

BRE Client Report

BRE Dwelling Level Housing Stock Modelling and Database for Leeds City Region

Prepared for: Leeds City Region

Date: 8 June 2017

Report Number: 298-896 Issue: 3

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Executive summary

- A number of local authorities within the Leeds City Region (LCR) commissioned BRE to undertake a series of modelling exercises on their housing stock¹ – Bradford, Calderdale, Kirklees, Leeds, Wakefield and York. Separate reports were produced for each council describing the modelling work and providing more granular details of the results obtained from the dwelling level models and database. Each council was also provided with a database enabling them to obtain specific information whenever required. This current report provides a high level summary for the Leeds City Region.
- This project also took advantage of the huge amount of locally held data, integrating hundreds of thousands of records into the BRE Housing Stock Models. For example, the 6 LCR local authorities supplied data from over half a million Energy Performance Certificates (EPCs). This way, information on the thermal characteristics from ‘actual’ observed inputs of 33% of the stock in these authorities, or 27% across the whole region were used in preference to modelled or imputed inputs. Not only does it therefore improve the quality of data used in the stock models for those properties covered by an EPC, but it also helps improve or confirm the data used; for example, on the property age or wall type of a significant number of adjoining properties. For Bradford alone, EPC data covering 52,000 properties was used to improve the energy inputs with actual data on loft insulation thickness, heating types, double glazing etc. and a further 49,000 addresses adjoining these properties covered by an EPC also had the accuracy of their wall type or age data improved.
- The main aims of this work were to provide estimates of:
 - The percentage of dwellings meeting each of the key indicators² for the Leeds City Region overall and broken down by tenure and then mapped by ward (private sector stock only)
 - Information relating to Local Authority Housing Statistics (LAHS) reporting for the private sector stock – Energy Performance Certificate (EPC) ratings and category 1 hazards³
- BRE Housing Stock Models were used to provide such estimates at dwelling level with a focus on private sector housing. The key indicators provide the local authorities in the Leeds City Region with

¹ The exception was Barnsley, Craven, Harrogate and Selby, however high level results for these local authority have been included in this report to enable the provision of Leeds City Region results and comparisons across the local authorities.

² Housing Health and Safety Rating System (HHSRS) category 1 hazards, excess cold hazards, fall hazards, disrepair, fuel poverty, low income households.

³ The 6 commissioning LCR local authorities were also supplied with information on Houses in Multiple Occupation (HMOs) and various energy efficiency variables. As this exercise was not carried out for the whole region this information has not been included in this summary report.



detailed information on the likely condition of the stock and the geographical distribution of properties of interest.

- A stock modelling approach has been developed and used by BRE for many years and the 2014 models used for the LCR project have been updated to make use of the results of the 2011 English Housing Survey (EHS)⁴ and additionally now incorporate a technique known as geomodelling⁵ which makes use of Ordnance Survey (OS) data. These dwelling level models are used to estimate the likelihood of a particular dwelling meeting the criteria for each of the key indicators. These outputs can then be mapped to provide the authority with a geographical distribution of each of the key indicators which can then be used to target resources for improving the housing stock.
- In addition to the stock models, the 6 local authorities commissioned BRE to produce a Health Impact Assessment (HIA) to better understand the effect of private sector housing hazards and intervention strategies on the health of residents in their area. An HIA is a formal method of assessing the impact of a project, procedure or strategy on the health of a population. The HIA draws on evidence of the health impact of hazards identified using the Housing Health and Safety Rating System (HHSRS) and a methodology developed by the BRE Trust and published in “The Real Cost of Poor Housing”⁶. The HHSRS is the method by which housing condition is now assessed in accordance with the Housing Act 2004. A dwelling with a category 1 HHSRS hazard is considered to fail the minimum statutory standard for housing and is classified as “poor housing”. This report summarises the findings of the HIAs carried out for the 6 commissioning local authorities, and combines this with HIA estimates for the other 4 LCR local authorities to provide a complete assessment for the region.
- The headline results are shown overleaf.

⁴ 2011 is the latest available data. Prior to the 2014 models EHS 2009 data was used.

⁵ The OS data has been used to update a number of the model inputs – the main value of the OS data is the ability to determine the dwelling type with much greater confidence – see Appendix B for more information.

⁶ The Real Cost of Poor Housing, M Davidson *et al.*, HIS BRE Press, February 2010



Headline results for the Leeds City Region

The Leeds City Region has a higher percentage of private sector dwellings containing fall hazards, disrepair, fuel poor households and low income households compared to England. *See the full results*

Energy efficiency of the private housing stock is, however, better than the England average (SimpleSAP of 57 rather than 55). This helps reduce excess cold hazards for the region to below the national average. Overall housing hazards are at a level similar to the national average. *See the full results*

17% of private sector stock is estimated to have a category 1 hazard. The greatest proportion is in Craven (27%) and the lowest is in Wakefield (13%). However, the largest numbers are found in Leeds and Bradford. The private rented sector contains higher rates of category 1 hazards at 24% of the stock *See the full results*

6% of private sector stock, and 9% in the private rented sector is estimated to have an excess cold hazard. The highest proportions for all private stock are in Craven (20%) and the lowest are in Bradford, Kirklees, Wakefield and York (4%). *See the full results*

11% of private sector stock, and 15% in the private rented sector is estimated to have a falls hazard. The highest proportions for all private stock are in Calderdale (15%) and the lowest are in Selby (8%). *See the full results*

7% of private sector stock, and 10% in the private rented sector is estimated to be in disrepair. The highest proportions for all private stock are in Bradford, Calderdale and Craven (8%) and the lowest are in Selby (4%). *See the full results*

For the private sector stock, Craven has the highest proportions of fuel poverty under both the 10% and Low Income High Costs definitions – 30% and 15%, respectively. This increases to 39% and 29% respectively for the private rented sector. *See the full results*

26% of the private sector stock is estimated to be occupied by low income households. The highest proportion is in Bradford (30%) and the lowest is in Harrogate (18%). However, for the private rented sector, the highest rates are in Calderdale (51%). *See the full results*

For the private sector stock, York has the highest average SimpleSAP rating (59) and Craven has the lowest (50). The average SimpleSAP rating for the region as a whole is 57. *See the full results*

EPC ratings - The percentage of private rented stock with an EPC rating below Band E for Leeds City Region as a whole is 13.5%. Craven has the highest percentage falling below Band E (31%) and York has the lowest (10%). *See the full results*

Maps are provided throughout the report for the above variables

The total cost of mitigating category 1 hazards in the region as a whole is estimated to be £474 million, with £134 million in the private rented sector. *See the full results*

There are an estimated 227,000 category 1 hazards in the private stock across the LCR



Key illustrations of headline results

The chart below shows the percentage of private sector dwellings in the Leeds City Region failing each of the key indicators compared to the percentage for England as a whole (2011 EHS data). The Leeds City Region has a higher percentage of private sector dwellings with fall hazards, in disrepair, in fuel poverty and on low income compared to England. The Leeds City Region performs the same as England for all hazards and slightly better for excess cold.

Comparison of the Leeds City Region with England (EHS 2011), % of private sector dwellings failing each of the indicators



Under the Energy Act 2011, new rules mean that from 2018 landlords must ensure that their properties meet a minimum energy efficiency standard - which has been set at band E - by 1 April 2018. The following table shows the percentage of private rented stock falling into each of the EPC ratings bands (based on SimpleSAP) for the region overall and by local authority. Whilst the majority of properties in the private rented sector fall in Bands D and E, 13.6% overall are estimated to fall into Bands F and G. Craven and Selby have the highest estimated proportion of private rented stock falling into these bands, with 31% and 24% respectively.



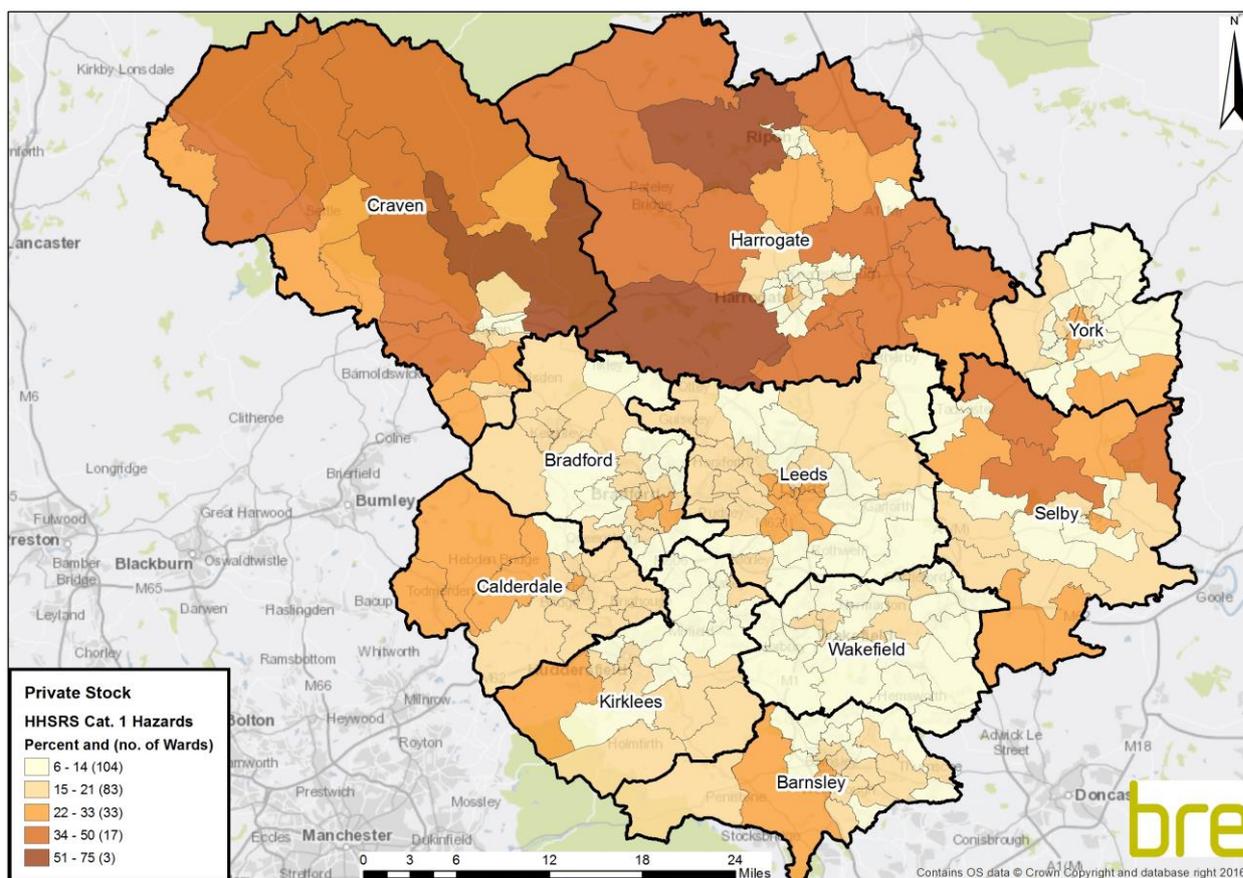
Percentage of private rented stock falling into each of the EPC ratings bands (based on SimpleSAP) by local authority

Distribution of EPC rating bands by local authority - private rented sector											
EPC rating band	Barnsley	Bradford	Calderdale	Craven	Harrogate	Kirklees	Leeds	Selby	Wakefield	York	Leeds City Region
(92-100) A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(81-91) B	0.3%	0.5%	0.6%	0.2%	0.6%	0.7%	0.8%	0.5%	0.7%	0.5%	0.6%
(69-80) C	15.5%	14.9%	15.7%	11.4%	15.8%	18.6%	14.2%	16.4%	18.3%	18.3%	15.8%
(55-68) D	44.6%	40.6%	36.4%	30.1%	37.8%	40.9%	33.5%	36.9%	41.5%	39.3%	37.9%
(39-54) E	29.3%	33.1%	33.0%	27.0%	24.9%	29.5%	36.3%	22.3%	28.9%	31.8%	32.2%
(21-38) F	6.8%	7.3%	10.1%	16.5%	11.9%	7.1%	9.2%	15.2%	7.7%	7.0%	8.7%
(1-20) G	3.5%	3.6%	4.2%	14.8%	9.0%	3.2%	6.0%	8.7%	3.0%	2.9%	4.9%



The map below shows the distribution of dwellings with a category 1 hazard across the region, indicating that this hazard is concentrated in rural areas where there are fewer flats and there tend to be more properties off the gas network.

Percentage of private sector dwellings in the Leeds City Region estimated to have a HHSRS category 1 hazard



HIA Key illustrations of headline results

The table overleaf provides a summary of the HIA results at local authority level and for the Leeds City Region as a whole.

Summary of HIA results for all HHSRS category 1 hazards, split by local authority and for the Leeds City Region as a whole

Local authority	Numbers of hazards (total private sector stock)	Estimated number of instances requiring medical intervention	Cost of mitigating all hazards	Potential annual costs of not mitigating hazards		Potential annual savings from mitigating hazards	
				Costs to NHS	Costs to society	Savings to NHS	Savings to society
Barnsley	17,960	883	£33,595,933	£3,156,720	£7,891,800	£2,936,180	£7,340,450
Bradford	37,099	1,774	£69,541,053	£6,520,900	£16,302,250	£6,060,740	£15,151,850
Calderdale	22,053	1,060	£45,499,458	£3,863,660	£9,659,150	£3,589,690	£8,974,225
Craven	8,761	251	£26,068,360	£1,512,880	£3,782,200	£1,386,830	£3,467,075
Harrogate	16,692	483	£47,494,053	£2,888,840	£7,222,100	£2,649,870	£6,624,675
Kirklees	30,479	1,387	£57,512,429	£5,356,900	£13,392,250	£4,972,320	£12,430,800
Leeds	50,943	2,167	£103,069,281	£8,934,510	£22,336,275	£8,276,650	£20,691,625
Selby	7,745	204	£24,110,677	£1,334,290	£3,335,725	£1,221,140	£3,052,850
Wakefield	22,719	1,164	£42,486,157	£3,992,660	£9,981,650	£3,717,870	£9,294,675
York	12,920	541	£24,199,400	£2,271,750	£5,679,375	£2,104,560	£5,261,400
Leeds City Region	227,372	9,914	£473,576,801	£39,833,110	£99,582,775	£36,915,850	£92,289,625



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1 Introduction

The majority of councils within the Leeds City Region commissioned BRE to undertake a series of modelling exercises on their housing stock⁷ – Bradford, Calderdale, Kirklees, Leeds, Wakefield and York. Separate reports were produced for each council describing the modelling work and providing details of the results obtained from the dwelling level models and database. Each council was also provided with a dwelling level database enabling them to obtain specific information whenever required. This current report provides a high level summary for the Leeds City Region.

The stock models and database provide each council with dwelling level information on various key housing indicators, focussing on private sector housing. The key indicators provide each council with detailed information on the likely condition of the stock and the geographical distribution of properties of interest. These properties are likely to be suitable targets for energy efficiency improvements or other forms of intervention, such as mitigating Housing Health and Safety Rating System (HHSRS) hazards. The key indicators are split into indicators related to house condition, energy efficiency and household vulnerability as shown in **Table 1** (see **Appendix A** for full definitions):

Table 1: Key indicators split into categories

Indicator	House condition indicators	Energy efficiency indicators	Household vulnerability indicators
Presence of HHSRS cat 1 hazard	✓		
Presence of Cat 1 hazard for excess cold	✓	✓	
Presence of Cat 1 hazard for falls	✓		
Dwellings in disrepair	✓		
Fuel Poverty (10% and Low Income, High cost definitions)			✓
Dwellings occupied by low income households			✓
SimpleSAP rating		✓	

N.B. Presence of category 1 hazard for falls does NOT include the hazard of falling between levels

The single indicators shown in **Table 1** can also be combined within each database to provide powerful information on the housing stock, for example dwellings suffering from excess cold and also occupied by

⁷ The exception was Barnsley, Craven, Harrogate and Selby, however high level results for these local authority have been included in this report to enable the provision of Leeds City Region results and comparisons across the local authorities.



households on a low income. The true potential of the databases lies in their ability to produce combined indicators such as this, as it allows council officers to explore the stock and to assess the likely scope of any programmes they might wish to implement.

It is also possible to extract other information from the database which is of use to local authorities. This information includes estimates relating to the Department for Communities and Local Government's (DCLG) Local Authority Housing Statistics (LAHS) reporting of Energy Performance Certificate (EPC) ratings and costs of mitigating hazards.

The key indicators and other information are derived from the Housing Stock Database which is made up of a series of dwelling level stock models. The BRE Dwelling Level Stock Models have been used for many years to provide key housing indicators to local authorities. The most recent 2014 models have been updated to make use of the results of the 2011 English Housing Survey (EHS)⁸ and additionally now incorporate a technique known as geomodelling⁹ which makes use of Ordnance Survey (OS) data. The models also make significant use of the Experian UK Consumer Dynamics Database of dwelling and household indicators as inputs to the models.

The information in each of the databases can be used to ensure councils meet various policy and reporting requirements. For example, local housing authorities are required to review housing conditions in their districts in accordance with the Housing Act 2004¹⁰.

Furthermore, having this information available will also help to facilitate housing strategy delivery. It will enable a targeted intervention approach to improving housing; therefore allowing councils to concentrate their resources on housing in the poorest condition or with the greatest health impact.

1.1 Project aims

The main aim of this project was to provide data on key private sector housing indicators for each of the separate local authorities included in the Leeds City Region. The main aims of this work were therefore to provide estimates of:

- The percentage of dwellings meeting each of the key indicators for the Leeds City Region overall and broken down by tenure and then mapped by ward (private sector stock only)
- Information relating to LAHS reporting for the private sector stock - EPC ratings and category 1 hazards

Information on the policy background to this work is included in **Appendix C** and the remainder of this report focusses on a description of the overall stock modelling approach, followed by the modelling results for the Leeds City Region covering each of the main aims above.

⁸ 2011 is the latest available data. Prior to the 2014 models EHS 2009 data was used.

⁹ The OS data has been used to update a number of the model inputs – the main value of the OS data is the ability to determine the dwelling type with much greater confidence – see **Appendix B** for more information.

¹⁰ <http://www.legislation.gov.uk/ukpga/2004/34/contents>



2 Overview of the BRE Dwelling Level Housing Stock Modelling approach

This section provides a simplified overview of the BRE dwelling level housing stock modelling approach. More detail on the methodology is provided in **Appendix B**.

A stock modelling approach has been developed and used by BRE for many years and dwelling level models are used to estimate the likelihood of a particular dwelling meeting the criteria for each of the key indicators (and other outputs of interest). These outputs can then be mapped to provide the council with a geographical distribution of each of the key indicators which can then be used to target resources for improving the housing stock. The process itself is actually made up of a variety of data sources, calculations and models.

The models are principally informed by the Department for Communities and Local Government's (DCLG) English Housing Survey (EHS)¹¹. The survey is not used to supply data for the database, but rather it allows the identification of patterns in the housing stock, so that this knowledge can be applied, in the form of mathematical algorithms, to impute key indicators and energy characteristics from other data available at the national level. The particular approach for the Leeds City Region, however, makes significant use of the Experian UK Consumer Dynamics Database of dwelling and household indicators as inputs to the models. One example is the BRE SimpleCO₂ Model which is based on dwelling level inputs from Experian and expands on these using imputation techniques to provide sufficient information to calculate the likely energy efficiency of each dwelling in the stock. Some of the key housing indicators, such as HHSRS excess cold category 1 hazards and BRE's SimpleSAP¹², can be directly inferred from this data.

Furthermore, the 6 commissioning local authorities provided additional sources of local data which were then incorporated into the BRE Housing Stock Model and Database to produce an integrated housing stock model and database. The additional data provided and how it was used is as follows:

- **EPC data** – EPCs contain data on key dwelling energy characteristics (e.g. energy demand, excess cold, SimpleSAP) and where these were available they were used in preference to the modelled data. It should be noted that to comply with bulk EPC data licencing requirements the EPC data is only used to inform the energy efficiency aspects of the model.
- **Other Local data**
 - **Local Land and Property Gazetteer (LLPG) data** – the Unique Property Reference Number (UPRN) from the LLPG is used to uniquely identify all properties, while the address details from the LLPG are used to merge the BRE models and EPC data using address matching.
 - **Benefits data** – any households listed in this data are set as households in receipt of benefits in the database.

¹¹ The most recent survey used in the housing stock models is 2011.

¹² A Simplified version of the SAP model that produces an output broadly comparable to SAP. The SimpleSAP model is distinct from both full SAP and RD SAP in that uses a smaller, simplified set of inputs.



- **HHSRS category 1 hazards data** – the data provided lists the hazards which have been resolved, therefore if these dwellings originally had a hazard in the database that hazard is removed from that dwelling.
- **HMO data** – list of properties recorded as being HMOs or licensed HMOs. The UPRNs were matched to the LLPG data and these HMOs were then added to the modelled outputs.

The number of records integrated and the impact it had on the modelling process is summarised in **Table 2** below.

Table 2: Integrated data summary

Data source	Total no. of records	No. (and %) of addresses matched	Notes / impact on the modelling process
EPC data Bradford Calderdale Wakefield York Kirklees Leeds	65,858 42,130 45,229 30,472 53,644 169,102	52,569 (80%) 40,215 (95%) 35,501 (78%) 23,853 (78%) 43,384 (80%) 156,672 (93%)	Several duplicate cases where the same property has multiple EPC surveys. Additionally, further dwellings e.g. 48,871 for Bradford had their age or wall type data improved as a result of being in the same block or terrace as dwelling with an EPC.
Benefit data Bradford Calderdale Wakefield	57,241 20,374 34,705	55,503 (97%) N/A -postcode level 35,501 (78%)	Used to update low income model
LLPG Bradford Calderdale Wakefield York	222,534 94,799 159,329 93,943	N/A	Used to form backbone of address list
HMO (York)	2,874	2,475	Used to compare with BRE model estimates
Social tenure (Calderdale)	14,583	14,575	Used to improve accuracy of tenure data
HHSRS data (Bradford)	32,668 hazards	5,029 dwellings	Used to improve accuracy of category 1 hazard data

Figure 1 shows a simplified flow diagram of the overall BRE housing stock modelling approach. The process is made up of a series of data sources and models which, combined with various imputation and regression techniques and the application of other formulae, make up the final database. The database is essentially the main output of the modelling and provides information on the key indicators and other data requirements (e.g. energy efficiency variables). More detailed information on the data sources and models is provided in **Appendix B** but to summarise:



The data sources are:

EHS, Experian, Ordnance Survey (OS) MasterMap other local data (if available).

The Models are:

SimpleSAP, Fuel Poverty, HHSRS (all hazards, falls hazards and excess cold), Disrepair and Low Income Households.

The data sources and models are linked as shown in the flow diagram and the modelling process itself can be divided into “energy inputs” and “other inputs”, which are summarised as follows:

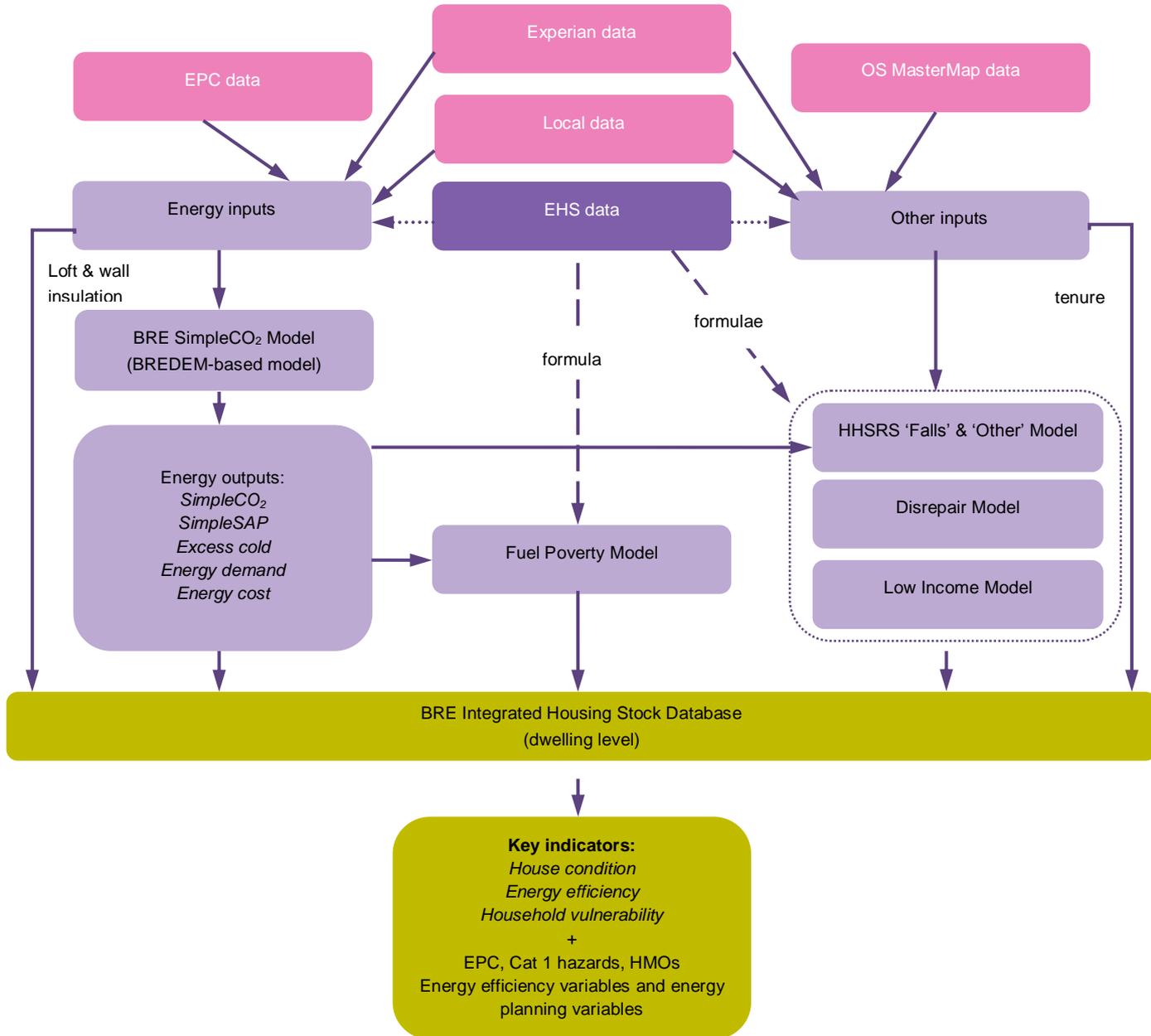
Energy inputs - are developed from Experian. The EHS data is used to impute (using cold deck imputation¹³) and interpolate where there are gaps in the data. The “energy inputs” are then fed into the SimpleCO₂ Model to produce the “energy outputs” for the database plus information on excess cold for the HHSRS Model and information on energy costs for the Fuel Poverty Model.

Other inputs – are developed from Experian, OS MasterMap and other local data sources. The EHS data is used to impute (using cold deck imputation¹³) and interpolate where there are gaps in the data. The “other inputs” are then fed into the HHSRS, Disrepair, and Low Income Models (note that tenure data is fed directly into the database). Information from the EHS also feeds into the Fuel Poverty, HHSRS, Disrepair and Low Income Models.

¹³ Cold deck imputation is a process of assigning values in accordance with their known proportions in the stock.



Figure 1: Simplified flow diagram of overall BRE housing stock modelling approach (N.B. the EHS data is only used to inform the mathematical algorithms of the model – it does not provide data)



- BRE housing stock modelling process
- Integration of additional data
- Data used for imputation & interpolation
- Outputs
- Data
- Imputed (cold deck)
- Information



3 Summary results for the Leeds City Region from the BRE Dwelling Level Housing Stock Models and Database

As described in the previous section, the housing stock modelling process consists of a series of different stock models with the main output being the database. The results provided in this section are a high level summary for the Leeds City Region as a whole. The individual reports and databases provided to each council are at a more detailed level.

The first sub-section below provides a map of the local authorities making up the Leeds City Region and a table summarising the tenure split for each local authority. The second section provides a comparison of the Leeds City Region with England based on the 2011 English Housing Survey (EHS).

The results are then displayed in the remaining sub-sections and include maps of a number of variables, thus enabling quick observation of the geographical distribution of areas of interest. The maps show the percentages of dwellings by ward for each local authority that are estimated to have met the requirements for each of the variables. The ranges shown in the map keys are defined based on the Jenks' Natural Breaks algorithm of the COA statistics¹⁴. The outputs in the lightest and darkest colours on the maps show the extreme ends of the range, highlighting the best and the worst areas. The maps also highlight the differences between areas, showing that the results for some areas are much worse than for others and these are the specific areas which might warrant attention. The maps also show that within local authorities there can be large differences between the results at ward level.

The sub-sections are as follows:

Comparison of the key indicators across the Leeds City Region local authorities (see **Appendix A** for full definitions):

- Presence of HHSRS category 1 hazard
- Presence of category 1 hazard for excess cold
- Presence of category 1 hazard for falls
- Dwellings in disrepair
- Fuel poverty (10% and Low Income High Costs definitions)
- Dwellings occupied by low income households
- Simple SAP rating

Comparison of information relating to LAHS reporting¹⁵:

- EPC ratings
- Cost of mitigating category 1 hazards

¹⁴ Natural breaks classes are based on natural groupings inherent in the data.

¹⁵ The 6 commissioning LCR local authorities were also supplied with information on Houses in Multiple Occupation (HMOs) and various energy efficiency variables. As this exercise was not carried out for the whole region this information has not been included in this summary report.

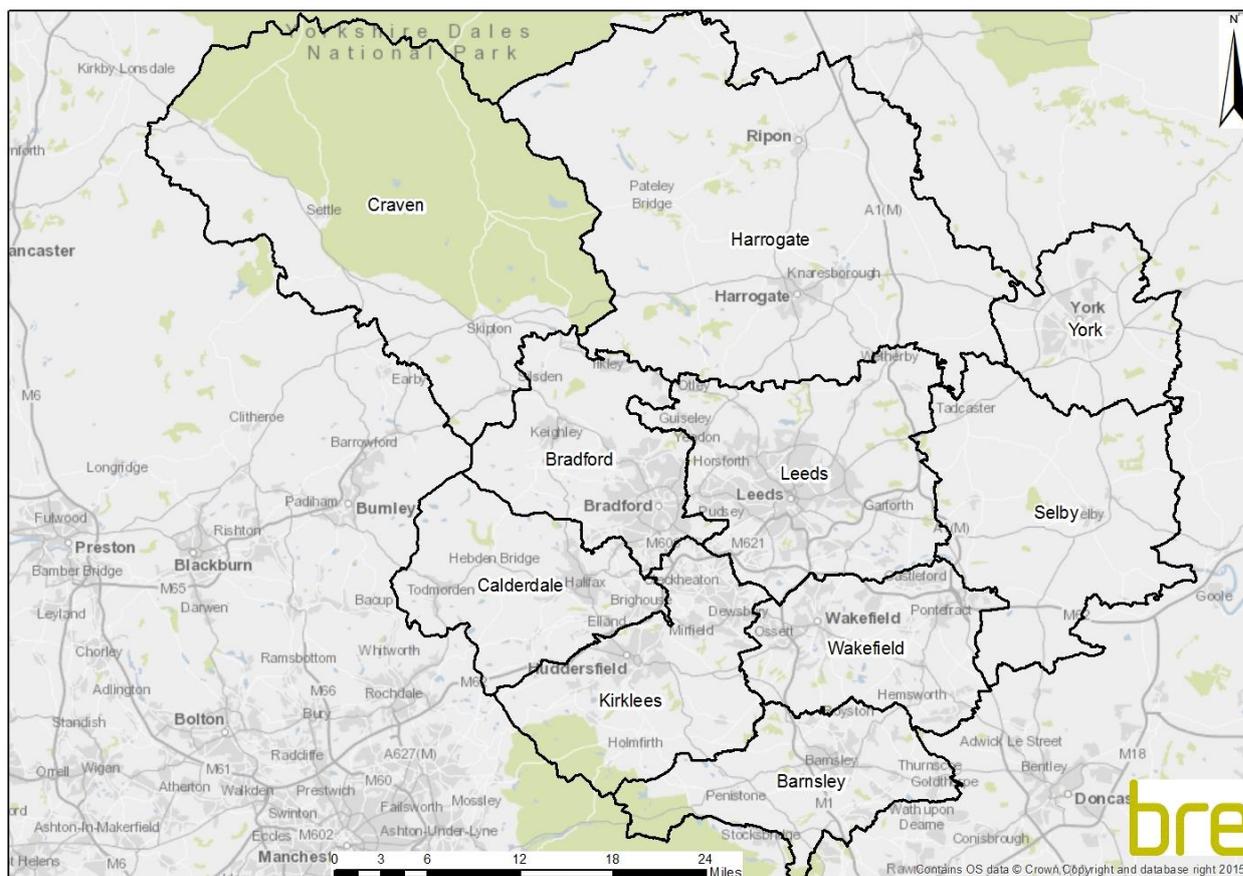


3.1 Overview of Leeds City Region

Map 1 below shows the 10 local authorities making up the Leeds City Region. The majority of data in this report is shown as a high level summary separated into local authorities; however, each local authority has been provided with a database which provides data at more disaggregated levels, e.g. ward, Census Output Area (COA).

Table 3 provides an overview of the housing stock in the Leeds City Region broken down by local authority and tenure.

Map 1: The local authorities in the Leeds City Region



**Table 3:** Overview of the Leeds City Region housing stock by private tenure for each local authority

Local authority	No. of dwellings			
	Private sector stock		Social	TOTAL
	Owner occupied	Private rented		
Barnsley	68,222	13,582	22,236	104,040
Bradford	139,782	38,588	33,400	211,770
Calderdale	64,102	15,998	14,611	94,711
Craven	19,626	4,183	2,402	26,211
Harrogate	50,112	12,411	6,489	69,012
Kirklees	128,381	25,456	26,721	180,558
Leeds	206,354	67,193	69,760	343,307
Selby	27,119	4,027	4,410	35,556
Wakefield	99,353	18,318	37,093	154,764
York	58,999	15,906	12,602	87,507
<i>Leeds City Region</i>	<i>862,050</i>	<i>215,662</i>	<i>229,724</i>	<i>1,307,436</i>
	<i>66%</i>	<i>16%</i>	<i>18%</i>	<i>100%</i>
EHS	<i>65%</i>	<i>18%</i>	<i>17%</i>	<i>100%</i>

3.2 Comparison of Leeds City Region with England

Figure 2 shows the percentage of private sector dwellings in the Leeds City Region failing each of the key indicators compared to the percentage for England as a whole (2011 EHS data). The Leeds City Region has a higher percentage of private sector dwellings with fall hazards, disrepair, fuel poor households (10% definition) and low income households compared to England. It does however, perform better for excess cold hazards and all hazards.

This is also the case for SimpleSAP ratings for the private sector stock, where Leeds City Region has an average rating of 57 compared to 55 for England as a whole.



Figure 2: Comparison of the Leeds City Region with England (EHS 2011), % of private sector dwellings failing each of the indicators



3.3 Comparison of the key indicators across the Leeds City Region local authorities

The following sub-sections provide the results for each of the key indicators.

3.3.1 Presence of HHSRS category 1 hazard

Table 4 shows the percentage of dwellings estimated to have a HHSRS category 1 hazard by local authority and tenure and for the Leeds City Region as a whole. The greatest proportion of all stock with hazards is in Craven (26%) and the lowest is in Wakefield (11%). The figure for the region overall is 15%.

For the private sector stock, again the highest proportion is in Craven (27%) and the lowest is in Wakefield (13%) with the figure for the region as a whole being 17%.

Overall, the social stock has a lower proportion of dwellings with hazards compared to the other tenures.

Map 2 shows the geographical distribution of private sector dwellings in the Leeds City Region estimated to have a HHSRS category 1 hazard. The greatest numbers of hazards are concentrated in Craven and Harrogate to the north of the region, and the least in Wakefield. The ranges shown in the map keys are defined based on the Jenks' Natural Breaks algorithm of the ward level statistics. The outputs in the lightest and darkest colours on the maps show the extreme ends of the range.

The commissioning local authorities were provided with maps at Census Output Area level. However, given this report is presenting a picture of the whole region, the maps within this report are produced at ward level. Using the first map below (**Map 2**) as an example, it can be seen that all 10 local authorities across the region are split into wards, and, in this instance there are 3 wards that have 51 - 75% of private sector dwellings estimated to have the presence of a category 1 hazard.



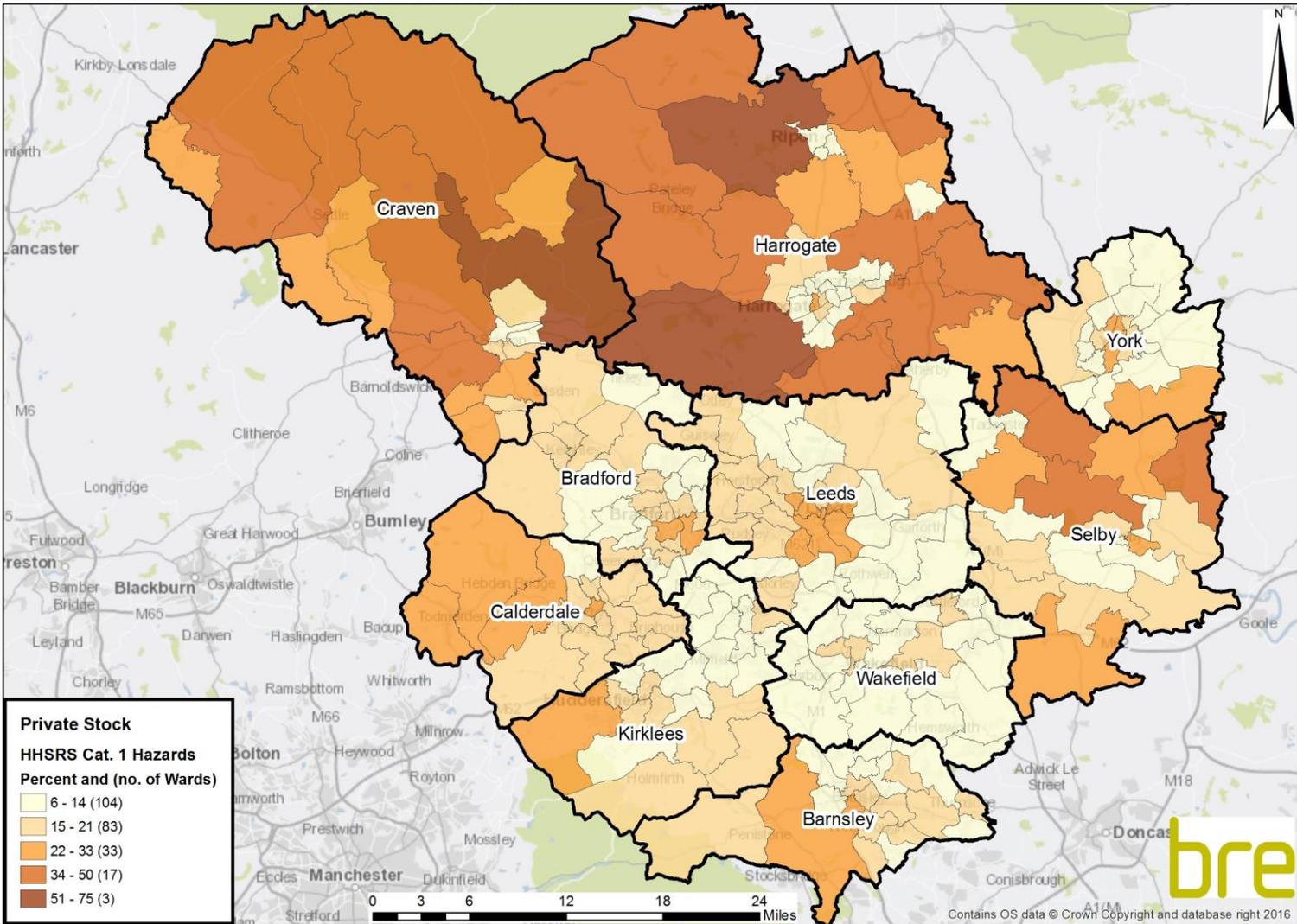
The maps also highlight the differences between areas, showing that the results for some areas are much worse than for others and these are the specific areas which might warrant attention.

Table 4: Percentage of dwellings estimated to have a HHSRS category 1 hazard by local authority and private sector tenure

Local authority	% of dwellings with HHSRS category 1 hazards			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	15%	14%	23%	13%
Bradford	16%	14%	21%	14%
Calderdale	20%	18%	26%	18%
Craven	27%	25%	41%	26%
Harrogate	21%	19%	29%	20%
Kirklees	15%	13%	21%	13%
Leeds	17%	14%	25%	15%
Selby	19%	18%	27%	18%
Wakefield	13%	12%	20%	11%
York	15%	13%	23%	14%
<i>Leeds City Region</i>	<i>17%</i>	<i>15%</i>	<i>24%</i>	<i>15%</i>



Map 2: Percentage of private sector dwellings in the Leeds City Region estimated to have a HHSRS category 1 hazard





3.3.2 Presence of category 1 hazard for excess cold

The percentage of dwellings estimated to have the presence of a category 1 hazard for excess cold is shown in **Table 5**, for the Leeds City Region as a whole and broken down by local authority and tenure. The greatest proportion of all stock with the presence of an excess cold hazard is in Craven (19%).

For the private sector stock, the highest proportion is also in Craven (20%), followed by Harrogate and Selby (both 14%), the remaining local authorities have much lower proportions of excess cold bringing the figure for the region as a whole to 6%.

Overall, and perhaps unsurprisingly, the social stock has a lower proportion of dwellings with excess cold hazards compared to the other tenures. However, the analysis for Leeds shows a slightly lower percentage of cold hazards in the owner occupied stock than the social stock.

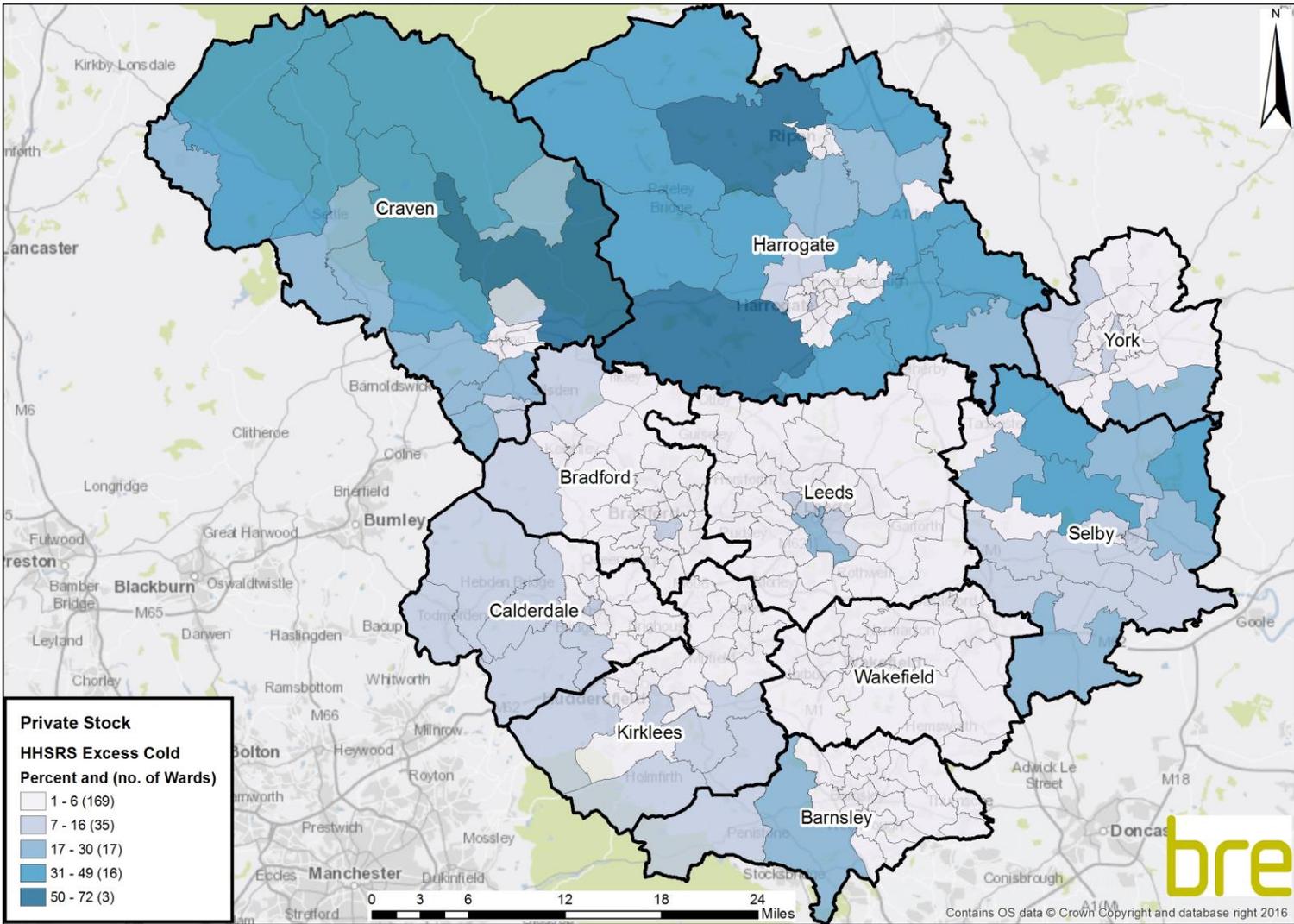
Map 3 shows the geographical distribution of private sector dwellings in the Leeds City Region estimated to have a category 1 hazard for excess cold. The greatest concentrations of excess cold are mainly to the north of the region and in more rural areas where dwellings tend to be older, there are fewer flats and there tend to be more properties off the gas network.

Table 5: Percentage of dwellings estimated to have a HHSRS category 1 hazard for excess cold by local authority and private sector tenure

Local authority	% of dwellings with category 1 hazard for excess cold			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	5%	4%	7%	4%
Bradford	4%	4%	6%	4%
Calderdale	7%	7%	8%	6%
Craven	20%	19%	25%	19%
Harrogate	14%	13%	16%	13%
Kirklees	4%	4%	6%	4%
Leeds	5%	3%	10%	5%
Selby	14%	14%	17%	13%
Wakefield	4%	4%	6%	4%
York	4%	3%	7%	4%
<i>Leeds City Region</i>	<i>6%</i>	<i>5%</i>	<i>9%</i>	<i>5%</i>



Map 3: Percentage of private sector dwellings in the Leeds City Region estimated to have a HHSRS category 1 hazard for excess cold





3.3.3 Presence of category 1 hazard for falls

Table 6 shows the percentage of dwellings estimated to have a category 1 hazard for falls by local authority and tenure and for the Leeds City Region as a whole. The greatest proportion of all stock with fall hazards is in Calderdale (13%) and the lowest is in Selby (8%).

For the private sector stock, the highest proportion is in Calderdale (15%) and the lowest is in Selby (8%) with the figure for the region as a whole being 11%.

Overall, the social stock has a lower proportion of dwellings with falls hazards compared to the other tenures.

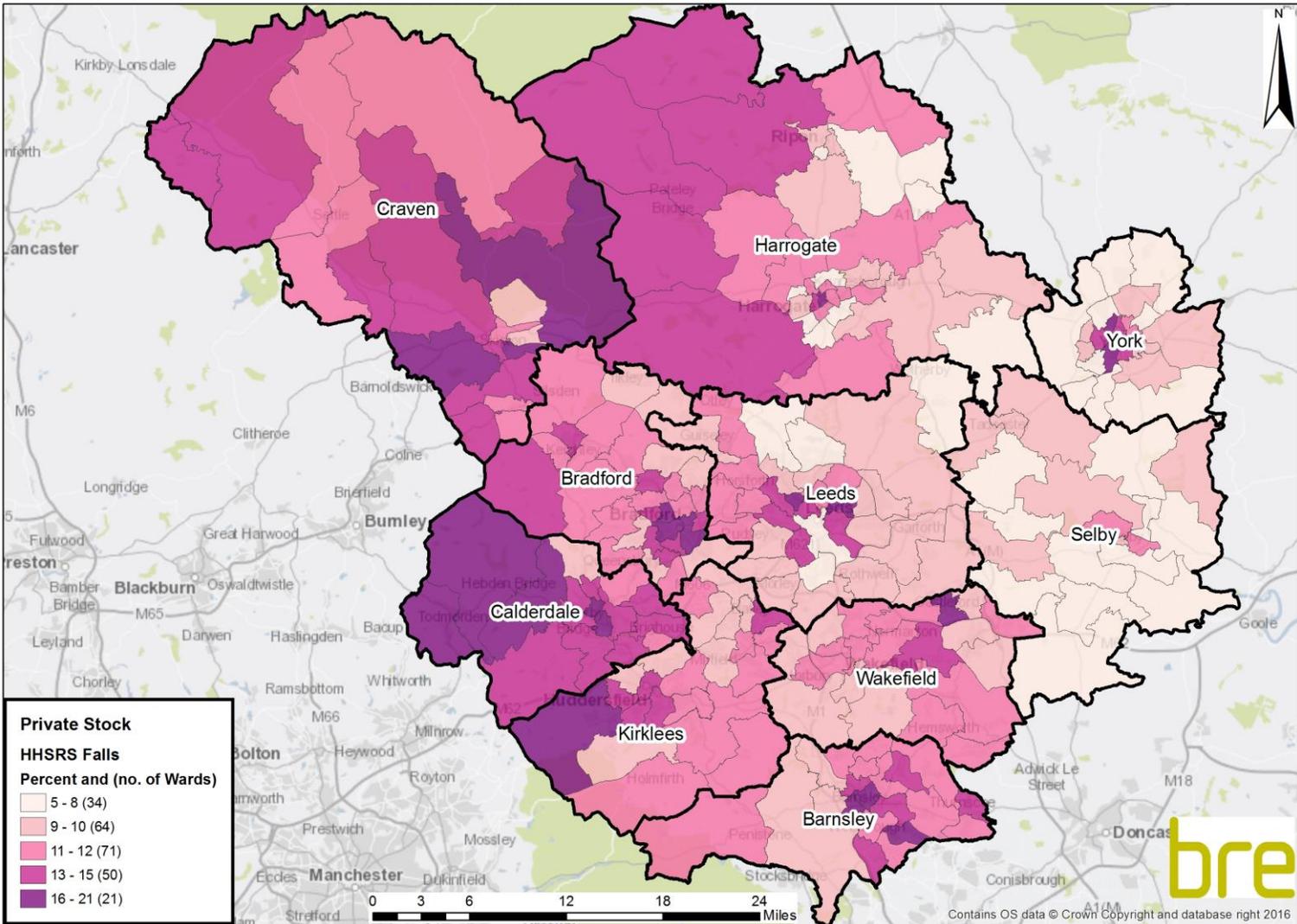
Map 4 shows the geographical distribution of private sector dwellings in the Leeds City Region estimated to have a category 1 hazard for falls. The greatest numbers of hazards are concentrated in the west of the region and in more urban areas. This may be a result of older, more terraced housing in urban areas which tends to result in more falls hazards.

Table 6: Percentage of dwellings estimated to have a HHSRS category 1 hazard for falls by local authority and private sector tenure

Local authority	% of dwellings with category 1 hazard for falls			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	13%	12%	17%	11%
Bradford	12%	11%	14%	11%
Calderdale	15%	14%	17%	13%
Craven	13%	12%	17%	12%
Harrogate	10%	10%	14%	10%
Kirklees	12%	11%	15%	10%
Leeds	10%	10%	13%	9%
Selby	8%	8%	11%	8%
Wakefield	11%	10%	14%	9%
York	10%	9%	15%	10%
Leeds City Region	11%	11%	15%	10%



Map 4: Percentage of private sector dwellings in the Leeds City Region estimated to have a HHSRS category 1 hazard for falls





3.3.4 Dwellings in disrepair

This indicator is based on the former Decent Homes Standard which states that a dwelling fails this criterion if it is not found to be in a reasonable state of repair. This is assessed by looking at the age of the dwelling and the condition of a range of building components (including walls, roofs, windows, doors, electrics and heating systems).

Table 7 shows the percentage of dwellings estimated to be in disrepair by local authority and tenure and for the Leeds City Region as a whole. The greatest proportion of all stock in disrepair is in Bradford, Calderdale and Craven (all 8%) and the lowest is in Selby (4%).

For the private sector stock, the highest proportion is again in Bradford, Calderdale and Craven (all 8%) and the lowest is again in Selby (4%) with the figure for the region as a whole being 7%.

Overall the social stock and owner occupied stock have similar proportions of dwellings in disrepair compared to the private rented stock which has almost double the proportion.

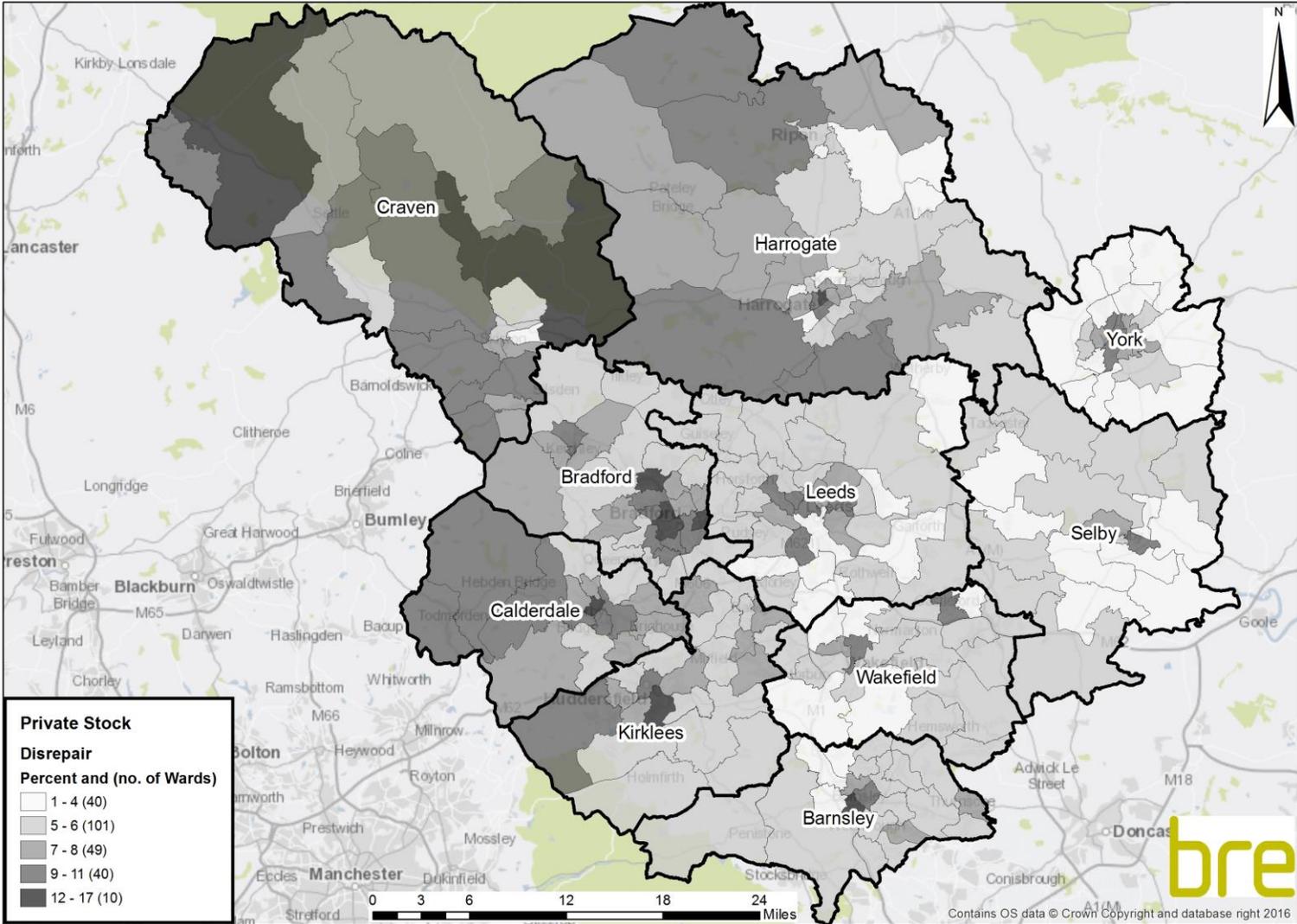
Map 5 shows the geographical distribution of private sector dwellings in the Leeds City Region estimated to be in disrepair. The greatest concentrations appear to be towards the north-west and west of the region, and also in parts of Leeds and Bradford.

Table 7: Percentage of dwellings estimated to be in disrepair by local authority and private sector tenure

Local authority	% of dwellings in disrepair			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	6%	5%	10%	6%
Bradford	8%	7%	12%	8%
Calderdale	8%	7%	12%	8%
Craven	8%	8%	12%	8%
Harrogate	7%	6%	11%	6%
Kirklees	7%	6%	11%	7%
Leeds	6%	5%	8%	6%
Selby	4%	4%	7%	4%
Wakefield	6%	5%	9%	5%
York	6%	5%	10%	6%
<i>Leeds City Region</i>	<i>7%</i>	<i>6%</i>	<i>10%</i>	<i>6%</i>



Map 5: Percentage of private sector dwellings in the Leeds City Region to be in disrepair





3.3.5 Fuel poverty (10% and Low Income High Costs definitions)

This report covers both the original definition and the more recent definition of fuel poverty. The original definition states that a household is said to be in fuel poverty if it spends more than 10% of its income on fuel to maintain an adequate level of warmth (defined as 21°C for the main living area, and 18°C for other occupied rooms in the 2012 Hills Fuel Poverty Review)¹⁶. For the purposes of this report this is termed “fuel poverty (10%)”.

Under the Low Income High Costs definition, a household is said to be in fuel poverty if they have required fuel costs that are above average (the national median level) and were they to spend that amount they would be left with a residual income below the official poverty line. For the purposes of this report this is termed “fuel poverty (Low Income High Costs)”.

Table 8 and **Table 9** show the results based on the 10% and LIHC definitions respectively. In general, the estimated percentages are lower under the LIHC definition. For the private sector stock, Craven has the highest proportions of fuel poverty under both definitions – 30% and 15%.

Map 6 and **Map 7** show the results based on the 10% and LIHC definitions respectively and both indicate that the highest concentrations tend to be in the rural areas and to the north of the region.

Table 8: Percentage of dwellings estimated to be in fuel poverty by local authority and by private sector tenure – 10% definition

Local authority	% of dwellings in fuel poverty (10% definition)			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	16%	14%	26%	16%
Bradford	18%	16%	26%	18%
Calderdale	21%	19%	28%	20%
Craven	30%	28%	39%	29%
Harrogate	23%	22%	30%	23%
Kirklees	17%	16%	25%	17%
Leeds	19%	16%	28%	19%
Selby	21%	20%	28%	20%
Wakefield	16%	14%	24%	16%
York	15%	13%	22%	15%
<i>Leeds City Region</i>	18%	16%	27%	18%

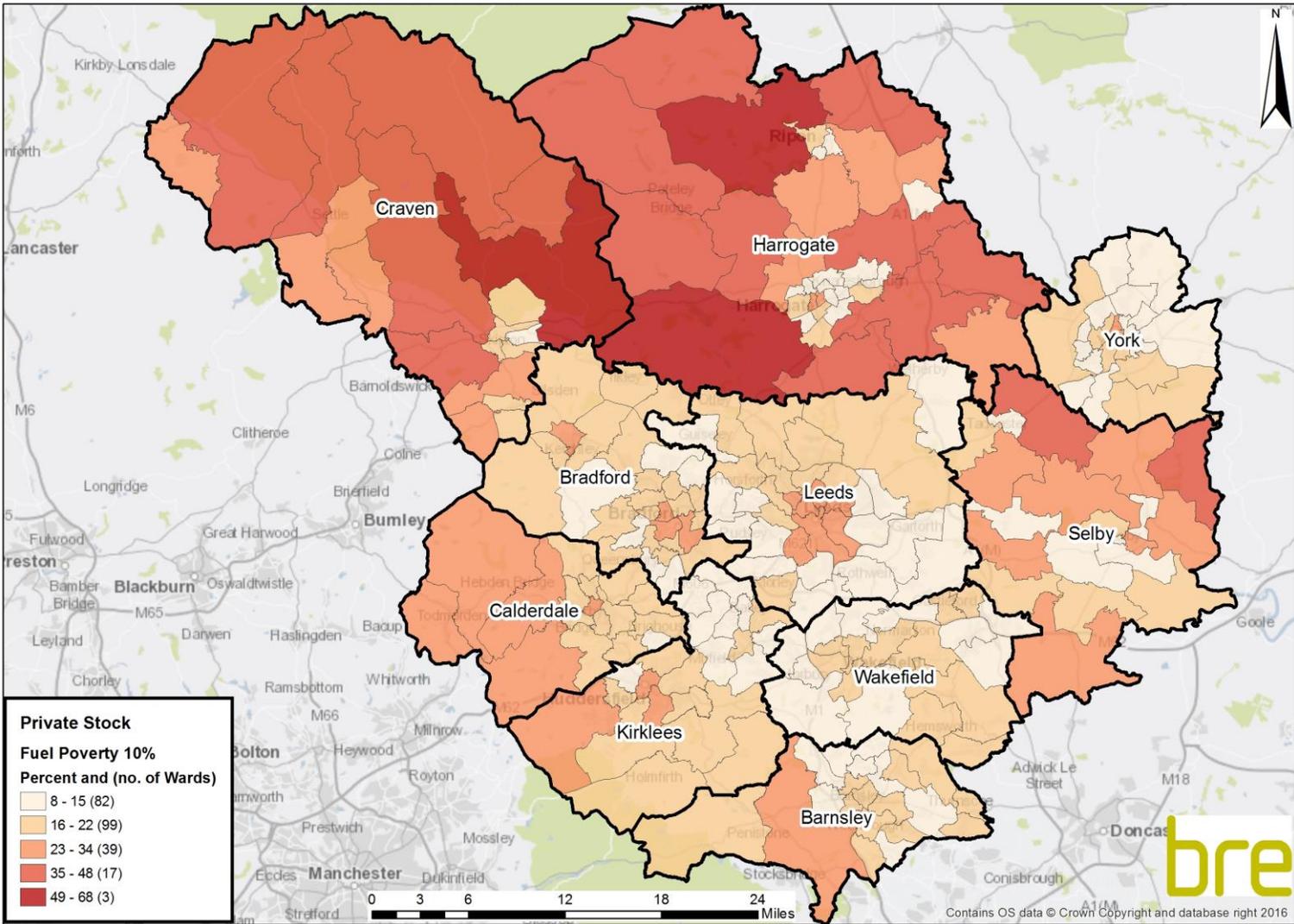
¹⁶ Hills, J. Getting the measure of fuel poverty - Final Report of the Fuel Poverty Review, London: LSE., 2012



Table 9: Percentage of dwellings estimated to be in fuel poverty by local authority and by private sector tenure – Low Income High Costs (LIHC) definition

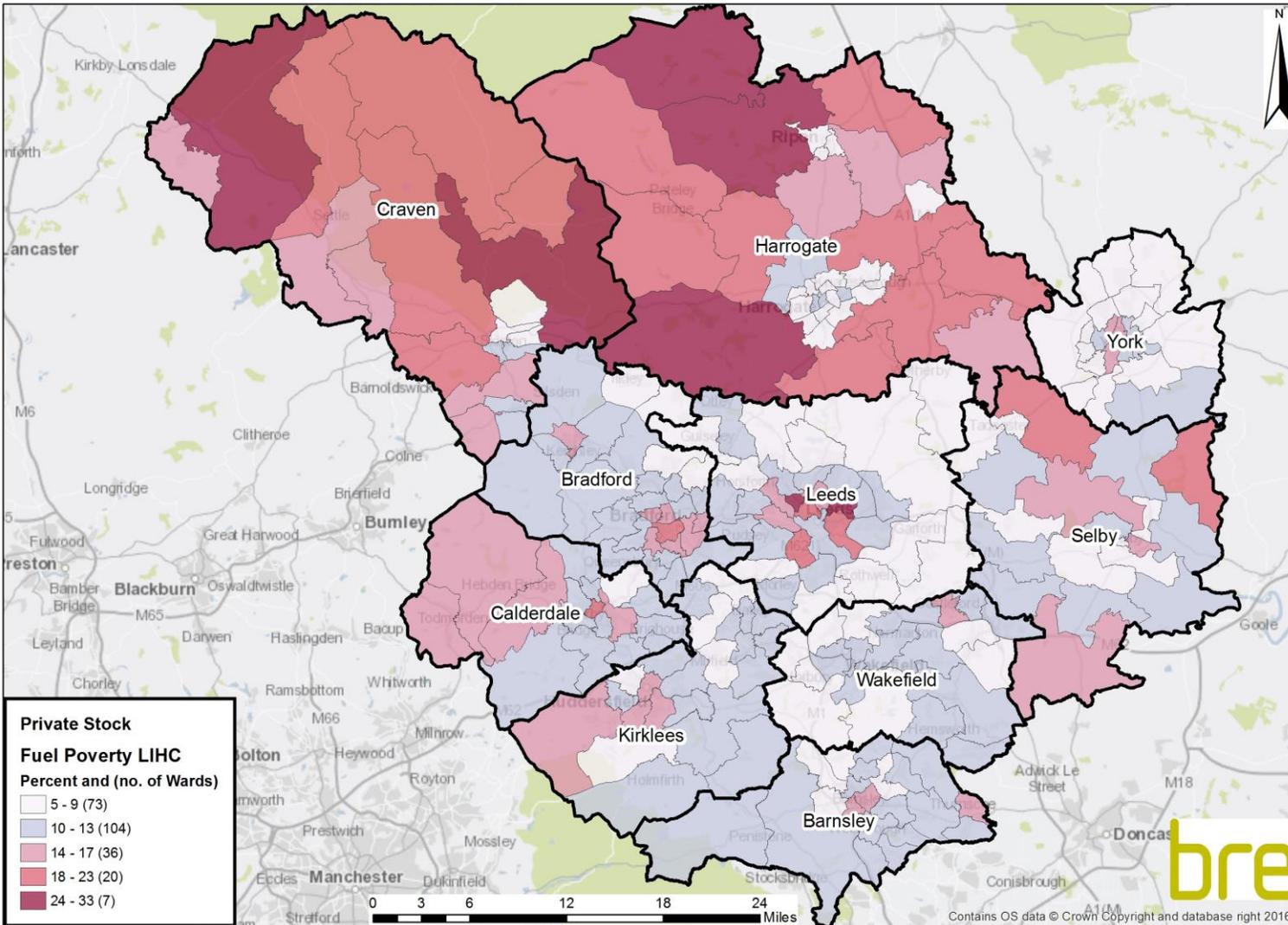
Local authority	% of dwellings in fuel poverty (LIHC definition)			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	11%	9%	25%	11%
Bradford	12%	9%	25%	12%
Calderdale	13%	10%	25%	12%
Craven	15%	12%	29%	14%
Harrogate	12%	9%	22%	11%
Kirklees	11%	9%	23%	11%
Leeds	12%	9%	21%	12%
Selby	11%	9%	24%	11%
Wakefield	10%	8%	23%	10%
York	9%	6%	20%	9%
<i>Leeds City Region</i>	<i>12%</i>	<i>9%</i>	<i>23%</i>	<i>11%</i>

Map 6: Percentage of private sector dwellings in the Leeds City Region estimated to be occupied by households in fuel poverty – 10% definition





Map 7: Percentage of private sector dwellings in the Leeds City Region estimated to be occupied by households in fuel poverty - Low Income High Costs definition





3.3.6 Dwellings occupied by low income households

Table 10 shows the percentage of dwellings estimated to be occupied by low income households by local authority and tenure and for the Leeds City Region as a whole. The greatest proportion of all stock occupied by households on a low income is in Wakefield (40%) and the lowest is in Harrogate (23%).

For the private sector stock, the highest proportion is in Bradford (30%) and the lowest is in Harrogate (18%) with the figure for the region as a whole being 26%.

Unsurprisingly, the social stock has a much higher proportion of dwellings on low income compared to the other tenures.

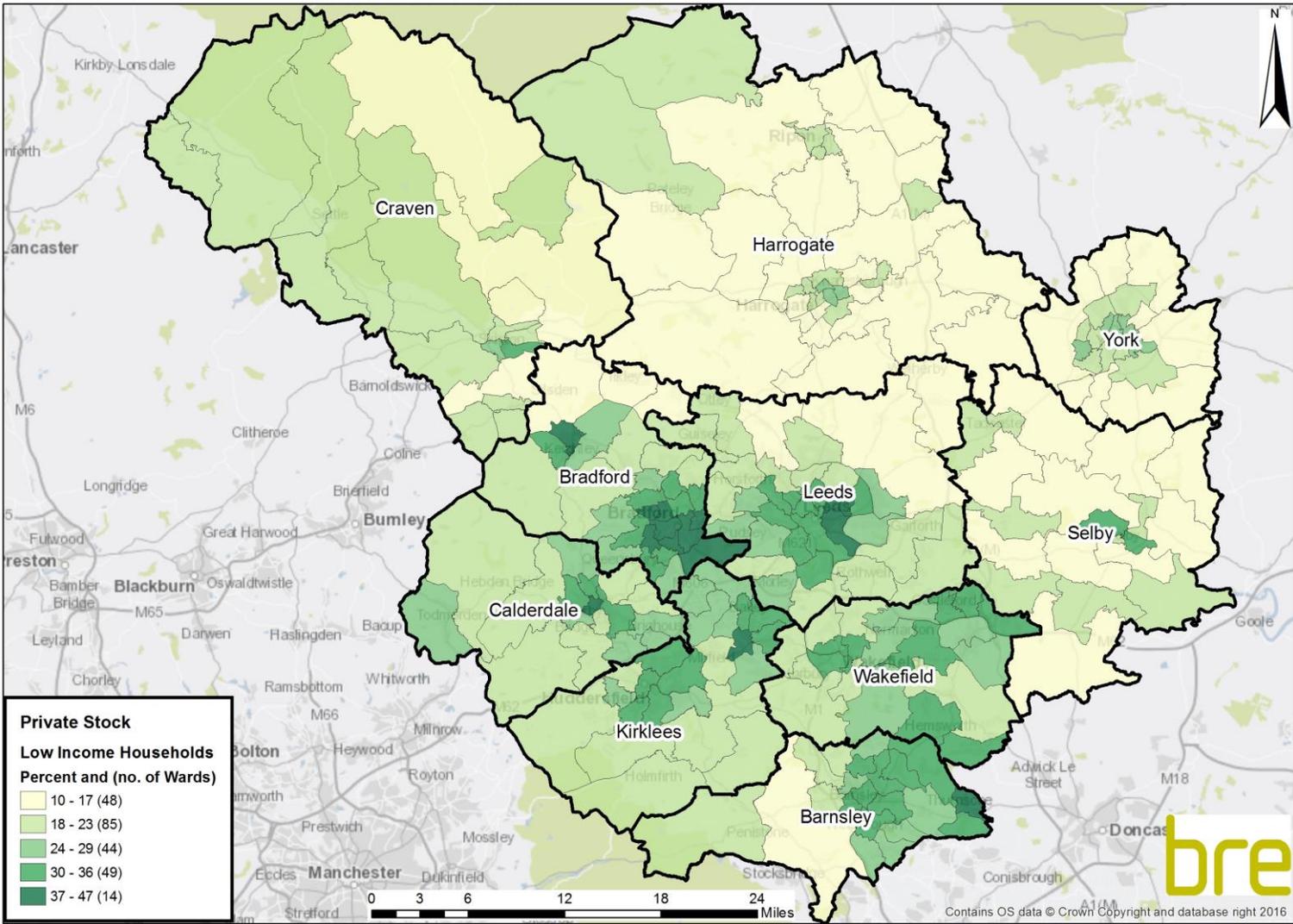
Map 8 shows the geographical distribution of private sector dwellings in the Leeds City Region on low income. The greatest numbers are generally concentrated to the south of the region and in the more urban areas.

Table 10: Percentage of dwellings estimated to be occupied by low income households by local authority and by private sector tenure

Local authority	% of dwellings on low income			
	Private sector stock			% of all stock
	% of private sector	% of owner occupied	% of private rented	
Barnsley	28%	24%	47%	39%
Bradford	30%	25%	45%	37%
Calderdale	26%	20%	51%	35%
Craven	20%	17%	36%	25%
Harrogate	18%	15%	31%	23%
Kirklees	27%	24%	45%	35%
Leeds	26%	21%	41%	37%
Selby	19%	16%	36%	26%
Wakefield	27%	23%	49%	40%
York	21%	17%	34%	28%
<i>Leeds City Region</i>	<i>26%</i>	<i>22%</i>	<i>43%</i>	<i>35%</i>



Map 8: Percentage of private sector dwellings in the Leeds City Region estimated to be occupied by low income households





3.3.7 SimpleSAP rating

The average SimpleSAP ratings for the Leeds City Region as a whole and broken down by local authority and tenure are shown in **Table 11**. For all stock, Barnsley, Wakefield and York have the highest average SimpleSAP rating (59) and Craven has the lowest average rating (51).

For the private sector stock, York has the highest average SimpleSAP rating (59) and Craven has the lowest (50). The average SimpleSAP rating for the region as a whole is 57 and the England average from the 2011 EHS is 55.

Overall the social stock has higher average ratings compared to the other tenures.

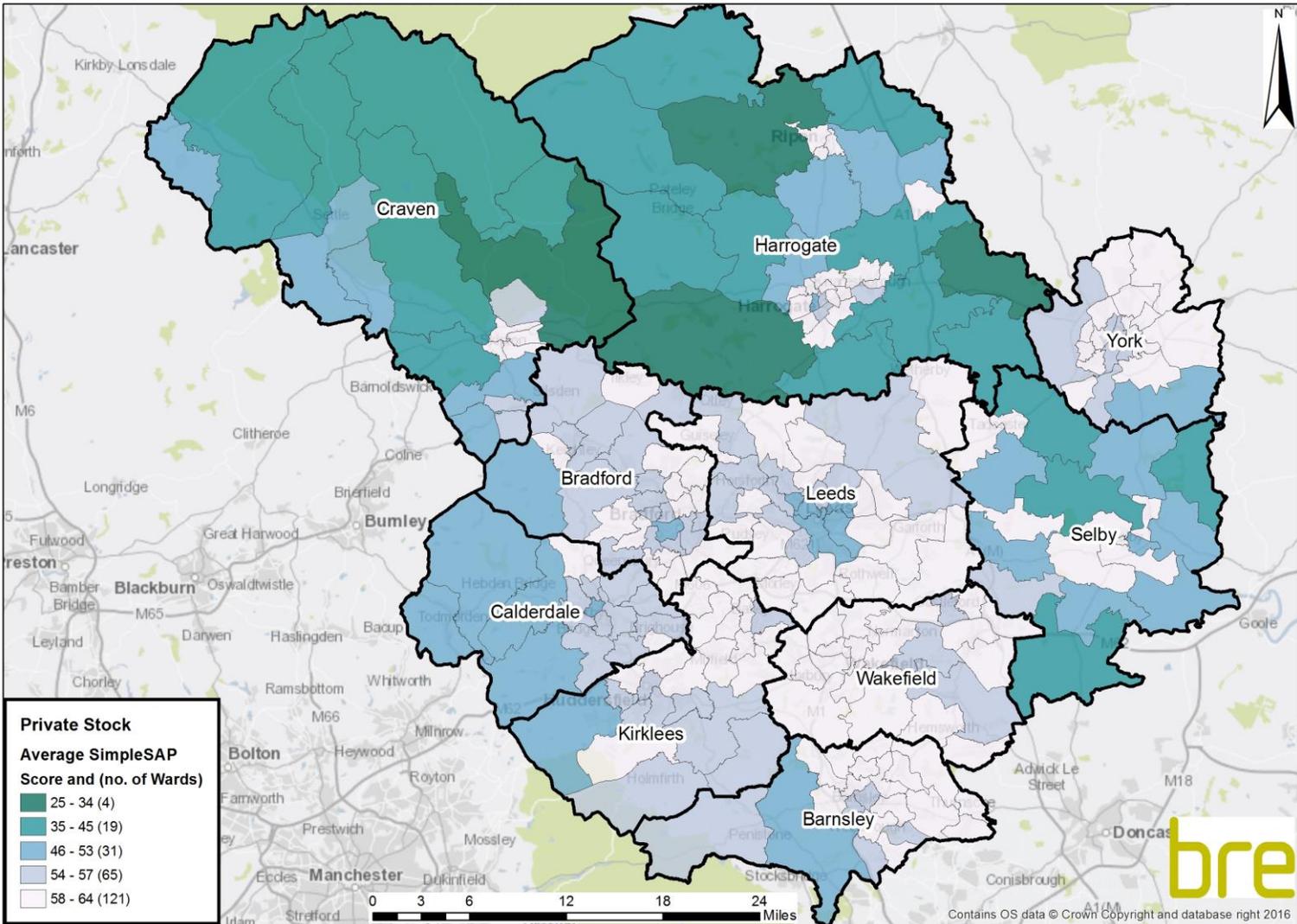
Map 9 shows the geographical distribution of average SimpleSAP ratings. Rural areas with low population densities tend to have the lowest ratings. The size of the home itself is not a factor in SimpleSAP, and properties in these areas may be more likely to be semi-detached or detached, and therefore have larger heat loss areas. As they are in a rural location, properties in these wards may also not be connected to the mains gas network leading to a decrease in SimpleSAP score.

Table 11: Average SimpleSAP rating by local authority and by private sector tenure

Local authority	Average SimpleSAP rating			
	Private sector stock			All stock
	Total private sector	Owner occupied	Private rented	
Barnsley	58	58	56	59
Bradford	57	58	55	58
Calderdale	55	55	54	56
Craven	50	50	46	51
Harrogate	54	54	52	54
Kirklees	57	58	56	58
Leeds	57	58	52	57
Selby	53	54	51	54
Wakefield	58	59	56	59
York	59	59	56	59
<i>Leeds City Region</i>	<i>57</i>	<i>57</i>	<i>54</i>	<i>57</i>



Map 9: Average SimpleSAP rating - private sector dwellings in the Leeds City Region





3.4 Comparison of information relating to LAHS reporting

The following sub-sections show the results for EPC ratings and the cost of mitigating category 1 hazards.

3.4.1 EPC ratings

An Energy Performance Certificate (EPC) is required whenever a new building is constructed, or an existing building is sold or rented out. An EPC is a measure of the energy efficiency performance of a building and is rated from band A – G, with A representing the best performance. The EPC ratings correspond to a range of SAP ratings from 1 – 100, with 100 being the best. It is possible, therefore, to give a dwelling an EPC rating based on the SAP rating.

Table 12 shows the Bands A – G and corresponding SAP scores in brackets. The columns show the percentage of private sector stock falling into each of the EPC rating bands for each local authority and for Leeds City Region as a whole.

The percentage of private sector dwellings with an EPC rating below Band E for Leeds City Region as a whole is 9.5%. Craven has the highest percentage falling below Band E (24.8%) and York has the lowest (6.5%).

A recent consultation paper, 'ECO: Help to Heat'¹⁷ has been released by the Department for Energy and Climate Change which has since become Department for Business, Energy and Industrial Strategy. One of the proposals is for inefficient social housing to become eligible for Affordable Warmth funding. The proposal is that all E, F and G social housing properties would become automatically eligible for funding for low cost insulation measures. Therefore, the LCR has asked for estimates on the number of social rented properties with an EPC rating below Band D, **Table 14** shows an estimated 21.8% of social stock below Band D. This equates to 52,470 social rented dwellings across the region.

Under the Energy Act 2011, new rules mean that from 2018 landlords must ensure that their properties meet a minimum energy efficiency standard - which has been set at band E - by 1 April 2018^{18, 19}.

Table 13 shows the breakdown of SimpleSAP results into the A – G Bands for the private rented stock only. The percentage of private rented dwellings with an EPC rating below Band E for Leeds City Region as a whole is 13.5%. Craven has the highest percentage falling below Band E (31.4%) and York has the lowest (10%). The distribution of dwellings with EPC ratings below band E is shown in **Map 10**. These are for the private rented stock only, since this is affected by the new rules on minimum standards. Under the legislation these properties would not be eligible to be rented out after 2018.

¹⁷https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/531964/ECO_Help_to_Heat_Consultation_Document_for_publication.pdf

¹⁸ <http://www.legislation.gov.uk/uksi/2015/962/contents/made>

¹⁹ Although landlords will still be able to rent out F and G rated properties after this date they will not be able to renew or sign a new contract.



Table 12: Percentage of private sector stock falling into each of the EPC ratings bands (based on SimpleSAP) by local authority

Distribution of EPC rating bands by local authority - private sector											
EPC rating band	Barnsley	Bradford	Calderdale	Craven	Harrogate	Kirklees	Leeds	Selby	Wakefield	York	Leeds City Region
(92-100) A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(81-91) B	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.4%	0.2%	0.3%	0.3%	0.3%
(69-80) C	19.1%	16.2%	14.7%	13.8%	17.2%	18.9%	16.8%	17.6%	18.7%	18.1%	17.3%
(55-68) D	49.6%	47.4%	41.2%	36.6%	42.3%	46.9%	45.6%	42.2%	49.6%	49.8%	46.3%
(39-54) E	23.7%	28.3%	31.4%	24.7%	22.7%	25.9%	28.6%	20.4%	23.9%	25.3%	26.6%
(21-38) F	5.4%	5.7%	8.9%	14.7%	11.0%	6.0%	5.9%	13.5%	5.7%	4.8%	6.7%
(1-20) G	2.1%	2.2%	3.5%	10.1%	6.5%	2.1%	2.7%	6.2%	1.8%	1.7%	2.9%

Table 13: Percentage of private rented stock falling into each of the EPC ratings bands (based on SimpleSAP) by local authority

Distribution of EPC rating bands by local authority - private rented sector											
EPC rating band	Barnsley	Bradford	Calderdale	Craven	Harrogate	Kirklees	Leeds	Selby	Wakefield	York	Leeds City Region
(92-100) A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(81-91) B	0.3%	0.5%	0.6%	0.2%	0.6%	0.7%	0.8%	0.5%	0.7%	0.5%	0.6%
(69-80) C	15.5%	14.9%	15.7%	11.4%	15.8%	18.6%	14.2%	16.4%	18.3%	18.3%	15.8%
(55-68) D	44.6%	40.6%	36.4%	30.1%	37.8%	40.9%	33.5%	36.9%	41.5%	39.3%	37.9%
(39-54) E	29.3%	33.1%	33.0%	27.0%	24.9%	29.5%	36.3%	22.3%	28.9%	31.8%	32.2%
(21-38) F	6.8%	7.3%	10.1%	16.5%	11.9%	7.1%	9.2%	15.2%	7.7%	7.0%	8.7%
(1-20) G	3.5%	3.6%	4.2%	14.8%	9.0%	3.2%	6.0%	8.7%	3.0%	2.9%	4.9%

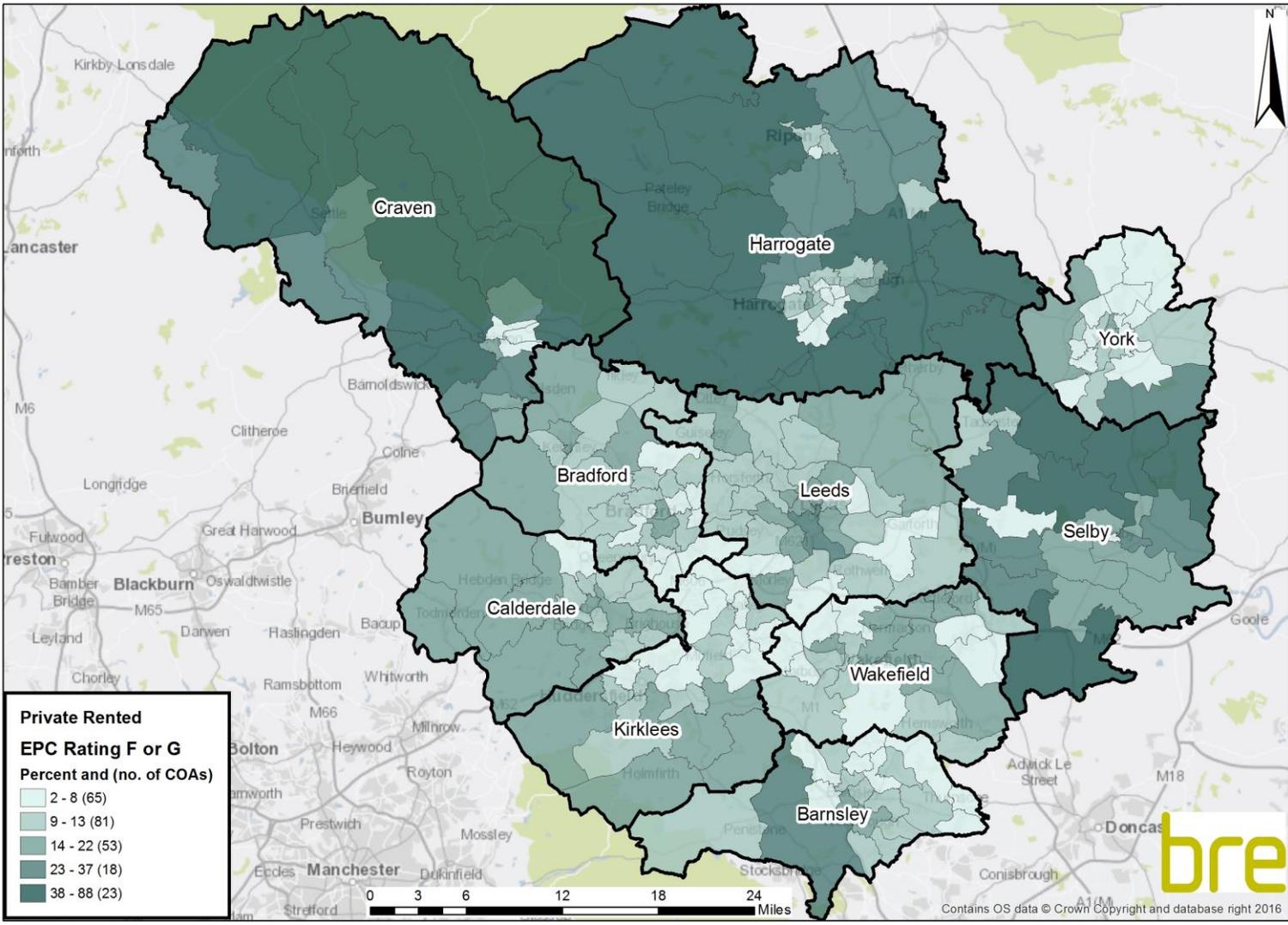


Table 14: Percentage of social stock falling into each of the EPC ratings bands (based on SimpleSAP) by local authority

Distribution of EPC rating bands by local authority - social sector											
EPC rating band	Barnsley	Bradford	Calderdale	Craven	Harrogate	Kirklees	Leeds	Selby	Wakefield	York	Leeds City Region
(92-100) A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(81-91) B	0.4%	0.9%	0.5%	0.5%	1.6%	1.4%	0.6%	0.8%	0.7%	0.9%	0.8%
(69-80) C	39.1%	38.7%	37.0%	36.8%	37.1%	41.2%	27.5%	35.2%	34.9%	41.1%	34.6%
(55-68) D	44.5%	40.9%	41.4%	39.1%	36.0%	40.7%	45.1%	39.8%	42.8%	42.1%	42.8%
(39-54) E	12.4%	15.2%	15.8%	14.1%	15.4%	13.4%	20.6%	15.1%	16.2%	12.3%	16.6%
(21-38) F	2.8%	3.0%	4.1%	5.8%	5.9%	2.6%	4.9%	6.5%	4.4%	2.8%	4.0%
(1-20) G	0.8%	1.1%	1.2%	3.7%	4.0%	0.7%	1.3%	2.6%	1.0%	0.8%	1.2%



Map 10: EPC rating F or G - private rented dwellings in the Leeds City Region





3.4.2 Cost of mitigating category 1 hazards

Table 15 shows the total number of dwellings with HHSRS category 1 hazards in the private sector stock overall and in the private rented stock for each local authority. It also shows the mitigation costs and a summary for the Leeds City Region as a whole. The costs are based on the average cost of mitigating category 1 hazards for Yorkshire and the Humber using EHS 2011 data²⁰.

The total cost of mitigating category 1 hazards in the region as a whole is estimated to be £474 million.

The hazards, mitigation costs and NHS/society costs and savings are discussed in more detail in the following Section summarising the Health Impact Assessment (HIA) work carried out.

Table 15: Total number and percentage of dwellings with category 1 hazards (private sector stock overall and private rented stock) and cost of mitigation, by local authority

Local authority	Total no. of dwellings with cat 1 hazards	% of private stock with cat 1 hazards	Cost of mitigating private stock (£)	% of private rented stock with cat 1 hazards	Cost of mitigating - private rented stock (£)
Barnsley	12,640	15%	33,595,933	23%	7,657,087
Bradford	28,277	16%	69,541,053	21%	19,879,125
Calderdale	15,933	20%	45,499,458	26%	10,504,256
Craven	6,518	27%	26,068,360	41%	5,885,768
Harrogate	12,946	21%	47,494,053	29%	11,713,727
Kirklees	22,566	15%	57,512,429	21%	12,730,972
Leeds	46,044	17%	103,051,174	25%	44,111,887
Selby	5,928	19%	24,110,677	27%	3,814,411
Wakefield	15,739	13%	42,486,157	20%	9,231,061
York	11,444	15%	24,199,400	23%	8,384,171
Leeds City Region	178,035	17%	473,558,695	24%	133,912,467

²⁰ Note that these costs are estimated based on standardised cost assumptions intended for comparison purposes. If available, local data on costs – such as grant or loan aided works – could be used; however, this type of data is usually biased. The estimates here are therefore considered as a useful starting point.



4 Health Impact Assessment (HIA) summary

4.1 Introduction

The Leeds City Region has recognised that poor housing has an important effect on health as most occupiers spend longer in their own home than anywhere else. Additional information is also required concerning private sector housing in order to inform the Joint Strategic Needs Assessment (JSNA).

BRE was commissioned to produce housing stock models to help understand the condition of the private sector housing within local authority areas (as described in the previous sections). The housing stock model is based on data gathered from a number of sources (including the English Housing Survey (EHS)) and includes an assessment of dwelling hazards using the Housing Health and Safety Rating System (HHSRS). It also integrates various data sources provided by local authorities, as discussed in Section 2. This data from the integrated housing stock model has then been used as a basis for this Health Impact Assessment (HIA) to better understand the effect of private sector housing hazards and intervention strategies on the health of residents across the region.

A Health Impact Assessment (HIA) is a formal method of assessing the impact of a project, procedure or strategy on the health of a population. This HIA draws on evidence of the health impact of hazards identified using the Housing Health and Safety Rating System (HHSRS²¹) and a methodology developed by the BRE Trust and published in the “Real Cost of Poor Housing”²². The HHSRS is the method by which housing condition is now assessed in accordance with the Housing Act 2004. A dwelling with a category 1 hazard is considered to fail the minimum statutory standard for housing and is classified as “poor housing”.

²¹ Housing Health and Safety Rating System Operating Guidance, Housing Act 2004, Guidance about Inspections and Assessments given under Section 9, ODPM, 2006

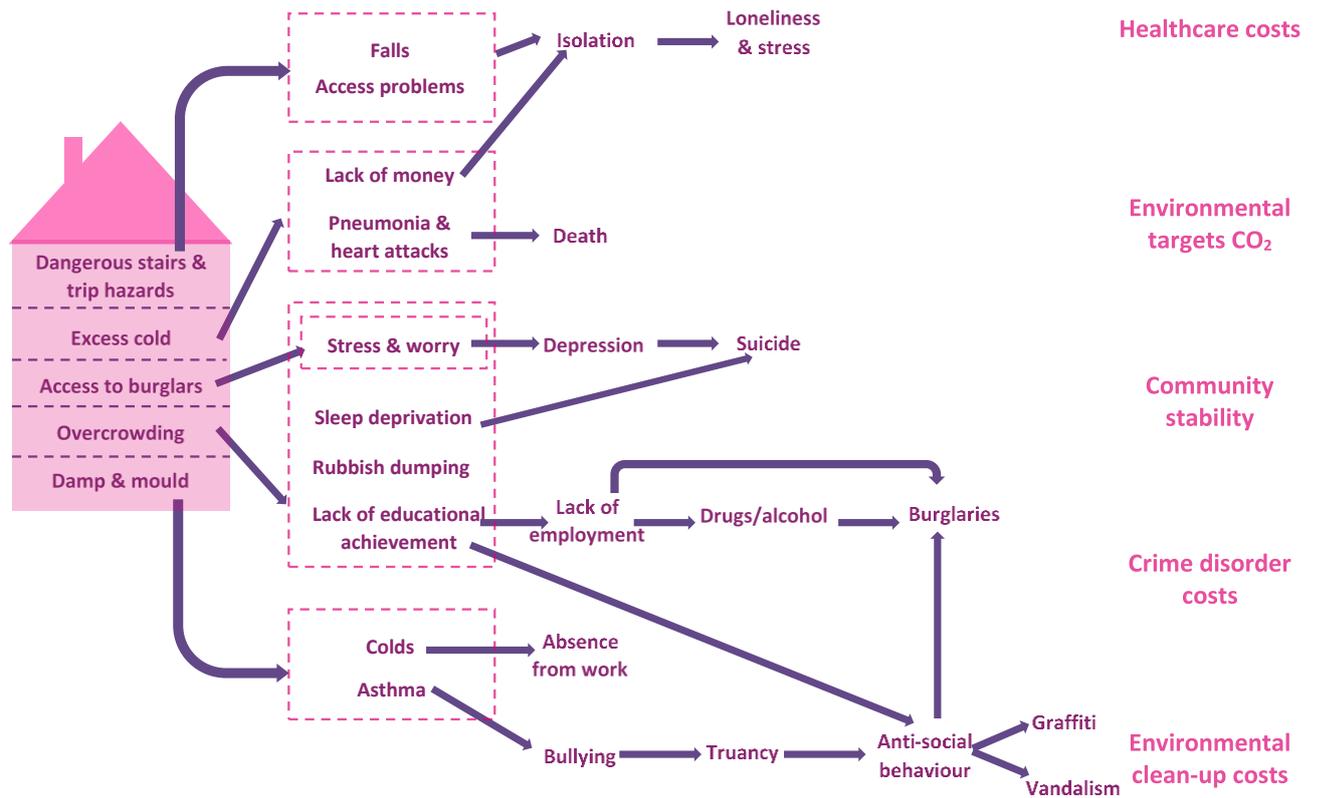
²² The Real Cost of Poor Housing, M Davidson *et al.*, IHS BRE Press, February 2010



4.2 Housing hazards

The links between hazards found in dwellings and the health issues that may arise are shown in **Figure 3**.

Figure 3: Relating housing hazards to health, adapted from CIEH publication²³



²³ Good Housing Leads to Good Health, A toolkit for environmental health practitioners CIEH, September 2008



Of the total 25 HHSRS hazards covered in the EHS, there are 15 hazards within the LCR which there is sufficient information to quantify the number of dwellings affected. The hazards are divided into those likely to cause:

- Physiological conditions
- Psychological illness
- Infection
- Accidents

Table 16: The 29 hazards covered by the HHSRS (those highlighted in bold are covered in this HIA, although the 3 infection hazards and electrical hazards are not covered in the cost benefit analysis due to insufficient information)

Physiological conditions	Psychological illness	Infection	Accidents
Damp & mould growth	Crowding & space	Domestic hygiene, pests & refuse	Falls associated with baths etc.
Excessive cold	Entry by intruders	Food safety	Falling on level surfaces
<i>Excessive heat</i>	<i>Lighting</i>	Personal hygiene, sanitation & drainage	Falling on stairs etc.
<i>Asbestos</i>	<i>Noise</i>	<i>Water supply</i>	Falling between levels
<i>Biocides</i>			Electrical hazards
<i>CO & fuel combustion productions</i>			Fire
<i>Lead</i>			Flames, hot surfaces etc.
<i>Radiation</i>			Collision & entrapment
<i>Un-combusted fuel gas</i>			<i>Explosions</i>
<i>Volatile organic compounds</i>			<i>Position & operability of amenities</i>
			<i>Structural collapse & falling elements</i>

Italics = not covered in any further detail in this report as there is insufficient data for these purposes.



Table 17 shows the main health conditions caused by each of the hazard types, the vulnerable groups most affected and the mitigation actions which could be taken

Table 17: Summary of the main hazards, their effects, vulnerable groups affected and potential mitigation actions

Housing Hazard type	Main health conditions	Vulnerable groups	Mitigating the hazard
Excess cold	Respiratory diseases, chronic obstructive pulmonary disease (COPD), cardio-vascular conditions Increased risk of falls Worsening of symptoms of rheumatoid arthritis and leg ulcers Excess winter deaths Work and school days lost, reduction in educational attainment (Marmot report)	Older people People in fuel poverty Families	Improving heating and thermal efficiency measures
Damp and mould growth	Asthma exacerbation, lower respiratory infections Social isolation	Children Adults	Improved heating, ventilation and addressing any structural problems
Entry by intruders	Fear of burglary Emotional stress	All	Window and door locks, security lighting and key safes
Falls in baths, on stairs, trips and slips	Accidents Fractures to older people and subsequent loss of independence General health deterioration	Older people	Stair rails, balustrades, grab rails, repair to paths
Accidents affecting children (falling between levels, flames & hot surfaces, electrical hazards, collision & entrapment)	Physical injury, falls, electrocution, severe burns and scalds	Children	Identifying hazards, provide more space, education of professionals



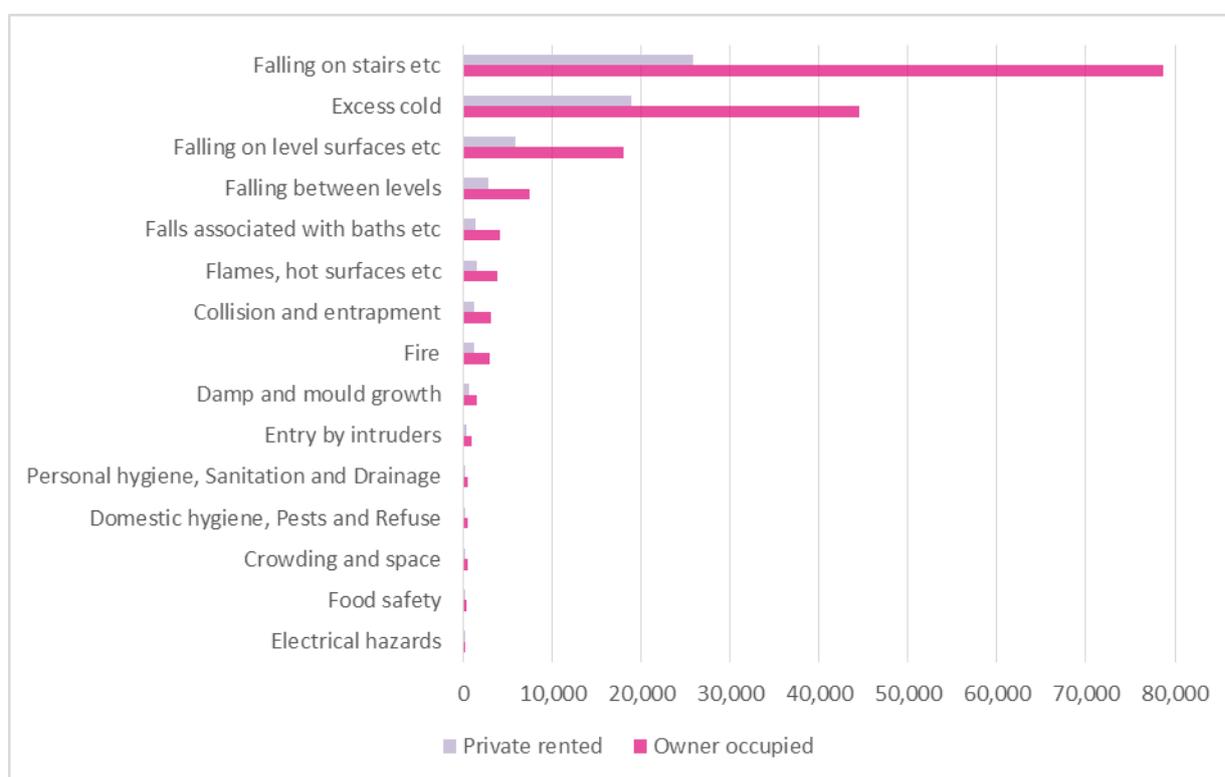
4.3 Methodology

4.3.1 Number of hazards and estimated instances requiring medical intervention

Maps provided in the previous sections of this report show the distribution of all HHSRS category 1 hazards in the Leeds City Region and the two most common hazards of excess cold hazards and fall hazards.

Figure 4 below shows the estimated number of category 1 hazards by private tenure. The tenure split is important because dwellings that are privately rented should have any category 1 hazard mitigated by the landlord at their expense in order to comply with the Housing Act 2004. The chart shows the figures for all hazards and it is clear that many of the hazards are not present in sufficient numbers to be considered further in this HIA.

Figure 4: Breakdown of hazard types by tenure for the Leeds City Region



For these hazards, it is then possible to estimate the number of harm outcomes requiring medical intervention resulting from these hazards. **Table 18** shows, the total number of category 1 hazards is 220,328 and the estimated number of instances requiring medical intervention expected across the region is 9,619. The most common category 1 hazard is falling on stairs etc. and the second most common is excess cold. The most common category 1 hazards do not necessarily mean the greatest number of medical interventions as the HHSRS scoring system requires an assessment of likelihood and the extent of harm outcome. For example, it could be the case that the hazard of damp and mould causes a greater number of incidents than excess cold although the severity of harm outcome would be less.



4.3.2 Cost of prospective interventions to reduce the number of hazards

The cost of work necessary to mitigate the hazards is representative of local (at a regional level) costs based on information from the English Housing Survey (EHS) and consistent with “The Cost of Poor Housing to the NHS²⁴” briefing paper produced by BRE as an update to “The Real Cost of Poor Housing²²” report. The cost is based on mitigating the hazard and bringing the dwelling up to the standard for an “average dwelling”.

The cost of excess cold makes up the largest proportion of the total mitigation costs at around £278 million.

4.3.3 Costs to the NHS and wider society of treating these health issues

Costs to the NHS are based on real estimates of the costs of incidents occurring as a result of the hazards and have been developed by looking at typical health outcomes and first year treatment costs that can be attributed to selected HHSRS hazards. This information is published in ‘The Real Cost of Poor Housing’²⁵ and as updated in ‘The Cost of Poor Housing to the NHS’²⁴. The NHS costs do not take into account the more complex nature of the wider cost impacts to society. ‘The Real Cost of Poor Housing’ report estimates that the costs to society are two and a half times those of the NHS costs and cover a variety of costs, which could include, but are not limited to, the following:

- Social services costs following discharge from hospital
- Capital value of the dwelling
- Loss of future earnings
- Increased spending on benefits
- Cost of moving
- Cost of enforcement action by councils

Table 18 summarises the estimated costs to the NHS and society of poor housing by LCR local authority. If category 1 hazards in the private sector across the region were mitigated, it is estimated this would save the NHS almost £37 million, with £92 million savings to wider society. **Table 19** summarises the estimated costs to the NHS and wider society, and potential savings if the hazard of excess cold was mitigated across the private stock. It is estimated that the NHS could save over £9 million, with savings to wider society of almost £24 million. This can be compared with the three fall hazards (defined as falls involving stairs and steps, associated with baths and trips and slips) where the vulnerable group is persons over 60 years of age. The potential saving to the NHS is £22 million, and to society is £55 million, as shown in **Table 20**.

²⁴ BRE Briefing Paper: The cost of poor housing to the NHS, Nicol S, Roys M and Garrett H, BRE Trust, 2015 - <http://www.bre.co.uk/filelibrary/pdf/87741-Cost-of-Poor-Housing-Briefing-Paper-v3.pdf>

²⁵ The Real Cost of Poor Housing, M Davidson *et al.*, IHS BRE Press, February 2010



4.3.4 Health cost benefit scenarios

Taking this a step further it is possible to look at a cost benefit analysis and determine the likely payback periods of mitigating hazards. The payback period is the time taken to break even on an investment and, in this case, is based on the cost of mitigating the hazard and the savings achieved from carrying out the mitigation work to an individual dwelling.

Because it is not possible to account for building type, local knowledge of the particular characteristics will be important for making decisions on whether a particular dwelling type is more cost effective for priority spending or whether the decision should be made in accordance with occupier need.

The HIA reports provided to the individual LCR local authorities provide a range of cost benefit analyses. However, the general results for each hazard assessed are depicted in **Figure 5** which shows that the lowest payback periods are always achieved for the society analysis because the savings are greater than for the NHS but the mitigation costs are the same. The hazards with the shortest payback periods are falls associated with baths and falls on the level since mitigation of these hazards can be achieved at relatively low cost. The hazards with the longest payback periods are those which are more complex and therefore more costly to mitigate, such as damp and mould, excess cold and fire.

4.4 Summary of findings

This section provides a summary of the HIA results at local authority level and for the Leeds City Region as a whole. A summary is provided for all HHSRS category 1 hazards and for the two most common hazards – excess cold and fall hazards.

Table 18: Summary of HIA results for all HHSRS category 1 hazards, split by local authority and for the Leeds City Region as a whole

Local authority	Numbers of hazards (total private sector stock)	Estimated number of instances requiring medical intervention	Cost of mitigating all hazards	Potential annual costs of not mitigating hazards		Potential annual savings from mitigating hazards	
				Costs to NHS	Costs to society	Savings to NHS	Savings to society
Barnsley	17,960	883	£33,595,933	£3,156,720	£7,891,800	£2,936,180	£7,340,450
Bradford	37,099	1,774	£69,541,053	£6,520,900	£16,302,250	£6,060,740	£15,151,850
Calderdale	22,053	1,060	£45,499,458	£3,863,660	£9,659,150	£3,589,690	£8,974,225
Craven	8,761	251	£26,068,360	£1,512,880	£3,782,200	£1,386,830	£3,467,075
Harrogate	16,692	483	£47,494,053	£2,888,840	£7,222,100	£2,649,870	£6,624,675
Kirklees	30,479	1,387	£57,512,429	£5,356,900	£13,392,250	£4,972,320	£12,430,800
Leeds	50,943	2,167	£103,069,281	£8,934,510	£22,336,275	£8,276,650	£20,691,625
Selby	7,745	204	£24,110,677	£1,334,290	£3,335,725	£1,221,140	£3,052,850
Wakefield	22,719	1,164	£42,486,157	£3,992,660	£9,981,650	£3,717,870	£9,294,675
York	12,920	541	£24,199,400	£2,271,750	£5,679,375	£2,104,560	£5,261,400
Leeds City Region	227,372	9,914	£473,576,801	£39,833,110	£99,582,775	£36,915,850	£92,289,625

Table 19: Summary of HIA results for category 1 excess cold hazards, split by local authority and for the Leeds City Region as a whole

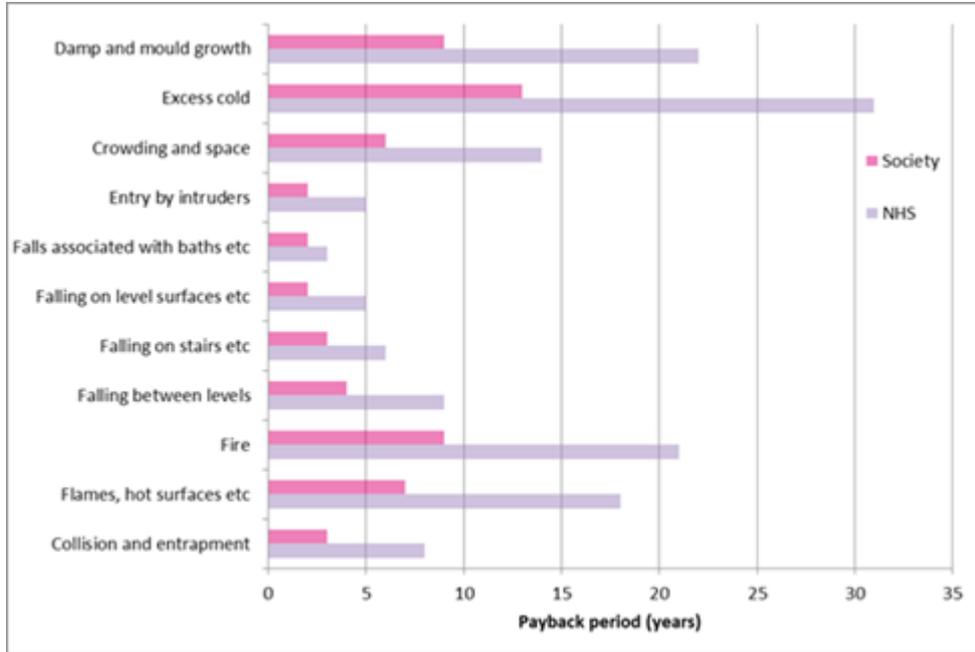
Local authority	Numbers of excess cold hazards (total private sector stock)	Estimated number of instances requiring medical intervention	Cost of mitigating all hazards	Potential annual costs of not mitigating hazards		Potential annual savings from mitigating hazards	
				Costs to NHS	Costs to society	Savings to NHS	Savings to society
Barnsley	3,780	21	£17,346,275	£635,410	£1,588,525	£571,870	£1,429,675
Bradford	7,999	44	£36,707,104	£1,344,620	£3,361,550	£1,210,150	£3,025,375
Calderdale	5,740	32	£26,340,640	£964,880	£2,412,200	£868,390	£2,170,975
Craven	4,735	26	£21,728,734	£795,940	£1,989,850	£716,350	£1,790,875
Harrogate	8,475	47	£38,891,450	£1,424,630	£3,561,575	£1,282,170	£3,205,425
Kirklees	6,885	38	£31,595,001	£1,157,350	£2,893,375	£1,041,620	£2,604,050
Leeds	13,645	76	£62,616,382	£2,293,700	£5,734,250	£2,064,330	£5,160,825
Selby	4,494	25	£20,622,794	£755,430	£1,888,575	£679,890	£1,699,725
Wakefield	4,635	26	£21,269,837	£779,130	£1,947,825	£701,220	£1,753,050
York	3,020	17	£13,858,664	£507,650	£1,269,125	£456,890	£1,142,225
Leeds City Region	63,408	352	£290,976,882	£10,658,740	£26,646,850	£9,592,880	£23,982,200

Table 20: Summary of HIA results for category 1 fall hazards affecting older people (i.e. falls associated with baths, falls on the level and falls on stairs), split by local authority and for the Leeds City Region as a whole

Local authority	Numbers of fall hazards affecting older people (total private sector stock)	Estimated number of instances requiring medical intervention	Cost of mitigating all hazards	Potential annual costs of not mitigating hazards		Potential annual savings from mitigating hazards	
				Costs to NHS	Costs to society	Savings to NHS	Savings to society
Barnsley	11,288	412	£9,395,536	£2,020,630	£5,051,575	£1,871,680	£4,679,200
Bradford	23,499	860	£19,559,699	£4,206,580	£10,516,450	£3,896,490	£9,741,225
Calderdale	12,683	463	£10,557,077	£2,270,430	£5,676,075	£2,103,070	£5,257,675
Craven	3,384	125	£2,816,488	£605,710	£1,514,275	£561,060	£1,402,650
Harrogate	7,071	258	£5,885,564	£1,265,760	£3,164,400	£1,172,450	£2,931,125
Kirklees	19,511	714	£16,239,847	£3,492,600	£8,731,500	£3,235,140	£8,087,850
Leeds	31,180	1,140	£25,953,154	£5,581,580	£13,953,950	£5,170,140	£12,925,350
Selby	2,742	100	£2,282,342	£490,840	£1,227,100	£454,650	£1,136,625
Wakefield	14,074	515	£11,714,997	£2,519,470	£6,298,675	£2,333,750	£5,834,375
York	8,534	312	£7,103,235	£1,527,630	£3,819,075	£1,415,020	£3,537,550
Leeds City Region	133,966	4,899	£111,507,940	£23,981,230	£59,953,075	£22,213,450	£55,533,625



Figure 5: Payback periods for mitigating all hazards





5 Conclusion

5.1 Conclusion

The majority of local authorities within the Leeds City Region commissioned BRE to undertake a series of modelling exercises on their housing stock²⁶ – Bradford, Calderdale, Kirklees, Leeds, Wakefield and York. Separate reports were produced for each council describing the modelling work and providing details of the results obtained from the dwelling level models and database. Each council was also provided with a dwelling level database enabling them to obtain specific information whenever required. This current report provides a high level summary for the Leeds City Region.

The stock models and databases for each of the separate local authorities have been used to provide the following, with a focus on private sector housing:

- The percentage of dwellings meeting each of the key indicators for Leeds City Region overall and broken down by tenure and then mapped by ward (private sector stock only)
- Information relating to LAHS reporting for the private sector stock – EPC ratings and category 1 hazards²⁷

Such information will facilitate the decision making process for targeting resources to improve the condition of housing and to prevent ill health resulting from poor housing conditions. Furthermore, the results of this project provide the local authorities in the Leeds City Region with information which will assist in health and housing policy and strategy development whether these are inspired locally, arise from obligations under the Housing Act 2004 or as responses to government initiatives such as DCLG's Housing Strategy Policy and ECO.

The project estimates that there are over 178,000 dwellings containing 227,000 serious (category 1 hazards) across the private stock. These hazards would require £474 million of improvements to mitigate, but would save the NHS an estimated £37 million per year, with total savings to society of £92 million. Given the potential savings from investing in mitigating housing hazards, falls hazards have the shortest payback period.

²⁶ The exception was Barnsley, Craven, Harrogate and Selby, however high level results for this local authority have been included in this report to enable the provision of Leeds City Region results and comparisons across the local authorities.

²⁷ The 6 commissioning LCR local authorities were also supplied with information on Houses in Multiple Occupation (HMOs) and various energy efficiency variables. As this exercise was not carried out for the whole region this information has not been included in this summary report.



5.2 Recommendations

The figures in this report will require careful consideration and can be fed into the JSNA and the Health and Wellbeing Boards to decide where resources can best be targeted. To aid this process, the following recommendations are made.

1. The poorest housing conditions are located in the private rented stock. Therefore, the following could be considered:
 - Advice services for private sector landlords
 - Support service advice for tenants – possibly around benefits / income maximisation
 - Working with Landlord in the private sector to enforce EPC / raise awareness including training
2. To assist vulnerable owner occupiers, particularly those elderly and on a low income, the Regional Homes and Loans Service could be used to support the removal of housing hazards/ repair
3. The evidence indicates that initiatives to reduce the incidence of falls at home should be one of the more cost effective strategies. The cost benefit scenarios show that the best value initiatives will look to small-scale repair or improvement works to stairs, trip hazards within the home and to uneven paths. Therefore, an active falls prevention service looking at both the individual and the condition of the home would increase the benefits.
4. Whilst at a regional level prevalence of cold hazards is lower than national averages, it is estimated that there are over 63,000 dwellings that do contain a category 1 hazard for excess cold. A number of interventions could include:
 - Expansion of the Better Homes Yorkshire approach / model
 - Potential for rural action programmes with higher rates of cold hazard – such as in north Yorkshire
 - Work on expansion of the gas network to reduce fuel poverty
 - Provision of energy advice services



Appendix A Definitions of the key indicators

1. House condition indicators

a. The presence of a category 1 hazard under the Housing Health and Safety Rating System (HHSRS²⁸) – reflecting both condition and thermal efficiency

Homes posing a category 1 hazard under the HHSRS – the system includes 29 hazards in the home categorised into category 1 (serious) or category 2 (other) based on a weighted evaluation tool. Note that this includes the hazard of excess cold which is also included as one of the energy efficiency indicators.

The 29 hazards are:

1 Damp and mould growth	16 Food safety
2 Excess cold	17 Personal hygiene, Sanitation and Drainage
3 Excess heat	18 Water supply
4 Asbestos	19 Falls associated with baths etc.
5 Biocides	20 Falling on level surfaces etc.
6 Carbon Monoxide and fuel combustion products	21 Falling on stairs etc.
7 Lead	22 Falling between levels
8 Radiation	23 Electrical hazards
9 Uncombusted fuel gas	24 Fire
10 Volatile Organic Compounds	25 Flames, hot surfaces etc.
11 Crowding and space	26 Collision and entrapment
12 Entry by intruders	27 Explosions
13 Lighting	28 Position and operability of amenities etc.
14 Noise	29 Structural collapse and falling elements
15 Domestic hygiene, Pests and Refuse	

b. The presence of a category 1 hazard for falls (includes “falls associated with baths”, “falling on the level” and “falling on stairs”)

The HHSRS Falls Model includes the 3 different falls hazards where the vulnerable person is over 60 as listed above.

²⁸ The Housing Health and Safety Rating System (HHSRS) is a risk-based evaluation tool to help local authorities identify and protect against potential risks and hazards to health and safety from any deficiencies identified in dwellings. It was introduced under the Housing Act 2004 and applies to residential properties in England and Wales.



c. Dwellings in disrepair (based on the former Decent Homes Standard criteria for Disrepair)

The previous Decent Homes Standard states that a dwelling fails this criterion if it is not found to be in a reasonable state of repair. This is assessed by looking at the age of the dwelling and the condition of a range of building components including walls, roofs, windows, doors, electrics and heating systems).

2. Energy efficiency indicators:

a. The presence of a category 1 hazard for excess cold (using SAP ratings as a proxy measure in the same manner as the English House Condition Survey)

This hazard looks at households where there is a threat to health arising from sub-optimal indoor temperatures. The HHSRS assessment is based on the most low income group for this hazard – persons aged 65 years or over (note that the assessment requires the hazard to be present and potentially affect a person in the low income age group should they occupy that dwelling. The assessment does not take account of the age of the person actually occupying that dwelling at that particular point in time).

The English Housing Survey (EHS) does not measure the actual temperatures achieved in each dwelling and therefore the presence of this hazard is measured by using the SAP rating as a proxy. Dwellings with a SAP rating of less than 31.5 (SAP 2005 methodology) are considered to be suffering from a category 1 excess cold hazard.

b. An estimate of the SAP rating which, to emphasise its origin from a reduced set of input variables, is referred to as “SimpleSAP”

The Standard Assessment Procedure (SAP) is the UK Government's standard methodology for home energy cost ratings. SAP ratings allow comparisons of energy efficiency to be made, and can show the likely improvements to a dwelling in terms of energy use. The Building Regulations require a SAP assessment to be carried out for all new dwellings and conversions. Local authorities, housing associations, and other landlords also use SAP ratings to estimate the energy efficiency of existing housing. The version on which the Average SAP rating model is based is SAP 2005.

The SAP ratings give a measure of the annual unit energy cost of space and water heating for the dwelling under a standard regime, assuming specific heating patterns and room temperatures. The fuel prices used are averaged over the previous 3 years across all regions in the UK. The SAP takes into account a range of factors that contribute to energy efficiency, which include:

- Thermal insulation of the building fabric
- The shape and exposed surfaces of the dwelling
- Efficiency and control of the heating system
- The fuel used for space and water heating
- Ventilation and solar gain characteristics of the dwelling

3. Household vulnerability indicators:

a. Fuel poverty - 10% definition

This definition states that a household is said to be in fuel poverty if it spends more than 10% of its income on fuel to maintain an adequate level of warmth (usually defined as 21°C for the main living area, and 18°C for other occupied rooms). This broad definition of fuel costs also includes modelled spending on water heating, lights, appliances and cooking.



The fuel poverty ratio is defined as:

$$\text{Fuel poverty ratio} = \frac{\text{Fuel costs (usage * price)}}{\text{Full income}}$$

If this ratio is greater than 0.1 then the household is in fuel poverty.

The definition of full income is the official headline figure and in addition to the basic income measure, it includes income related directly to housing (i.e. Housing Benefit, Income Support for Mortgage Interest (ISMI), Mortgage Payment Protection Insurance (MPPI), Council Tax Benefit (CTB)).

Fuel costs are modelled, rather than based on actual spending. They are calculated by combining the fuel requirements of the household with the corresponding fuel prices. The key goal in the modelling is to ensure that the household achieves the adequate level of warmth set out in the definition of fuel poverty whilst also meeting their other domestic fuel requirements.

b. Fuel poverty - Low Income High Costs definition

The government has recently set out a new definition of fuel poverty which it intends to adopt under the Low Income High Costs (LIHC) framework²⁹. Under the new definition, a household is said to be in fuel poverty if:

- They have required fuel costs that are above average (the national median level)
- Were they to spend that amount they would be left with a residual income below the official poverty line

c. Dwellings occupied by a low income household

A household in receipt of:

- Income support
- Housing benefit
- Attendance allowance
- Disability living allowance
- Industrial injuries disablement benefit
- War disablement pension
- Pension credit
- Child tax credit
- Working credit

For child tax credit and working tax credit, the household is only considered a low income household if it has a relevant income of less than £15,050.

²⁹ <https://www.gov.uk/government/collections/fuel-poverty-statistics>



The definition also includes households in receipt of Council Tax benefit and income based Job Seekers Allowance.



Appendix B Methodology for the BRE Dwelling Level Housing Stock Modelling approach

This Appendix provides a more detailed description of the models which make up the overall housing stock modelling approach and feed into the database. The process is made up of a series of data sources and models which, combined with various imputation and regression techniques and the application of other formulae, make up the final database. The database is essentially the main output of the modelling and provides information on the key indicators and other data requirements (e.g. energy efficiency variables). An overview of the approach and a simplified flow diagram are provided in Section 2 of this report.

The models making up the overall housing stock modelling approach are:

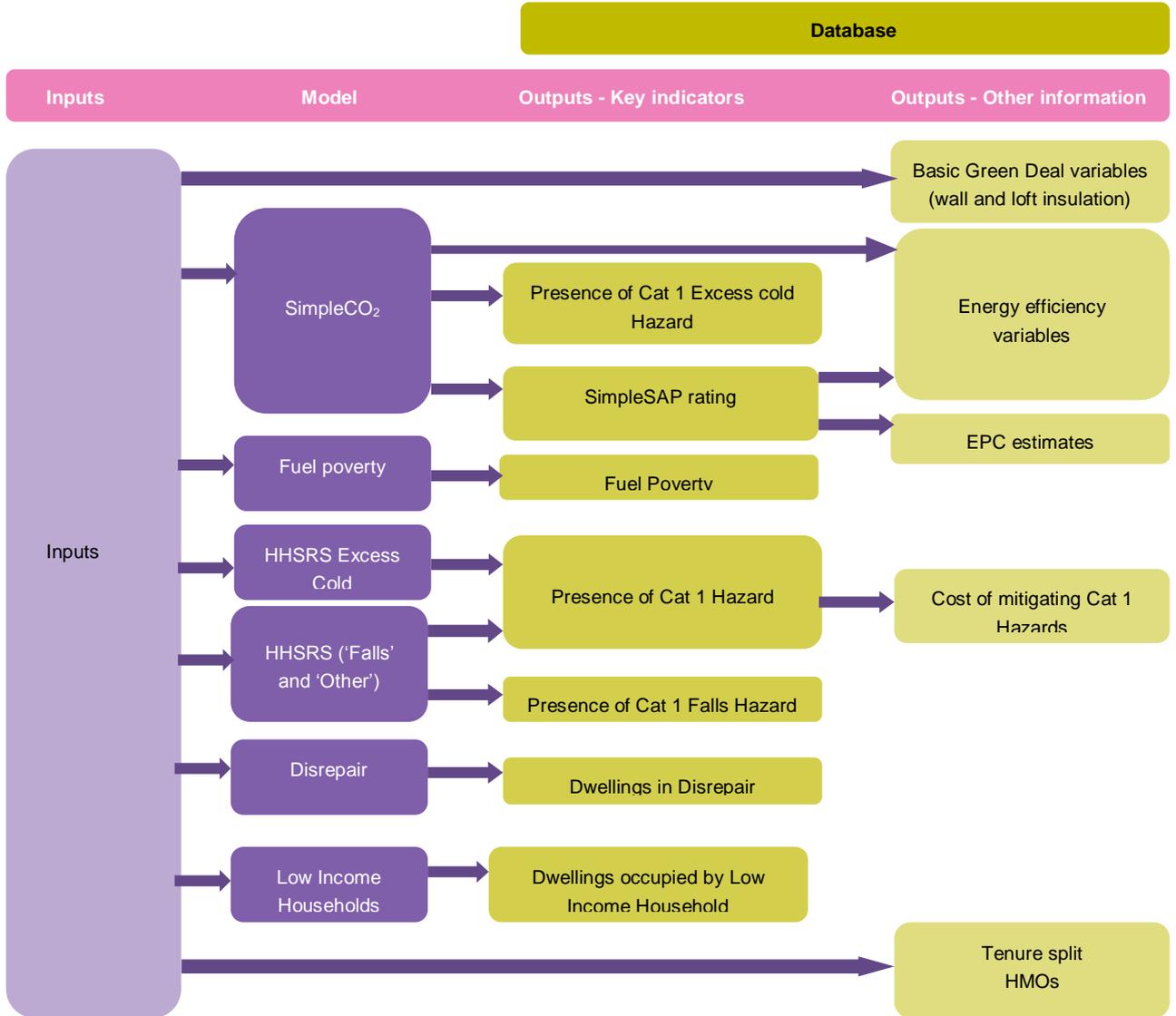
- SimpleCO₂ Model
- Fuel Poverty Model
- HHSRS (All Hazards, Falls Hazards and Excess Cold) Models
- Disrepair Model
- Low Income Households Model

Figure B. 1 shows the data flows for the stock modelling approach, showing which models each of the outputs in the database (split into the key indicators and other information) come from. The exception is the Green Deal variables (if used) which come directly from the Energy inputs, and the tenure and HMO data (if used) which come directly from the other inputs.

Section B.1 describes the SimpleCO₂ Model in more detail, Section B.2 provides more information on the other four models and Section B.3 gives details of the OS MasterMap/geomodelling approach.



Figure B. 1: Simplified data flow for the housing stock modelling approach





B.1 BRE SimpleCO₂ Model

BRE have developed a variant of the BREDEM software, named 'SimpleCO₂', that can calculate outputs from a reduced set of input variables. These outputs are indicative of the full BREDEM outputs and the minimum set of variables the software accepts is information on:

- Dwelling type
- Dwelling age
- Number of bedrooms
- Heating fuel
- Heating system
- Tenure

The Experian UK Consumer Dynamics Database is used as a source of these variables and they are converted into a suitable format for the SimpleCO₂ software. However, these variables alone are insufficient for the software to calculate the 'SimpleSAP' rating or carbon emissions estimate (one of the outputs of the SimpleCO₂ model). Additional variables are required and as these values cannot be precisely inferred then a technique known as cold deck imputation is undertaken. This is a process of assigning values in accordance with their known proportions in the stock. For example, this technique is used for predicting heating fuels as the Experian data only confirms whether a dwelling is on the gas network or not. Fuel used by dwellings not on the gas network is unknown, so in most cases this information will be assigned using probabilistic methods. The process is actually far more complex e.g. dwellings with particular characteristics such as larger dwellings are more likely to be assigned with oil as a fuel than smaller dwellings.

The reason for taking this approach is to ensure that the national proportions in the data source are the same as those found in the stock nationally (as predicted by the EHS or other national survey). Whilst there is the possibility that some values assigned will be incorrect for a particular dwelling (as part of the assignment process has to be random) they ensure that examples of some of the more unusual types of dwelling that will be present in the stock are included.

Whilst this approach is an entirely sensible and commonly adopted approach to dealing with missing data in databases intended for strategic use, it raises issues where one of the intended uses is planning implementation measures. It must therefore be kept in mind at all times that the data provided represents the most likely status of the dwelling, but that the actual status may be quite different. That said, where EPC data has been used, the energy models (which use EPC data) are likely to be more accurate.

It is important to note that some variables have been entirely assigned using cold decking imputation techniques. These include presence of cavity wall insulation and thickness of loft insulation as there is no reliable database with national coverage for these variables.

The 'SimpleCO₂' software takes the combination of Experian and imputed data and calculates the 'SimpleSAP' rating for each dwelling in the national database. The calculated 'SimpleSAP' ratings are the basis of the estimates of SAP and Excess cold. How the other key variables are derived is discussed later in this Appendix.

Because the estimates of 'SimpleSAP' etc. are calculated from modelled data it is not possible to guarantee the figures. They do, however, provide the best estimates that we are aware can be achieved from a data source with national coverage and ready availability. The input data could, however, be improved in its:

- accuracy for example through correcting erroneous values,



- depth of coverage, for example by providing more detailed information on age of dwellings,
- breadth by providing additional input variables such as insulation.

Improving any of these would enhance the accuracy of the output variables and for this reason it is always worth considering utilising additional information sources where they are available. Using EPC data will go some way towards meeting these improvements by providing more accurate data.

B.2 Housing Condition and Household Vulnerability Models

This section provides further information on the remaining four models – Fuel Poverty, HHSRS, Disrepair and Low Income Households. These models are discussed together since the approach used for each one is broadly the same.

These models are not based solely on thermal characteristics of the dwelling, and in some cases are not based on these characteristics at all. A top down methodology has been employed for these models, using data from the EHS and statistical techniques, such as logistic regression, to determine the combination of variables which are most strongly associated with failure of each standard. Formulae have been developed by BRE to predict the likelihood of failure based on certain inputs. The formulae are then applied to the variables in the national Experian dataset to provide a likelihood of failure for each dwelling. Each individual case is then assigned a failure/compliance indicator based on its likelihood of failure and on the expected number of dwellings that will fail the standard within a given geographic area. Thus if the aggregate values for a census output area are that 60% of the dwellings in the area fail a particular standard then 60% of the dwellings with the highest failure probabilities will be assigned as failures and the remaining 40% as passes.

The presence of a category 1 hazard failure is the only exception to this as it is found by combining excess cold, fall hazards and other hazards such that failure of any one of these hazards leads to failure of the standard.

B.3 OS MasterMap information ('geomodelling')

The OS data has been used to update a number of the SimpleCO2 model inputs. The most valuable use of the OS data is the ability to determine the dwelling type with much greater confidence.

The existing dwelling type is replaced with a new dwelling type derived from OS data. By looking at the number of residential address points it can be inferred whether the building is a house or block of flats (houses have one residential address point and blocks of flats have two or more).

Houses - where the dwelling is a house the number of other buildings it is attached to can be observed and the following assumptions made:

- If there are no other dwellings attached, the house is detached
- If two dwellings are joined to one another, but not to any other dwellings, they are semi-detached
- If they are attached to two or more other dwellings, they are mid terraced
- If they are attached to only one dwelling, but that dwelling is a mid-terrace, they are an end-terrace

Flats - if the building is a block of flats, its exact nature is determined by its age and the number of flats in the block and the following assumptions made:

- If there are between two and four flats in the block (inclusive) and the dwelling was built before 1980 then it is a conversion
- Otherwise it is purpose built



This information can also be used to reconcile discrepancies within blocks of flats, terraced and semi-detached houses. These discrepancies occur in variables such as dwelling age, location of flat in block, number of storeys, loft insulation, wall insulation, wall type and floor area.

Looking at dwelling age, although the OS data does not itself provide any information on age, it does allow reconciliation of age data within semi-detached, terraces and blocks of flats.

Where a group of buildings are all attached in some way, such as a terrace, it is logical to assume that they were built at the same time. Therefore the age of each building is replaced with the most common age among those present. Where the most common age occurs in equal numbers, this is resolved by looking at the average age of houses in the same postcode.

If one dwelling has an age that is notably newer than its neighbours, then the age is not changed, as it is assumed that the original dwelling was destroyed and rebuilt.

Figure B. 2 and **Figure B. 3** below show how the initial base data is adjusted using the OS data to produce more consistent and reliable results.

Considering the number of storeys and the location of a flat in its block, if the OS data reveals that the dwelling type is significantly different from the original value – specifically if a house becomes a flat, or vice versa then the variables are adjusted. If this is the case a new location for the flat within the block or the number of storeys will be imputed using the same method as before, but taking into account the revised dwelling type.

Similarly with floor area, loft insulation and wall type - if the dwelling type or location of a flat within a block changes as a result of OS data then the variables are calculated using the same method of imputation as the original models, but taking into account the new data.



Figure B. 2: Dwelling level map showing the base data, prior to using the OS data

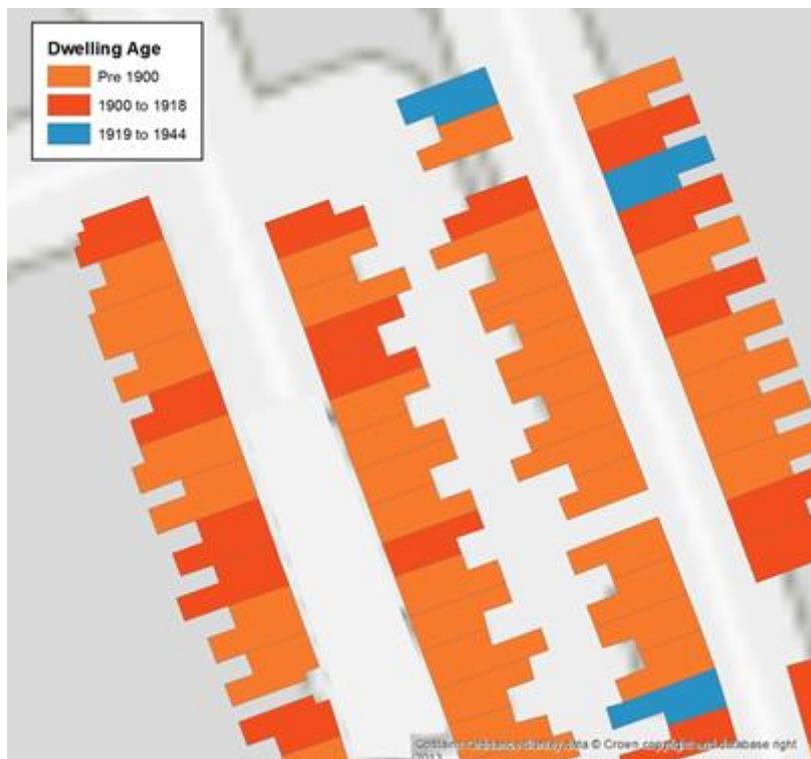
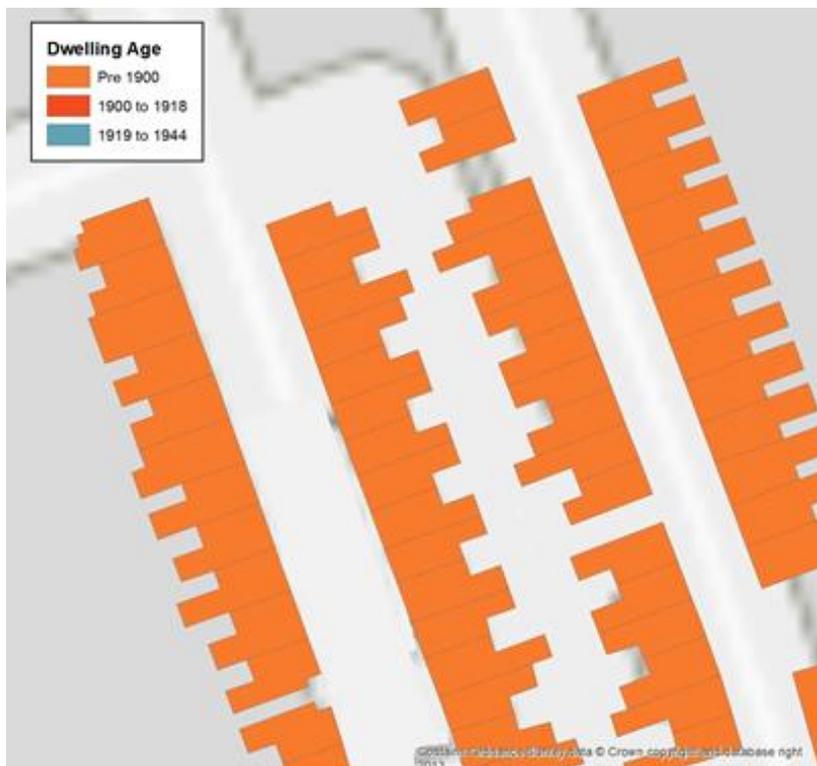


Figure B. 3: Dwelling level map showing the OS updated data





Appendix C Policy background

The detailed housing stock information provided in this report will facilitate the delivery of the Leeds City Region's housing strategy and enable a targeted intervention approach to improving housing. This strategy needs to be set in the context of relevant government policy and legislative requirements. These policies either require reporting of housing-related data by local authorities, or the use of such data to assist in meeting policy requirements. The main policies and legislative requirements are summarised in the following sub-sections.

C.1 Housing Act 2004

The Housing Act 2004 requires local housing authorities to review housing statistics in their district. The requirements of the Act are wide-ranging and also refer to other legislation which between them covers the following:

- Dwellings that fail to meet the minimum standard for housings (i.e. dwellings with HHSRS category 1 hazards)
- Houses in Multiple Occupation (HMOs)
- Selective licensing of other houses
- Demolition and slum clearance
- The need for provision of assistance with housing renewal
- The need to assistance with adaptation of dwellings for disabled persons

C.2 Key housing strategy policy areas and legislation

In the report 'Laying the Foundations: A Housing Strategy for England' Chapters 4 and 5 focus on the private rented sector and empty homes.

Private rented sector

There has been significant growth in the private rented sector in recent years and new measures are being developed to deal with rogue landlords and to encourage local authorities to make full use of enforcement powers for tackling dangerous and poorly maintained dwellings. The report encourages approaches which work closely with landlords whilst still operating a robust enforcement regime (e.g. landlord forums and panels across the country).

Health inequalities

The government's white paper 'Choosing Health' states that the key to success in health inequalities will be effective local partnerships led by local government and the NHS working to a common purpose and reflecting local needs. Housing is a key determinant of health, and poor housing conditions continue to cause preventable deaths and contribute to health inequalities. An example in this area is the work carried out by Liverpool City Council in partnership with Liverpool Primary Care Trust – the 'Healthy Homes Programme'. This has identified over 3,800 hazards and led to an estimated £4.8 million investment by landlords, delivering sustainable health improvements and enhancing community wellbeing.



Integrated care

It has been recognised by central government that to fully address the health needs of the population, services need to become more integrated and there needs to be better communication between different providers. Housing is a key aspect of this:

“Many people with mental and physical disabilities, complex needs, long-term conditions and terminal illness also need to access different health care, social care, housing and other services, such as education, and often simultaneously” .

It is therefore essential that departments providing or regulating housing work with other council departments and health organisations to provide services that are integrated and take full account of the needs of the individual.

Public Health Outcomes Framework

The Public Health Outcomes Framework ‘Healthy lives, healthy people: Improving outcomes and supporting transparency’ sets out desired outcomes for public health and how they will be measured. Many of the measurements have links to housing, some of the more relevant being:

- Falls and injuries in over 65’s
- Fuel poverty
- Excess winter deaths

Joint Strategic Needs Assessment (JSNA) and Joint Health and Wellbeing Strategies

The JSNA and joint health and wellbeing strategy allow health and wellbeing boards to analyse the health needs of their local population and to decide how to make best use of collective resources to achieve the priorities that are formed from these. The Department of Health document ‘Joint Strategic Needs Assessment and joint health and wellbeing strategies explained - Commissioning for populations’ says “This will ensure better integration between public health and services such as housing and education that have considerable impact on the wider determinants of health” .

Energy Act 2011

The Energy Act 2011 requires that from 2016 reasonable requests by tenants for energy efficiency improvements will not be able to be refused. Furthermore, from 2018 it will be unlawful for landlords to rent out properties that do not reach a minimum standard of energy efficiency (likely to be set at Energy Performance Certificate rating E). While there will be various caveats to these powers, they will provide a new minimum standard for rented accommodation. Part of this current project includes provision of a private rented sector variable that should assist in identifying such dwellings.

Empty homes

Empty homes brought back into use will qualify for the New Homes Bonus where, for the following 6 years, the government will match fund the Council Tax on long term empty properties brought back into use. In addition, from 2012-15, £100million of capital funding from within the Affordable Homes Programme will be available to tackle problematic empty homes. Whilst the data provided by this project cannot necessarily assist with the actual identification of empty homes, the database provided would be the logical place for such information to be stored should it be gathered from other sources.

C.3 Other policy areas

The following policy areas, whilst not directly relating to environmental health services, will have an effect on demand and local authorities will need to be aware of the possible impact in their area.



Welfare Reform Act 2012

The key parts of this Act for environmental health services are the sections relating to the under occupation of social housing, and the benefit cap. Whilst this will mainly affect tenants in the social rented sector it will undoubtedly have an impact on private sector services. Social tenants may find themselves being displaced into the private sector, increasing demand in this area, and the tenants of Registered Providers (RP's) and some private landlords may have greater trouble affording rent payments. If tenants are in arrears on their rental payments then authorities may be met with reluctance from landlords when requiring improvements to properties.

Localism Act 2011

The Localism Act allows social housing providers to offer fixed term, rather than secure lifetime, tenancies. As with the Welfare Reform Act, this has a greater direct impact on the social rented sector, however, there is some concern this may lead to greater turnover of tenancies meaning that some 'traditional' social tenants may find themselves in the private rented sector.

Both of these policy changes above may increase the number of vulnerable persons in private sector properties. If this occurs any properties in this sector in poor condition are likely to have a far greater negative impact on the health of those occupiers

Potential increase in private rented sector properties

Policies such as the Build to Rent and the New Homes Bonus are aimed at increasing the supply of properties. As the private rented sector is already growing, it is reasonable to assume that many of the new properties being built will be rented to private tenants. Local authorities will need to be aware of the potential impact on the demand for their services and how their perception of their local area may have to change if large numbers of properties are built.

C.4 Local Authority Housing Statistics (LAHS)

The purpose of these statistics is twofold – firstly to provide central government with data with which to inform and monitor government strategies, policies and objectives as well as contributing to national statistics on housing, secondly, to the local authorities themselves to help manage their housing stock. Local authorities are required to complete an annual return which covers a wide range of housing-related issues. Of particular relevance to this current project is 'Section F: Condition of dwelling stock' which, amongst other things, requests the following information:

- Average EPC rating of the private sector stock and the proportion below a certain rating.
- Total number of dwellings and number of private sector dwellings with category 1 HHSRS hazards and the estimated costs of mitigating these
- Estimates of the number of HMOs and the number of mandatory licensable HMOs



Glossary of terms

BREDEM	BRE Domestic Energy Model
Category 1 hazard	Hazards with a HHSRS score of > 1,000. A dwelling with a category 1 hazard is considered to fail the minimum statutory standard for housing
CLG	Department for Communities and Local Government
COA	Census Output Area Designed for statistical purposes, built from postcode units, approximately 125 households
DCLG	Department for Communities and Local Government
Disrepair	Based on former Decent Homes Standard criteria which states that a dwelling fails this if it is not in a reasonable state of repair – this is based on the dwelling age and condition of a range of building components including walls, roofs, windows, doors, electrics and heating systems
ECO	Energy Companies Obligation Places legal obligations on the larger energy suppliers to deliver energy efficiency measures to domestic energy users
EHS	English Housing Survey A continuous national survey commissioned by the Department for Communities and Local Government (DCLG). It collects information about people's housing circumstances and the condition and energy efficiency of housing in England
EPC	Energy Performance Certificate Present the energy efficiency of domestic properties on a scale of A (most efficient) to G (least efficient)
Fuel poverty	The original definition of fuel poverty states that a household is in fuel poverty if it needs to spend more than 10% of their income on fuel to maintain an adequate level of warmth (10% definition). The new definition now adopted by government is that a household is said to be in fuel poverty if they have fuel costs that are above average and were they to spend that amount they would be left with a residual income below the official poverty line (Low Income High Costs definition)
GIS	Geographic Information System A system designed to capture, store, manipulate, analyse, manage and present spatial or geographical data
HHSRS	Housing Health and Safety Rating System A risk assessment tool to help local authorities identify and protect against potential risks and hazards to health and safety related deficiencies in dwellings, covering 29 categories of hazards



HIA	<p>Health Impact Assessment</p> <p>A formal method of assessing the impact of a project, procedure or strategy on the health of a population</p>
HMO	<p>Houses in Multiple Occupation</p> <p>An entire house or flat which is let to 3 or more tenants who form 2 or more households and who share a kitchen, bathroom or toilet</p> <p>A house which has been converted entirely into bedsits or other non-self-contained accommodation and which is let to 3 or more tenants who form two or more households and who share kitchen, bathroom or toilet facilities</p> <p>A converted house which contains one or more flats which are not wholly self-contained (i.e. the flat does not contain within it a kitchen, bathroom and toilet) and which is occupied by 3 or more tenants who form two or more households</p> <p>A building which is converted entirely into self-contained flats if the conversion did not meet the standards of the 1991 Building Regulations and more than one-third of the flats are let on short-term tenancies</p> <p>In order to be an HMO the property must be used as the tenants' only or main residence and it should be used solely or mainly to house tenants. Properties let to students and migrant workers will be treated as their only or main residence and the same will apply to properties which are used as domestic refuges</p>
HSM	<p>Housing Stock Model</p> <p>Desktop based modelling used to determine the condition of the housing stock</p>
Jenks' Natural Breaks	<p>The natural breaks classification method is a data clustering method determining the best arrangement of values into different classes. It is achieved through minimising each class's average deviation from the class mean while maximising each class's deviation from the means of the other groups. The method seeks to reduce the variance within classes and maximise variance between classes thus ensuring groups are distinctive</p>
JSNA	<p>Joint Strategic Needs Assessment</p> <p>An assessment of the current and future health and social care needs of the local community</p>
LACORs	<p>Local Authority Coordinators of Regulatory Services – now renamed Local Government Regulation</p>
LAHS	<p>Local Authority Housing Statistics</p> <p>National statistics on housing owned and managed by local authorities</p>
LIHC	<p>Low Income High Cost</p>



	Measure of fuel poverty, considers a household to be in fuel poverty if required fuel costs are above average, or if they were to spend that amount they would be left with a residual income below the official poverty line
LLPG	Local Land and Property Gazetteer An address database maintained by local authorities
LSOA	Lower Super Output Area Designed for statistical purposes, built from census output areas, approximately 400 households
MSOA	Medium Super Output Area Designed for statistical purposes, built from lower super output areas, approximately 2,000 households
NHS	National Health Service
Older people	People over 65 for the excess cold hazard, people over 60 for the fire and fall hazards (excl. falling between levels)
OS	Ordnance Survey
Poor housing	Dwellings where a category 1 hazard is present
Private sector housing	Housing not owned by the local authority or a housing association
SAP	Standard Assessment Procedure Method system for measurement of energy rating of residential buildings.
SimpleSAP	An estimate of a residential dwelling's likely SAP score, it is not based on the full required range of data for a SAP calculation or a reduced data SAP calculation (RDSAP), it should only ever be considered an estimate of the SAP score, and used as a guide
UPRN	Unique Property Reference Number A unique 12 digit number assigned to every unit of land and property recorded by local authorities as part of their LLPG
Vulnerable persons	Persons who are more likely to be affected by the particular hazard as defined by the HHSRS Operating Guidance