed, or modelled. See Section 5 below for commentary on this distinction. The databases are primarily split into two categories:

1. Those which contain EPC data (beyond the EPC band).

- This includes data about all elements of the building.
 - EPC data is the basis of “Home Analytics”
 - Home Analytics is itself the basis of several other databases (see Appendices B, C and D for details)
2. Those that don’t contain EPC data beyond the EPC band.

The only public data set with data of a higher quality on the individual building elements than the EPC data is the Scottish House Condition Survey (SHCS). The SHCS data is based on a small sample set of the housing stock and then extrapolated over the whole stock to generate the associated report. This level of quality and accuracy is also present in “Single Survey” data, which is present for a much larger percentage of the stock, though this is held privately at present.

One of the few databases which provide centralised and accessible information about Heat Network Zones is the Scotland Heat Map, providing that Local Authority LHEES data has been uploaded to it.

Organisation	Name/title	EPC band	EPC data	Heat network zone	Roof insulation	Floor insulation	Windows	Air leakage	Controls	Hot water generation	Clean heating system
Registers of Scotland	Sasine Register	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Energy Saving Trust	EPC Register	YES	YES	NO	YES	YES	YES	NO	NO	YES	YES
National Records of Scotland	Valuation Database	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Scottish Government	Scottish House Condition Survey	NO	NO	NO	YES	YES	YES	NO	YES	YES	YES
Registers of Scotland	Scotlis	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Scottish Government	Improvement Service	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Scottish Energy Officers Network	Public Sector Benchmarking	NO	?	NO	NO	NO	NO	NO	NO	NO	NO
Energy Savings Trust	Home Analytics	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES
Energy Savings Trust	Non-Domestic Analytics	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES
IRT Surveys	DREam	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES
National Grid ESO	National Grid ESO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Scottish Government	Scotland Heat Map	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO
DESNZ	National Household Model	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
Trustmark	PAS2035 Data Warehouse	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES

Table 5 Databases cross-referenced with HiB compliance criteria

4.7 Data sharing and transferability

Data is held by various organisations in a mix of structured and unstructured databases. Some of them are publicly or privately accessible via APIs. Some of them require the export of data in usual formats (CSV or XLS). Some of them do not have any built-in connections, but this could be created on demand. More problematic is the lack of a common framework for what the data means, different ownership of data, the lack of data sharing agreements, and the rights that individuals and organisations have to make it available to others.

While SAP (upon which the EPCs are based) provides a useful definition and structure for each element it looks at, enabling comparisons across buildings, this is not an exhaustive way of looking at and analysing buildings. These gaps, and the lack of a common standard, are quickly filled by other assessment methods created by trade bodies or organisations for their own purposes, which results in a fragmented, hardly interoperable, and ultimately unactionable data universe. For instance, while SAP determines floor area in a certain way, Royal Institution of Chartered Surveyors (RICS) determines it differently. While RICS or RIAS leave it up to Chartered Professionals to prioritise fabric interventions, SAP provides a proscriptive way. While PAS2035 provides a specific list of possible interventions, these are not used across the board in all retrofit assessment software available.

In short, there is no commonly agreed way of fully describing the characteristics, condition, and work required of all buildings. Work is underway in the private sector to address some of these gaps and differences. For instance, we are aware that a study group within the [National Retrofit Hub](#) is working on creating a data scheme suitable for domestic properties. Such a scheme could then be adopted by [Residential Logbook Association](#) (RLBA) members to standardise the way in which data is recorded and presented in their platforms. This work could further be integrated into the emerging Property Data Trust Framework being developed by the [Open Property Data Association](#) in order to standardise access to various data points. As a whole, this work could provide a standard for the description of buildings, increase interoperability of platforms and databases, and pave the way for faster rollout of retrofit measures. There is also currently a small project being funded by BE-ST to investigate the opportunity of a national buildings ‘domestic’ database.

Before data can truly be transferable, however, other issues need to be considered as part of this work. These include data ownership and data sharing consent mechanisms. For instance, some of the data which a homeowner could make use of in order to plan retrofit, such as Home Analytics, belongs to the Scottish Government, is held by the Energy Saving Trust and can only be accessed by request from local authorities or registered social landlords, but not homeowners. This creates a barrier to access information which ultimately relates to the property in the ownership of the person trying to access it. Similarly, Trustmark logs information covering all past government-funded interventions, but this information isn’t readily accessible to the homeowners. Access to this would allow homeowners to have precise and up to date information of their property’s heat and energy installations, and the potential for further work. For consumer access to such information to be possible, such as through the medium of a property logbook (also called “green building passport”), a trusted means of verifying the identity of the person requesting the data needs to be agreed upon by all parties.

Particular attention should be paid to the data ownership and sharing provisions of data held by third-parties on behalf of the government. The study team recognises the commercial incentives that organisations holding data on behalf of the government have to restrict, and in some cases charge for, access to data which is in public (government) ownership. A review of the government's data sharing agreements with third-party organisations holding data on its behalf could be conducted to ensure that:

- publicly-owned data can be made available to appropriate persons and organisations (such as the householder or their consultants);
- publicly-owned data is not privatised;
- only modelled data derived from third party organisations' own investment and Intellectual Property can be commercialised.

4.8 Summary of existing energy & building data landscape

Our review showed that there is no single existing source of data which could readily be used as a compliance and monitoring tool for the Scottish Government for the aspects of building construction and performance set out in the HiB Bill consultation. The existing data landscape described above is patchy in its coverage, with even the most comprehensive data set (Domestic EPCs) covering just over 50% of the stock to which it applies¹. Some databases, such as EPCs, have the potential to contribute an important proportion of the data required. However, they suffer from issues which preclude their wholesale adoption for the purpose of compliance and monitoring.

Furthermore, while the structure of EPC data is consistent, there are variations in the structure, unit of measurement and phraseology of the other data points gathered, held, and processed in other databases which could all be complimentary if this issue were resolved.

Two of the databases listed above - the Scotland Heat Map and the National Grid - bring together complementary datasets to provide a more holistic picture of the decarbonisation potential of building heat sources, but it is hard to use them for HiB compliance as they present data for groups of buildings, rather than individual buildings.

In conclusion, any solution for the monitoring and tracking of the HiB compliance will have to draw on several datasets and be enriched with additional data to close gaps where modelled/assumed data is currently relied upon.

¹ <https://epbd-ca.eu/wp-content/uploads/2021/07/Implementation-of-the-EPBD-in-the-United-Kingdom-%E2%80%93-Scotland-%E2%80%93-2020.pdf>

5 Observations

The following section contains our more detailed observations of the datasets outlined in summary above in more detail with commentary arranged by topic.

5.1 Indexing

Accessing information about a given property across multiple databases would require searching indexed data according to a single unique identifier for the property.

There are several ways in which properties in the UK have been identified. These include Property Title numbers, Unique Property Reference Numbers (UPRN), Meter Point Reference Numbers (MPRN), and Postal Addresses. Unfortunately, these aren't immediately usable: Property Titles can relate to more than one dwelling, UPRNs aren't present for every building in the UK, MPRNs can relate to multiple properties at once, and Postal Addresses have multiple formats. A breakdown of the strengths and drawbacks of various identifiers is in Appendix E.

5.2 Heat network zones

The HiB Bill consultation refers to the Local Heat and Energy Efficiency Strategies (LHEES) published by each Local Authority. Each LHEES identifies potential Heat Network Zones, areas where a heat network appears to be viable. LHEES are to be updated every 5 years. The second round of LHEES will take into account designated heat network zones. Some LHEES data on Heat Network Zones is being uploaded to the Scottish Heat Map. The Scottish Government will update the Heat Map data and Local Authorities will report any inaccuracies/ ad hoc updates, making use of the Heat Map's GIS framework to make them interactive and usable.

Given the high priority the HiB Bill consultation gives Heat Network Zones, knowing whether a property is in a Zone or not is a key piece of information for compliance monitoring. Having all LHEES potential heat network zone data and designated Heat Network Zone data digitised and accessible would provide a key plank of the SG monitoring and compliance framework. Potential zone data isn't vital for compliance – but could help to communicate where zones might soon be.

5.3 EPCs, RdSAP, Home Analytics

Domestic buildings must have an Energy Performance Certificate (EPC) created on construction, sale, or lease (or marketing thereof). An EPC must be created through an approved modelling methodology called SAP, or RdSAP in its simplified version. The certificate must be lodged on a public register, which in Scotland is administered on behalf of the Scottish Government by the Energy Saving Trust (EST).

The base data that is collected and used for creating EPCs (EPC data) is collated and owned by the Scottish Government. This data is then enriched with socio-economic and spatial indicators, such as Local Authority Ward, topographical information, Scottish Index of Multiple Deprivation, and other indicators to create a data set called "Home Analytics" (HA). Predictive modelling is then used to:

- **Close the gaps:** of the 2.7m homes in Scotland, only around 1.5m of them have EPCs. To get a Scotland-wide picture, HA predicts EPCs using the EPCs of nearby properties.
- **Identify decarbonisation opportunities.** By looking at several other simple datasets (e.g., orientation, typology, nearby land) it can suggest measures which might be viable for each property (such as the installation of a wind turbine, or solar panels).

Where data has been assumed, or predicted based on an algorithm, confidence ratings applied to show that these data points were not produced via observation by an energy assessor. 100% confidence is given to original information, and lower ratings for derivative or modelled information. Home Analytics is available to public sector organisations and their subcontractors for specific projects.

Due in part to difficulties in accessing the Home Analytics dataset, many of the organisations we spoke to have constructed their own database based on the public EPC register, augmented by combining with various other data sources to generate more informed conclusions about either the country-wide picture, or smaller zones of stock.

5.4 Non-domestic analytics

Non-domestic buildings also must have an EPC on construction, sale or lease, or marketing thereof. SBEM or an approved Dynamic Simulation Model (DSM) can be used to produce the EPCs. In the same way as domestic EPCs, the input and output data is owned by the Scottish Government and is managed by EST. Our research did not extend into the non-domestic analytics database. However, from discussion with interviewees the study team were informed that the non-domestic analytics database contains less observed data, and more modelling than HA (due to bigger variance in non-domestic buildings).

5.5 Public Buildings Standards

Having spoken to several key managers within the public building portfolios sector, we found that the energy performance data held by the public sector about their buildings is variable and incomplete.

Scottish Futures Trust (an executive non-departmental public body of the Scottish Government, established to improve public infrastructure investment) are now onto the second revision of their [Net Zero Public Buildings Standard](#), which “helps public bodies define objectives for their new or retrofit construction project in pursuit of a credible path to net zero operational energy”.

As noted above, HiB notes the target for public buildings is to have clean heating systems first and foremost, with achieving a broader level of energy efficiency a further implicit means of improving the efficiency of said heating system. Given this, the target for this stock may be purely to decarbonise heating systems.

5.6 PAS2035 and Trustmark

PAS2035 is the UK Government specification for the retrofit of domestic buildings. It establishes a complete process, creates new roles and responsibilities, and brings in checks and balances which aim to avoid the pitfalls of previous Government-funded home energy efficiency investments. It is currently mandated where the “ECO” funding stream is used for

projects, and some public sector bodies in England and Wales mandate it for works funded by other streams. From the study team's experience, standard PAS2035 practice relies heavily on EPCs as the tool to determine the energy efficiency of buildings before and after any work.

Trustmark is the organisation tasked with applying quality assurance (QA) to the PAS2035 process. A key element of this quality assurance is that installation data should be uploaded to a Trustmark-managed 'data warehouse' at the end of a PAS2035-compliant project. This data comprises the wider QA documentation generated, such as "before and after" EPCs, photographs, reports, drawings, and specifications.

The Scottish Government, and the wider construction industry in Scotland, have been debating the role of PAS2035 in retrofit activity for several years. As of the date of this study, there appears to be a mixed response to increasing use of the PAS2035 standard for retrofit work, in part due to the higher cost implications. This may be discounting the benefits of record-keeping and post-installation data lodging aspects which PAS2035 brings.

Trustmark notes that the data is considered publicly owned, and consequently private commercial organisations cannot easily access it, despite ongoing explorations into how to expose more of it. They also note that the vast majority of what is held relates to properties in England, given the small number of PAS2035 projects carried out in Scotland. Trustmark reported that only around 600,000 properties (2% of UK 27 million existing homes) have data lodged in the 'data warehouse'.

5.7 Microgeneration Certification Scheme (MCS)

The MCS is a quality assurance scheme for small renewable energy, heat pump and Photovoltaic (PV) cell installations. It was created to improve the quality of work carried out by having a defined list of approved installers, and a methodology to track such installations. It was implemented by the UK Government from 2011 onwards. MCS requires registration of installers, standard methods of generating specifications and quotes, and guarantees for equipment installed and after-sales care. The documentation of each system installed is lodged with MCS and held centrally.

5.8 Lead vs lag

Many databases comprise data for buildings which can be described as "historic" or "stale" (i.e., not recent). We refer to them as 'lag' data. Others use this historic data as inputs into models which suggest what measures individual buildings, groups of buildings, whole estates, or the national stock could benefit from. This second type of data is considered 'lead' data.

For the purposes of tracking compliance, the lag data sources are more useful because though they might be stale, they are not predicted, which implies a lower confidence. But this raises the question of the point at which the lag data gets updated. These data update points are described as "update points" below.

5.9 Property Logbooks / Building Passports

Two of the organisations we spoke to provide property logbooks (sometimes referred to as "building passports"). These software applications are emerging digital tools which provide

a comprehensive digital record of the building's past. Some of them comment on fabric condition, occupancy patterns, and provide a 'roadmap' for work to be undertaken to the building into the future. The advent of these digitised data repositories and improvement plans is something the focus of this paper (accessing and synthesising building databases) could leverage.

Two-way connections between building logbooks produced by private companies and nationwide databases, such as Home Analytics and Scotland's Heat Map, could create a joined up, dynamic and holistic data environment about buildings, and have positive impacts extending beyond the current aims of the Heat in Buildings Bill.

The provision of property logbooks is now mandatory in France for newbuilds and retrofitted properties (Today's Conveyancer, 2023). A European research project (DemoBLog) is contributing to the evidence that a holistic and digital approach to building data can accelerate reduced environmental impact of buildings (European Commission, 2023).

A Scottish equivalent is the recommendations of the Scottish Parliamentary Working Group on Tenement Maintenance and their proposal for five-yearly inspection reports. These documents would include Building Passport-level information on the mutual parts of tenements and be mandated by statute. To be useful in the context of HiB compliance, they would have to then be digitised and accessible.

5.10 Modelled vs measured

Measured or observed data comprises data captured in-situ and reported directly without processing. However, we found that very few properties have had an in-situ performance measurement, and that sample sizes would be too small to extrapolate to the whole stock, or even to archetypes. While this data can be relied upon to measure compliance, this data is incomplete (more measurements should be made) or stale/lag (which can be addressed by update points described below).

Where it hasn't been possible to measure data in situ, chiefly due to the cost of surveying, tools have sought to model (or predict) data based on a variety of criteria, such as similar typologies nearby and assumed occupant behaviours. As noted above, this is a core component of Home Analytics, but it is also used in some of the private sector databases.

This distinction becomes complex as EPCs use observed data as an input, and then use software to model energy usage and fabric based heating demand, making them a hybrid of both.

Compliance monitoring relying on modelled/predicted data may lead to disputed findings where the approved modelling is shown to conflict with real-world observed measurements. For instance, should an RdSAP-based EPC state that fabric based heat demand is over 120kw/sqm/year, but measured heat demand proves to be lower, would the property be deemed to be in compliance? This is an important matter for an upcoming Bill to make clear, with consequences for a digital compliance monitoring system.

5.11 Update points

As noted above, EPCs are required by regulations:

- When a domestic or non-domestic building is built, sold, or leased (when advertised for such).
- As a condition of receiving funding, such as grants for energy improvement works (Home Energy Scotland, Business Energy Scotland, or Local Energy Scotland), or ECO (which requires PAS2035).

These update points allow for the refresh of data, which, over a period of months trickles all the way through to various datasets, including Home Analytics, and others. Having more update points, such as at any intervention listed in the Standard, would help measure compliance using existing datasets.

Several key triggers are noted in the HiB Bill consultation, including one focussing on the property's purchase. The chances of the HIB trigger points, and the trigger points for updating the other databases, aligning in a reasonable time frame should be considered. For instance, if an EPC is updated on purchase to show that the building is not on a clean heating system, and then one is installed without an obligation to have a new EPC created, and then the Scottish Government checks for compliance, the record would show that the building does not comply.

5.12 Confidence and risk

Variation in data quality and the widespread use of modelling to produce apparently complete datasets has led to lack of trust from practitioners, who like to rely on their own measurements prior to providing retrofit advice. This has been a primary driver behind the UK and Scottish Government's recent work to 'improve' or 'enhance' areas such as the process and content of EPCs (Scottish Government, 2023). Concern over data quality is not unique to the construction and property sectors. A challenge for the Scottish Government is how any existing data source can be used to check for compliance if the data is of potential uncertain provenance and fidelity.

The traditional construction and property sectors used a structure of insurances, professional qualifications, and codes of ethics to provide a quality assurance system for work with buildings. Where advice and design is concerned, this system relies on professional indemnity insurance backed up with chartered professionals such as architects, surveyors and engineers. These structures are notably absent from the energy efficiency and retrofit sector, which contributes to a lower level of trust in the sector by the public.

There is some quality assurance built into some of the datasets the study team reviewed. For example, Trustmark, via the Scheme Providers, carries out sampling of EPCs to check for compliance against the standard process for producing EPCs. Some private operators align and utilise British Standards quality assurance or data management certifications.

5.13 Energy focus

A significant number of the datasets reviewed are focused on energy (kWh/sq.m/year), rather than building fabric, or connection to a heat network zone. The reasons for this are varied, though perhaps linked to the prevalence of EPC bands as a primary focus in recent

years. EPC data includes building fabric information, which can be used for HiB Standard monitoring and compliance, though this is not present where just the EPC band itself is used in a given database. From this we observe that the EPC data is more useful for monitoring and compliance than just the EPC band itself.

5.14 The future of EPCs

An obvious challenge to basing a compliance scheme on EPC data modelling is the ongoing initiatives in the public sector that could result in changes to the methodology and outputs of the EPC over the next few years. The Scottish Government refer to their ambition to improve the EPC in the HiB Bill consultation and recently consulted on a range of options. In parallel, the UK Government is looking to replace SAP with the Home Energy Model (HEM).

5.15 Self-certification

In researching compliance against the Heat in Buildings Standard we considered the potential approaches involving either self-declaration (relying solely on the building owner/occupant), or the role of existing compliance and check mechanisms.

Below we have outlined examples of self-certification compliance approaches:

The census: it is mandatory for everyone to complete the census. There are fines for not doing so, or for giving false information. There is not, as far as we're aware, a process for checking the validity of information given by respondents to the census. However, there is no gain or loss to the person completing the census for the information they provide, and so there is no particular pressure to report any given way.

Building Standards: Building Standards (the control over building regulation consent in Scotland) requires drawings to be submitted showing how the proposed works meet the building regulations. A Building Warrant is issued, enabling the works to be built legally by the local authority when they deem the proposals meet the Building Regulations. At the end of the works, the client or their representative issues a Completion Certificate, self-certifying that the works meet the drawings consented as part of the warrant. The Local Authority does spot-checks on the works to confirm that this is the case, and, if satisfied, will issue an Acceptance of Completion Certificate.

SER: the Structural Engineers Register is a limited company appointed by the Scottish Government's Building Standards Division to administer a scheme for Certification of Design (Building Structures). This is one of only two areas where self-certification is allowed. The scheme requires structural engineering firms and individual engineers to maintain registration with SER though qualifications and audits of their work. This allows them to sign off the structural design of buildings and avoid review by the local authority. The oversight of the scheme is stringent and the structural calculation assessments are checked by a separate engineer. For Section 6 of the Building Regulations (Energy), there is an online submission procedure administered by RIAS.

EPCs: Domestic Energy Assessors (DEAs) undergo a 3-day training course, submit photo evidence of their inspections, and are checked on a percentage of their assessments. They carry Professional Indemnity Insurance (PII), they have a code of practice administered through Trustmark, and are required to carry out Continual Professional Development (CPD). Their obligation is to run the RdSAP process correctly, but they are not responsible

for the result of the EPC, or for the recommendations given by the EPC (which are generated by algorithm).

MOTs: In the case of motor vehicles, cars must have an MOT annually and hold a certificate stating they meet the checklist of performance indicators. Qualified test centres check this, for which there is a nominal charge. Any factors not in compliance are notified to the vehicle owner/user. Using a car which has failed to pass a MOT certificate means it is illegal to drive the vehicle.

Competent person: A “competent person” is required to carry out processes mandated by organisations like RICS, and this level of qualification is set out in the relevant professional standard. BS7913 sets best practices for work with historic buildings and establishes the role of a “competent person” and what qualifies a person as such. In both cases, funders or clients of work to which this competence relates require this standard to be met to enable them to fund the work.

5.15.1 Self-reporting

Self-reporting may be suitable for reporting compliance with the clean heating system mandate, with checks being carried out at purchase (such as the Building Warrant used for new build, or for existing buildings where the assessment is included within the pre-sale survey of the building). If a statement has been made that a clean heating source is present, but this is found not to be the case on sale by the Home Report Surveyor, then the sale value is likely to be affected and may fall foul of the Sale of Goods Act (1979).

Self-reporting is however more complex for the energy efficiency standard, as the definition of something seemingly simple, such as the loft-roll being compliant, varies from standard to standard. Questions arise, such as whether it is evenly installed, pushed into corners, whether there is a vapour control layer under it, whether it is dressed around the cold-water storage tank, etc. A further challenge is that not everyone is able to access the loft, or sufficiently computer-literate to use the digital systems. It is our recommendation that some form of survey by an assessor with some level of training and consumer protection could undertake this work.

The energy efficiency metric (kW/m^2) is more complex still, as it requires training in how to use a dedicated piece of software, and how to reliably enter data to get consistent results. Again, we propose that a competent assessor is best placed to carry out this work

Finally, homeowners must seek advice on what alterations to make to a property to make it compliant. At present, the RdSAP EPC is very clear that the recommendations are suggestions, and not “advice” to be followed without further checks. This distinction frequently escapes the public, which could lead to widespread failure of retrofit to deliver reliable improvement. However, this is where an ‘archetypes approach’ for retrofit guidance could assist homeowners and property managers.

An advantage is that self-reporting can lead to wide societal engagement, and more education and agency over the task at hand.

The challenge with self-reporting is to incentivise individuals to do it and to make the process easy to comply with. The quality of self-reporting will vary. Like the census process, the questions being asked and the possible answers need to be precisely determined (such

as using multiple choice answers). There is a risk of false reporting to gain advantage unless there is some policing/checking if the answers given will lead to any gain or loss.

5.15.2 Consultant reporting

The challenge with consultant reporting is that there are significant differences behind the designation of 'consultant', with training ranging from 3 days to 7 years. Some consultants have legally protected status, codes of ethics and some have a code of practice. Some carry PII, some don't. PII only insures the advice given for a certain area of competence. For instance, a structural engineer's PII will not pay out if the advice was given on non-structural matters. Both the PII and the confirmed area of competence are therefore important. Without PII and a defined area of competence, there is no consumer protection for the advice given by the consultant.

There are differentiations between different specialisms. We suggest it would be useful to conduct further research assessing how HiB Standard compliance could be conducted by different disciplines and roles, their areas of competence required, and requirements for PII.

Reporting should show confidence rating linked to the qualifications/ability/consumer protection of the person making the statement. Red/Amber/Green ratings are used by some, others (Home Analytics for example) used percentages.

6 Options to consider

This study suggests three main options that may be considered by the Scottish Government for the establishment of a digital compliance and monitoring tool.

6.1 Option 1: Use existing data sources in their current locations

Data sources remain in their current locations, with two options:

- **Option 1a. Homeowners are required to self-report into these locations and upload evidence.**
- **Option 1b. Professional reporting into existing locations (status quo).**

For both options, the responsibility to demonstrate compliance rests with the homeowner with either self-reporting or professionals reporting.

Advantages

- Requires little investment from the government.

Drawbacks

- Would likely be difficult for homeowners due to the complexities of the Standard and the need to look for information in various places.
- It may be long-winded for owners who are not familiar with digital technology.
- Reduced consistency if homeowner reporting, rather than a professional with PII.

Requirements

- Create “how-to” guides to help homeowners understand where they can gather the information.
- Ensure that the appropriate data sharing mechanisms and identity verification mechanisms are in place so that information can be queried from data holders by homeowners.
- Ensure that non-digital means of accessing the information are available.
- Identify opportunities for market to engage; district heating providers to broker connections between public/commercial anchor load buildings and homes in heat zones, clean heat system providers provide support apps/websites, surveyors promote building assessment services.

6.2 Option 2: Professional reporting from linked databases

Data remains in its current locations. Government looks at a single portal, which in turn looks at existing sources. The responsibility to assess compliance could rest with the government or homeowners, but the government must first create a means of collating the relevant information on a per property basis.

Advantages

- Saves homeowners’ time.
- Gives the government a more comprehensive picture of any property in the country.
- Makes property data more actionable and consistent in reporting

- Public facing online data input platforms already exist, with confidence ratings, allowing self-monitoring at the front end. Back-end data logging to be linked by unique identifier.
- Consumer protection and consistency of data due to presence of PII.

Drawbacks

- Requires more technical investment from the government
- Medium risk to privacy infringements

Requirements

- Create or generalise the use a unique identifier per property
- Create more data update points
- Create or use an existing data nomenclature and phraseology
- Review and update existing data sharing agreements with relevant data holders
- Create APIs to enable data transfer
- Create a public facing ‘check if your building is compliant’ government portal such as [Check vehicle tax](#)

6.3 Option 3: Professional reporting into a new central database

Data is moved from existing data sources to a new government-managed platform. The responsibility to assess compliance could rest with the government or the homeowners, but the government must first gather all relevant information on all properties in a new data holding structure.

Advantages

- Saves homeowners’ time
- Gives the government a complete picture of every property in the country
- Makes property data more actionable and enhances consistency of reporting.
- Provides country-level insights on all property and energy needs
- Enables more modelling and place-based answers to decarbonisation needs.
- Consumer protection and consistency of data due to presence of PII

Drawbacks

- Requires significant government investment
- Could be construed as government overreach
- Existing data custodians could offer pushback
- Might slow down innovation if human resources are not devoted to exploiting data
- Higher risk to privacy infringements.

Requirements

- Create or generalise the use of an unique identifier per property
- Create a public facing ‘check if your building is compliant’ government portal such as [Check vehicle tax](#)
- Create more data update points
- Create or use an existing data nomenclature and phraseology

- Create technical infrastructure required to hold data
- Terminate existing data sharing agreements with relevant data holders and organise data handover
- Either create APIs to enable data transfer between existing data custodians and the government, or change the data lodging mechanisms to feed in directly into the government data lake
- Create a frontend dashboard to query information from all databases at once
- Identify opportunities to exploit data strategically.

7 Further Key Considerations

The following points should be considered alongside the options set out above.

7.1 Data governance

The industry suffers from a lack of commonly agreed standards and procedures which would allow data to flow between organisations and databases. While there exists virtually no technical difficulty in moving data across platforms, the legal basis for this, the format of the data, and the necessary safeguards in terms of data ownership, are absent.

This lack of such a data governance framework is a significant hurdle to the emergence of the retrofit industry, and ultimately, the decarbonisation agenda. To fill the gap, private sector actors have been forming associations and trade bodies, to formulate answers to these issues, such as the Open Property Data Association or Residential Logbooks Association. Our view based on our research and experience is that for real progress to be made, governments will need to take ownership of the data governance issue and standardisation of process and reporting structure, participate in industry work, and eventually endorse the outcomes of this work, as was done when the UK Government endorsed the SAP methodology for assessing buildings.

In general, providing that the ownership of a given property can be proven (such as through the Property Data Trust Framework), publicly-owned information about a property should be available free of charge to that property's owner, and their consultants.

7.2 Identifying and indexing

There is currently no comprehensive way to identify every structure considered a separate building in Scotland. Several possibilities exist. UPRN would be a good way forward for domestic properties compliance, but less so for non-domestic buildings. A separate piece of work is required to find a way to identify and index all buildings to which the Standard and associated monitoring and compliance checking will apply.

7.3 Archetype approaches

An exercise to analyse how archetype approaches and interventions could support a compliance methodology may be useful, considering the high number of house and apartment types within an archetype construction (e.g., tenements, timber frame, no fines). Studies and reports have cited archetype approaches [(ZEST Taskforce, 2021), (Smith, 2021), (Bros-Williamson & Smith, 2024)] to retrofit, and archetype-specific list of measures to be applied to demonstrate compliance aligned to a specific EPC band.

7.4 Common Scheme Standardisation / nomenclature

A significant piece of work would be required to ensure that, once a building identifier has been produced, the data attached to this identifier is labelled according to a nomenclature shared across the industry. The work required would involve:

- Determining a common format in which input data pertinent to retrofit objectives can be collected to enable interoperability, transfer and actionability regardless of provenance and destination.
- Determining a common format for output data reflecting the resulting programme of works.
- Encouraging any relevant organisation to adopt the standard, starting with property logbook providers.
- Working with governments to publicise the scheme and insert it within the Property Data Trust Framework.

7.5 Data access and data sharing

Building data is the fundamental building block on which national retrofit efforts are planned and delivered. Without easy access to publicly-owned information about their property, homeowners may delay their investigations and home improvements. Without free access to publicly-owned information about their property, homeowners could be made to finance organisations that have no ownership of this data. The study team believes that a strict distinction should be made between publicly-owned and privately-owned data, and that the former be made readily available to appropriate persons.

7.6 Beyond operational energy

The primary emphasis of the HiB Bill consultation centres on promoting clean heating systems, such as heat networks or individual building systems powered by clean electricity, and on fabric improvements. The focus on building fabric does not include comment on the condition of the building, which is a factor of fabric performance. Factoring condition into the HiB Standard, on top of monitoring and compliance, could provide an opportunity to address the condition of the nation's building stock as part of the retrofit agenda. We suggest that broadening the approach to compliance and monitoring to encompass building condition could offer an opportunity for synergistic improvement to fabric and energy and underpin a future legacy of a pan-Scotland built environment approach.

8 Appendices

8.1 Question List/Appendix A

Data Field	Description of question
Organisation	name of the organisation interviewed.
Name	the name of the database or initiative.
Status	the status of the conversation with the organisation, whether they have been contacted, interviewed,
Organisation ownership	public or private, or a mix.
Geography	Geography covered by the data
Description	Description of the database
Energy coverage	whether the database includes energy data.
Content	a brief description of the content of the database.
Data ownership	who owns the data in the database.
Access control	who controls access to the database.
Coverage	what facets of the building the database covers.
Gaps	what gaps are acknowledged to be present in the data, from the perspective of its use as a HiBs compliance tool.
Connections	how the data can be exported/imported.
Use	the use of the data.
Users	the organisations, individuals or sectors who currently use the data.
Cost	the charging model, if any, for accessing the data.
Contact name	the name of the person responsible for the data.
Contact details	Contact details for the person responsible for the data.
Link	for any online interface or website for the database.

Table 6 Areas of discussion with database owners

8.2 Detailed commentary to section 4.3/Appendix B

Sasine Register. Not spoken to. Information in the study is from publicly available data on what the register does.

EPC Register. The EPC register is a database of all EPCs created for domestic and non-domestic buildings in Scotland. It is managed by the Energy Savings Trust.

Valuation Database. Not spoken to. Information in the study is from publicly available data on what the Database does.

Scottish House Condition Survey. This is a subset of the Scottish Household Survey who survey 10,000 households a year, asking a huge range of demographic questions (age, disabilities, activities, etc.). They then re-survey 3,000 dwellings with a physical inspector (assessor, architect), who do a full physical survey, recording everything about the house in terms of energy efficiency (fuel, central heating, insulation, age and efficiency of boiler) and things like disrepair. The selection of buildings is intentionally representative of the wider housing stock.

Scotlis. The land register can be used to find property prices, view boundaries on a map, check if land or property is on the land register, and identify who owns the property. Not spoken to. Information in the study is from publicly available data on what the register does.

PAS2035 Data Warehouse. Trustmark hosts retrofit lodgement data (PAS2035) for buildings that have been retrofitted under government funded retrofit schemes. This includes information about the retrofit work done. Each home is lodged individually. Trustmark's key role is quality assurance, so they test a sample of these installations using a risk-based approach for desktop and on-site audit using the information uploaded to the data warehouse.

8.3 Detailed commentary to section 4.4/Appendix C

Scotland Heat Map. It is a GIS tool, a collection of datasets, that primarily Local Authorities use to check for demand for heat, to help introduce policies to reduce CO₂ from heat production. Are areas suitable for heat networks. It is one of the core datasets in LHEES. At the moment some Local Authority LHEES are being uploaded to it. It's about bringing data together in a spatial way. The main metric is heat demand metrics generated from a range of sources. Based on UPRN, they have a strong relationship with the Ordnance Survey. Uses a layered approach, footprint on an OS map, and applying energy benchmarks. Different sources of subjective reliability. Indicative tool bringing together data generated for other purposes, have to make some gross assumptions based on not much information. It answers the question: does this area look promising for heat networks?

Improvement Service. This is a data sharing portal. It helps Local Authorities make data useable, standardised, and actionable. Their first big project was to put some order to the property address dataset.

Public Sector Benchmarking. They have performed energy benchmarking analysis for Scottish Public Sector assets. It shows data for a "typical" building of that type to compare against "best practice". Public sector building managers can then compare their building to that. The point of this document was always to do comparisons. Highland Council have

taken this data and analysed the whole estate and made the data public but that is yet to happen elsewhere.

Home Analytics. It's an address level database with information on all properties in Scotland ranging from building characteristics to heating systems based on the RdSAP input and output data from domestic EPCs. It contains more or less half of all buildings as survey data and uses algorithms to create assumed EPCs for those which don't exist. It is indexed by UPRN (which is produced by Ordnance Survey). Installations which require a new EPC due to funding rules will lead to this data ending up in Home Analytics, which is uploaded/updated every 6 months.

Non-Domestic Analytics. The EST team who run this were not spoken to, so the data in our report is based on publicly available information about non-domestic analytics. Like Home Analytics but for non-domestic buildings. It contains everything Home Analytics does, except there is less modelling behind it. Fewer non-domestic properties have an EPC, so there are more unknowns. Big exception is access.

DREam. Home analytics data augmented with IR survey results and asset management data provided by a private company IRT. The dataset remains the property of the Local Authority or RSL commissioning the study.

National Grid ESO. This tool cross-compares other datasets to provide long term energy forecasting for domestic and non-domestic demands, and potential opportunities as the nation decarbonises.

National Household Model. Not interviewed.

8.4 Detailed commentary to section 4.5/Appendix D

Kuppa. A modelling tool for options appraisal: "Kuppa gives you a holistic view of a home's energy performance, now, and how it could be in the future."

Zoopla. Not interviewed.

National Buildings Database. Emergency services and safety data, edging into climate resilience currently under development by Edinburgh University and others.

Shedyt. Shedyt is a digital homeowner manual which exists to simplify property management for occupiers in collaboration with a marketplace of real estate experts, starting with residential property developers. It's a tech company first and foremost, offering a marketplace. They match property developers to the people who sell to them. When a newbuild goes up, everything is specced up: the aim is to not throw this away. Long term ambition being to help the occupier down the line. Up to now, the data wasn't captured for the benefit of the homeowner, but only themselves & legislation. The idea is to offer one place to manage your home idea.

The Property Logbook Company. Their business came from the legal side of use cases. In 2003 the land registry went from analogue to electronic titles. All the analogue documents become irrelevant when things went digital. Going digital has actually slowed down conveyancing. PLC suggested making "the big warehouse" digital to overcome that - for the lawyer, it provided the certainty that a document existed. It's a digital interpretation of a very analogue process. PLC built B2B business which the consumer accessed whenever they

bought and sold properties. The homeowner has access to the system. When they put new windows in, for example, they can upload the document to evidence this

Single Survey. The single survey is a condition survey presented in a legislatively mandated format, standardised for all homes transacted in Scotland. The data gathering and report production is by proprietary software created by the individual providers. Quest (owned by Landmark) have a database. OneSurvey, in Scotland, is controlled by Allied Surveyors. MovMachine in Edinburgh (ESPC) is used as CRM. SurvPoint is used by Shepherds is also used as CRM and Project Management platform. Quest is £12/use. The data is owned by the surveying firm. Information gathered is given to Rightmove, Zoopla etc. this information could've been collated centrally, but RICS didn't proceed with the idea. The richer data is in the Surveyor's notes, but that's difficult to access. It could be possible to strip out the condition codes from the online databases. Postal address is key identifier.

PropEco. Futureproofing home with advanced data and analytics

Chimni. A property logbook company. Secure digital record of all transactions (conveyancing), maintenance, DIY and certifications (such as connectivity with EPC register), Trustmark supporting retrofit. They provide an additional group of APIs which allows a homeowner to access the info that sits in the Trustmark Data Warehouse. Their aim is building API certifications with as many places as possible.

Kamma Data. Originally a geospatial map company. The first thing they do is attach UPRN to addresses. Their end product is data. They note that property data is poor quality, with no proper framework and thus inconsistent. They've built a machine learning module which helps match properties together and build a profile for property. They have a retrofit automation tool which takes pricing data and data from the national grid to make recommendations, making it an optimisation engine.

Novoville Shared Works. A property logbook/building passport looking at people, property and its constituent elements. Structured around RICS, RIBA and GFI frameworks for data and cross-compatible with RdSAP data structures, Shared Works can connect to thermal modelling engines such as Scene to provide retrofit optioneering to build a plan which is then audited by a construction professional such as an architect or surveyor. The Shared Works Building Passport can be looked at alongside other to form buying communities and so create community groups and cost efficiencies.

Kestrix. Similar to IRT's DREam but coming at it from different direction. Kestrix's premise is scalability of IR to the building energy efficiency market, and once scaled to work towards accuracy. The lack of accurate actionable data is the challenge they're trying to solve. Their tool captures vision and thermal imagery to build 3D models. Their goal is to get to U Values from IR. They aim to create a more accurate than EPC building physics model to leverage and make retrofit recommendations for portfolio. The imagery is aerial, oblique shot from drones, thermal imagery shot at night, private mode right now, project based. They outsource the drone work. They are a software company.

8.5 Property Identifier Commentary/Appendix E

8.5.1 UPRNs

Of all the above, the Unique Property Reference Numbers (UPRNs) appear as the best way of identifying private residential buildings. This is because they are already used in many of the datasets reviewed, they are unique, and supported by the Ordnance Survey.

For those working with non-domestic buildings where different buildings may all reside on one campus, UPRNs were deemed insufficient by some of the interviewees since several buildings will share one UPRN yet may be very different.

8.5.2 Property Title Numbers

When HM Land Registry register a property, they give it a unique reference called a title number and prepare both a register and, in most cases, a title plan. Like the UPRN, this is connected to the legal property, and so would be the same for individual structures all on the same legal title and therefore present shortcomings when dealing with some non-domestic buildings.

8.5.3 MPRN

MPRNs act as unique identifiers for the gas meter in each building. However, with the ongoing decarbonisation of homes and considering the 16% of the Scottish housing stock not connected to the gas grid, the use of MPRNs related to gas would not provide adequate coverage and might over time become a redundant identifier.

8.5.4 MPAN

A meter point access number (MPAN) is used for electric meters in buildings. As with MPRNs, these identifiers are not suitable, as some buildings have several meters, and some meters serve more than one building.

8.5.5 VOA

In December 2023 the Dept for Net Zero and Energy Security established a research project to develop a National Buildings Database (commencing with non-domestic buildings). One of the potential identifier codes for each building that may be used is the Valuation Office Agency (VOA) registration for each building. The Property Details dataset was introduced in the 1970s and was originally known as the Dwelling House Coding guide. Its original purpose was to provide a simple system for understanding the main features and attributes of a property. VOA datasets do not contain information about individuals or households. The information VOA collects and holds about domestic properties supports statutory functions for valuation and maintenance of Council Tax lists under the Local Government Finance Act 1992. It's the statutory requirement of VOA to maintain accurate valuation lists for Council Tax. However, VOA only collects data needed to place an accurate band on the property.

As council tax is operated separately in Scotland and given the separate laws and regulations for Scotland's property, it may be useful to determine if there is a Scottish equivalent identifying code which could be utilised as part of the monitoring and tracking of HiBs.

8.5.6 Outside of Britain

Unique Building Identifier (**UBID**) is an initiative by the US Department of Energy (DOE) to establish a system for generating and maintaining unique ID's for all buildings across the

planet. The UBID algorithm generates a unique ID based on the geo-spatial location and form of a building footprint. A unique building ID will provide a universal indexing mechanism for the collection, linking and aggregation of building-centric data from disparate sources (see: [GitHub - Open city model data for the United States](#)).

9 References

- BRE Trust, 2020. *The Housing Stock of the United Kingdom*. [Online]
Available at: <https://www.gov.scot/publications/delivering-net-zero-scotlands-buildings-consultation-proposals-heat-buildings-bill/pages/1/>
- Bros-Williamson, J. & Smith, S., 2024. Applying a retrofit and low-carbon technology archetype approach to buildings in Scotland, Edinburgh: University of Edinburgh.
- European Commission, 2023. *Demo-BLog - Development and Demonstration of Digital Building Logbooks*. [Online]
Available at: <https://build-up.ec.europa.eu/en/resources-and-tools/links/demo-blog-development-and-demonstration-digital-building-logbooks>
- National Records of Scotland, 2023. *Housing*. [Online]
Available at: <https://www.gov.scot/publications/delivering-net-zero-scotlands-buildings-consultation-proposals-heat-buildings-bill/pages/1/>
- Office for National Statistics, 2023. *Housing, England and Wales: Census 2021*. [Online]
Available at: <https://www.gov.scot/publications/delivering-net-zero-scotlands-buildings-consultation-proposals-heat-buildings-bill/pages/1/>
- PBC Today, 2022. *Timber frame homes UK market to rise by £70m*. [Online]
Available at: <https://www.pbctoday.co.uk/news/mmc-news/timber-frame-homes-uk/107522/#:~:text=In%20Scotland%20timber%20frame%20homes,%2C%20rising%20by%20almost%2060%25>
- Reed, R., 2021. *Property Development*. Abingdon: Routledge.
- Registers of Scotland, 2023. *Property market report 2022-23*. [Online]
Available at: <https://www.ros.gov.uk/data-and-statistics/property-market-report-2022-23#:~:text=In%202022%2D23%3A,when%20compared%20with%202021%2D22>
- Scottish Government, 2021. *Heat in Buildings Strategy - achieving net zero emissions in Scotland's buildings*. [Online]
Available at: <https://www.gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/>
- Scottish Government, 2023. *Building standards approved energy assessment software: guidance*. [Online]
Available at: <https://www.gov.scot/publications/building-standards-approved-energy-assessment-software-guidance/>
- Scottish Government, 2023. *Delivering net zero for Scotland's buildings - Heat in Buildings Bill consultation*. [Online]
Available at: <https://www.gov.scot/publications/delivering-net-zero-scotlands-buildings-consultation-proposals-heat-buildings-bill/pages/1/>
- Scottish Government, 2023. *Energy Performance Certificate (EPC) reform: consultation*. [Online]
Available at: <https://www.gov.scot/publications/energy-performance-certificate-epc-reform-consultation/pages/2/>

Scottish Government, nd. *Scottish House Condition Survey: Collection*. [Online]
Available at: <https://www.gov.scot/collections/scottish-house-condition-survey/>

Serin, B., Kintrea, K. & Gibb, K., 2018. *Social housing in Scotland*. [Online]
Available at: https://housingevidence.ac.uk/wp-content/uploads/2024/03/R2018_SHPWG_Scotland.pdf

Smith, S., 2021. *Developing Net Zero Technical Solutions for Scotland's Future Mass Retrofit Housing Programme*, Edinburgh: Scottish Government.

Today's Conveyancer, 2023. *Property logbooks made compulsory in France*. [Online]
Available at: <https://todaysconveyancer.co.uk/property-logbooks-made-compulsory-france/>

ZEST Taskforce, 2021. *Achieving net zero in social housing: The Zero Emissions Social Housing Taskforce Report*. [Online]
Available at:
<https://www.gov.scot/binaries/content/documents/govscot/publications/independent-report/2021/08/achieving-net-zero-social-housing-zero-emissions-social-housing-taskforce-report/documents/zero-emissions-social-housing-taskforce-report/zero-emissions-social>

© The University of Edinburgh, 2024

Prepared by EALA Impacts CIC, Novoville and University of Edinburgh on behalf of ClimateXChange, The University of Edinburgh. All rights reserved.

While every effort is made to ensure the information in this report is accurate, no legal responsibility is accepted for any errors, omissions or misleading statements. The views expressed represent those of the author(s), and do not necessarily represent those of the host institutions or funders.



Scotland's centre of expertise connecting
climate change research and policy

ClimateXChange, Edinburgh Climate Change Institute, High School Yards, Edinburgh EH1 1LZ

✉ info@climatexchange.org.uk

☎ +44 (0) 131 651 4783

✂ @climatexchange_

🌐 www.climatexchange.org.uk

If you require the report in an alternative format such as a Word document, please contact info@climatexchange.org.uk or 0131 651 4783.