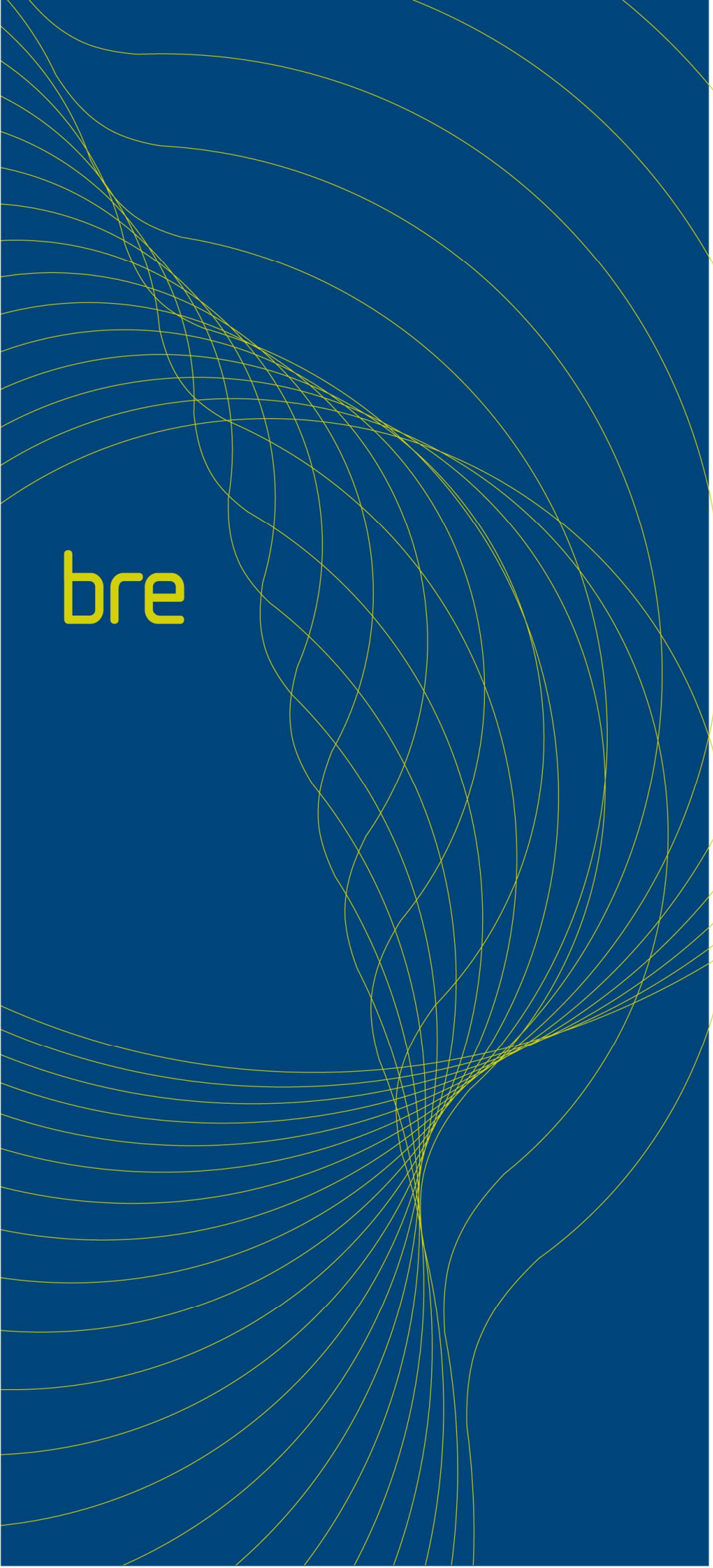

Oxford City Council Integrated Housing Stock Database

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23 January 2014

Client report number 285-216

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Executive Summary

Oxford City Council commissioned BRE to provide information on key housing and domestic energy variables, with a focus on private sector housing.. Principal among these indicators is the rate of Category 1 Housing Health and Safety Rating Hazards found in the stock as this is now the minimum standard for housing which every housing authority is obliged to keep under review. The information on Category 1 Hazards provided here, also forms the principal inputs for the Health Impact Assessment (HIA) of private sector housing which the Authority has also commissioned. The results of the HIA are provided in a separate report.

The estimates for Category 1 Hazards and the other indicators have been provided using a stock modelling methodology. Such approaches have been used for many years by BRE but this particular set of models is one of the first of its kind to make significant use of the Experian UK Consumer Dynamics Database of dwelling and household indicators as inputs to the models. This and data from the Department for Communities and Local Government's English Housing Survey (EHS) have been the main input data to the models.

The methodology is explained in more detail in the report and appendices but begins with dwelling level inputs provided by Experian and expands on these using inference techniques to provide sufficient information to calculate the likely energy efficiency of each dwelling in the stock. Some of the housing standards can be directly inferred from this data while others use regression techniques to predict whether a dwelling is likely to meet the standard.

Oxford City Council identified a number of additional 'local' sources of data which were used to update the BRE dwelling level models to provide an integrated database. These data sources were:

- Local Land and Property Gazetteer (LLPG)
- Housing benefits data
- Energy Performance Certificates (EPCs)
- Building control data
- Housing Assistance data
- List of licensable HMOs

The LLPG has been used to form the backbone of the database and the Unique Property Reference Number (UPRN) field should allow the Council to merge any additional data they require into the BRE stock model database.

The EPC and building control data have been used to update a number of key energy characteristics of the dwellings which have been used as inputs in the BRE models. This has enabled the modelling of energy demand and HHSRS Category 1 Hazards for Excess cold, and to produce the SimpleSAP rating, an estimate of CO_2 emissions (SimpleCO_2) as well as estimates of energy and heat demand and fuel costs. The remaining data has been used to modify the outputs of the BRE models.

Table E1 summarises the modelled estimates for the private sector housing stock in Oxford and includes national results from the 2009 EHS for comparison.

Table E1: Modelled data, private sector stock: authority level summary

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Oxford	52,704	9,204 (17%)	2,753 (5%)	5,979 (11%)	4,110 (8%)	5,816 (11%)	11,353 (22%)	54
2009 EHS (private stock)		(22%)	(9%)	(13%)	(6%)	(18%)	(22%)	51

The house condition indicators suggest the private sector housing stock in Oxford to be better than the national average with regard to health and safety and energy efficiency, though slightly worse in terms of disrepair. For HHSRS Category 1 Hazards Oxford is lower than the national level (17% compared with 22%); Fall Hazards are lower than the 2009 EHS average (11% compared with 13%) and there are less homes that suffer from excess cold (5% compared with 9%).

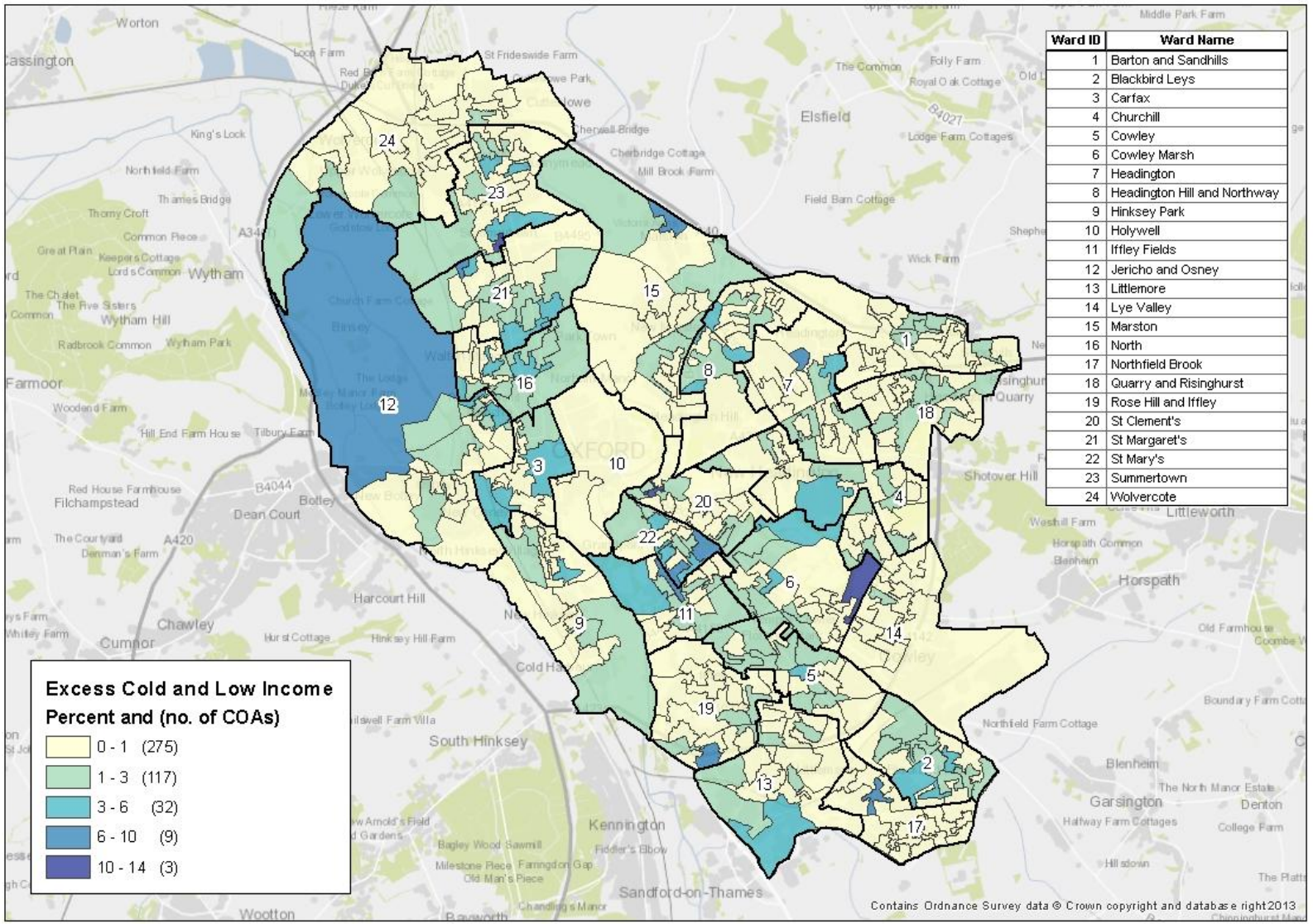
Levels of disrepair in Oxford are slightly higher than the national average (8% compared with 6%) possibly due to the older stock that can be found in Oxford (50% of Oxford's housing stock was built before 1944). The energy efficiency indicators suggest that the private sector housing stock in Oxford is slightly better than the national average. Excess Cold, which is the most common Category 1 Hazard, is less common in Oxford's housing stock (5% compared with 9%).

The average SimpleSAP rating for Oxford is 54 which is higher than the England average of 51 . As previously mentioned the housing stock in Oxford is older than the England average and therefore it might be expected that the SimpleSAP rating would be worse; however, it is possible that the high proportion of purpose built flats – most likely student accommodation – is improving the rating.

Fuel Poverty was estimated to occur in 11% of private sector households which is better than the 2009 national average of 18%. The sole indicator of purely socio-economic conditions, Low Income Households, is 22% in both Oxford and England as a whole.

The authority level data is valuable as it allows the results to be placed in a national context and can be used to predict the likely demand for private sector housing services. The dwelling level database however, holds the most useful information as it allows cross tabulations to be made with different variables, the results of which can be mapped to highlight small areas which are likely to be of most interest to Council Officers. Map E1 below illustrates how cross tabulating Category 1 Hazards for Excess Cold with Low Income Households can indicate where the authority is most likely to find concentrations of households both on the lowest incomes and in dwellings which are hard to heat.

Map E1: Percentage of private sector dwellings with the presence of a HHSRS Category 1 Hazard for Excess Cold and occupied by Low Income Households



Ward ID	Ward Name
1	Barton and Sandhills
2	Blackbird Leys
3	Carfax
4	Churchill
5	Cowley
6	Cowley Marsh
7	Headington
8	Headington Hill and Northway
9	Hinksey Park
10	Holywell
11	Iffley Fields
12	Jericho and Osney
13	Littlemore
14	Lye Valley
15	Marston
16	North
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Such maps, and the dwelling lists that underlie them, are useful when considering how best to target the Council's efforts to improve private sector housing whether these are focused on publicity, joint working or use of enforcement powers.

To further assist the targeting of energy improvement measures the database also contains indicators of the wall type and level of loft insulation present within a dwelling. This information is of particular use, as dwellings with uninsulated cavity walls or low levels of loft insulation are good targets for Green Deal or improvements carried out under the Energy Company Obligations (ECO). Energy companies seeking to fulfil their ECO obligations can be directed to areas where such dwellings are common, leading to an improvement to the stock that does not have to be directly funded by the Council. Table E2 shows the Green Deal opportunities available in Oxford.

Table E2: Modelled data, private sector stock: authority level summary

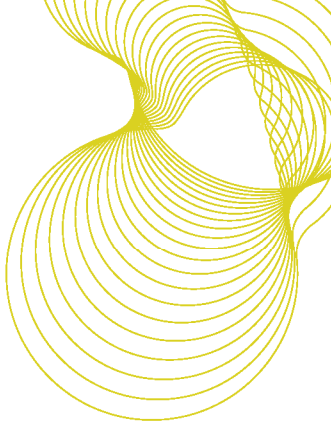
Ward	Dwellings	Wall Type			Levels of Loft Insulation						
		Solid Wall	Insulated Cavity Wall	Uninsulated Cavity Wall	No Loft	Loft but no Insulation	50mm	100mm	150mm	200mm	250mm plus
Oxford	52,704	15,149 (29%)	17,978 (34%)	19,577 (37%)	6,641 (13%)	5,084 (10%)	10,533 (20%)	18,119 (34%)	5,213 (10%)	3,829 (7%)	3,285 (6%)
2009 EHS (private stock)		(33%)	(32%)	(35%)	(8%)	(3%)	(11%)	(37%)	(17%)	(13%)	(11%)

The modelled results for Oxford City Council suggest that a sizeable proportion of the private sector stock could benefit from energy efficiency improvements with an estimated 19,577 dwellings having uninsulated cavity walls. The model also estimates that while the majority of the housing stock in Oxford has some level of loft insulation, there are still 5,084 dwellings (10%) with uninsulated lofts, and a further 6,641 (13%) having no loft to insulate. There are also 10,533 dwellings (20% of the private rented stock) with only 50mm of loft insulation, which could benefit from topping up. These types of dwellings are likely to be of particular interest to Green Deal providers. The maps below also provide an illustration of the distribution of dwellings with uninsulated cavity walls, solid walls and dwellings with loft insulation less than 100mm at a local level.

Data from the forerunner to ECO - the Carbon Emissions Reduction Target (CERT) scheme - reports that 7% of dwellings in Oxford City Council had cavity wall insulation installed and 3% had loft insulation installed under the four year scheme. It is surprising that the incidence of work for loft insulation is only 3% compared to a national average of 10% when Oxford appears to have such high levels of uninsulated or under-insulated lofts.

The summary results and maps provide valuable outputs of the project though its main strength is the dwelling level database from which these tables and maps are derived. This can be used by Council officers to manipulate, amalgamate and extract information to aid Oxford City Council's Housing Services' projects and reporting. All of the housing stock model outputs (tables and maps) in this report have been calculated by using the dwelling level information from the database.

Contents



Introduction

Oxford City Council commissioned BRE to provide information on key housing indicators. These include the Housing Health and Safety Rating System (HHSRS) and Fuel Poverty. The information has been derived from a series of models which make use of the Experian UK Consumer Dynamics Database using a range of statistical methods. This data provides officers at Oxford City Council with detailed information on the likely condition of the stock and the geographical distribution of properties of interest, such as those that might benefit from energy efficiency improvements, or other forms of intervention.

Before considering the stock models themselves this report first discusses the basic legislative, government and local reporting requirements on private sector housing information. The report then considers the results of the modelling.

Background

Local housing authorities are required to review housing conditions in their districts in accordance with the Housing Act 2004 s3. This is a wide ranging requirement as it refers to other parts of the Act as well as other legislation, which between them cover:

- Dwellings that fail to meet the minimum standard for housing i.e. dwellings with Category 1 Hazards under the HHSRS
- 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 for assistance with adaptation of dwellings for disabled persons.

Whilst these are the areas covered by the legislation, the latter does not prescribe precisely what information should be collected when an authority reviews its housing.

Regional and local information requirements

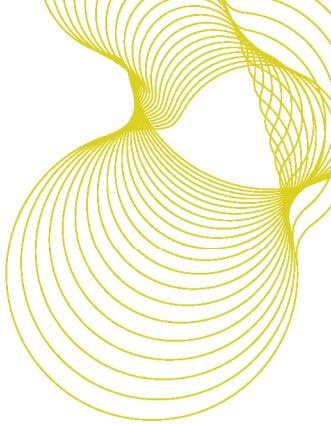
The information to be collected is therefore largely for the authority to decide, although it needs to take account of Government policy. The previous Government (through the CLG) took the view that primary responsibility for repairing and improving homes in the private sector lies with the owner'. They recognised, however, that some - particularly the elderly and other vulnerable groups - would not have the resources necessary for this. Authorities were expected, through the powers they have under the Regulatory Reform Order 2002, to have developed policies on providing such assistance. Government funding for such assistance was channelled via the Regional Assemblies, who were expected to prioritise those most in need.

Audit Commission guidance[1] further advised on the need and methodology for collecting information and how it should be used.

Since the subsequent abolition of the Regional Assemblies, the Regional Development Agencies, the Government Offices for the Regions and the Audit Commission, the DCLG in their Draft Structural Reform Plan has announced among other measures that it will 'Move from local authorities primarily reporting to central government to local authorities that report to local people'. This has included the abolition of Comprehensive Area Assessment and it is pledged to cut local government inspection. It has also announced its intention to 'design and implement a new approach with less reporting burdens on local government and greater transparency for local people'. This has been followed up by a letter from the Minister to all local authorities, revoking all Local Area Agreements, and effectively handing over control of Local Agreements to local authorities. The letter specifically states that authorities wishing to drop any targets may do so, and where authorities choose to retain targets DCLG will not monitor them. It is therefore very much for Oxford City Council to decide on its housing priorities.

Before turning to the modelled results, the next sections briefly consider how the most recent government policy is shaping local authority housing information requirements.

[1] Updated strategic approach to housing KLOE for use from 12 April 2010 Audit Commission January 2010



Coalition Government Policy: Laying the foundations: A Housing Strategy for England

The Coalition Government has recently published a strategy document 'Laying the Foundations: A Housing Strategy for England'[2]. The main focus of this document is on areas other than private sector housing; notably on increasing housing supply and reforming social and affordable housing. However, two chapters of the report do focus on traditional areas of private sector housing policy interest; the private rented sector and empty homes.

The growth of the private rented sector in recent years is acknowledged, and they state that they are 'looking at measures to deal with rogue landlords and encouraging local authorities to make full use of the robust powers they already have to tackle dangerous and poorly maintained homes'. They commend the approach adopted by Liverpool City Council, which works closely with landlords through a Landlord Forum and Panel operating a Landlord Accreditation Scheme, but still operates a robust enforcement regime. They also commend the partnership with Liverpool Primary Care Trust. The 'Healthy Home Programme' has identified over 2000 hazards and led to an estimated £3 million investment by landlords into the housing stock, delivering sustainable health improvements and enhancing community wellbeing. The Health Impact Assessment which will be informed by the Category 1 Hazard models is a first stage in the development of such a program.

The document also draws attention to the Green Deal (discussed in more detail below), which enables all consumers to install energy efficiency measures at no upfront cost. Householders will repay the cost of the measures through their energy bill savings.

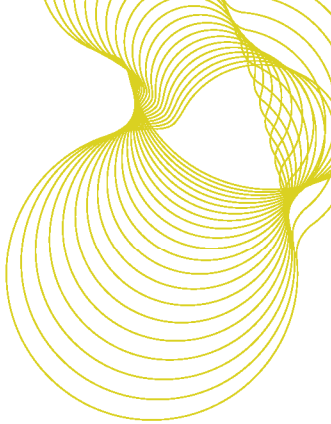
From 2016 reasonable requests by tenants for such energy efficiency improvements will not be able to be refused and from 2018 it will be unlawful for landlords to rent out properties that do not reach a minimum standard of energy efficiency. While there will be various caveats to these powers, they will provide a new minimum standard for rented accommodation. Part of this project includes provision of a private rented sector variable that should assist in identifying such dwellings.

The document does, however, also point out that the Housing Health and Safety Rating can be used effectively to improve rented property and quotes Hull City Council's PEAL scheme (Proactive housing and Environmental Action Locally) as an example of how training for landlords in the Rating System can result in effective self-regulation.

So, while new powers will become available in 2016, there are existing powers that can be used effectively to deal with the hazards identified by the BRE models.

Empty homes brought back into use will qualify for the New Homes Bonus where, for the following six years, the Government is to match funds from Council Tax revenues on long term empty properties brought back into use. The document also draws attention to the Empty Homes Toolkit provided by the Homes and Communities Agency. From 2012-15, £100million capital funding from within the Affordable Homes Programme will be available to tackle long-term empty homes. While the data provided by this project cannot necessarily assist with identification of empty homes, the database provided would be the logical place for such information to be stored could it be gathered from other sources.

[2] Laying the Foundations: A Housing Strategy for England CLG 2011
http://www.communities.gov.uk/publications/housing/housingstrategy2011



The Green Deal and ECO

We referred to the forthcoming enforcement powers under the Green Deal, but this policy is primarily about encouragement to take up energy efficiency measures. Local authorities can, if they choose, become Green Deal Providers. Others, while not intending to be providers (i.e. installing and financing Green Deal measures), are taking major steps to engage with providers; e.g. the Birmingham Energy Savers scheme, which will result in favoured status for a particular provider.

The Green Deal and Energy Company Consultation Document[3] and the associated local authority information note[4] outline the various roles an authority can adopt. These can be summarised as to provide, partner or promote, depending on the extent of engagement the authority decides on. For all three levels of engagement, however, they are 'likely to act as partners, adding value by, for example, providing information on local housing stock, and endorsing and helping market company activity, using their position as a trusted interlocutor with households to increase local acceptance and take-up'. The Home Energy Conservation Act 1995 is to be retained, and is likely to be used to encourage local authorities by requiring annual reporting on how they plan to engage with the Green Deal and Energy Company Obligation (ECO). Both the consultation and the information note refer to the local authority role in identifying street-by-street opportunities for Green Deal roll out. Furthermore, the information provided in this report can be used to contribute to the evidence base required for competitive funding bids to central Government – e.g. the DECC Green Deal Communities Local Authority Fund[5], which has recently been increased from £20 million to £80 million[6].

It is quite clear that the availability of small-area data, on energy efficiency in particular, will be of particular value as authorities rise to the challenge of the Green Deal and ECO.

[3] The Green Deal and Energy Company Consultation Document DECC 2011
http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx
[4] Local Authorities and the Green Deal DECC 2011
http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx
[5] Green Deal Communities – Local Authority Fund: Application Pack, DECC, 25 July 2013
[6] https://www.gov.uk/government/news/govt-action-to-help-hardworking-people-with-energy-bills

BRE Dwelling Level Housing Stock Models

The original BRE Housing Stock Models, developed in 2003, were the result of an 18-month development program supported by the BRE Trust. Until recently these models were based on a combination of data from the English Housing Survey (EHS) and nationally available small area datasets such as the census. These models proved to be useful and very popular with authorities, with over 230 Local Authorities in England purchasing the models.

Over the last few years BRE have been looking to further improve the quality of this service. The models provided to Oxford use BRE's new approach which improves upon the previous methodology and is dwelling rather than area based.

This new methodology makes use of a model originally devised for modelling carbon emissions which we call 'SimpleCO_2'. The model uses basic dwelling descriptions from the Experian UK Consumer Dynamics Database e.g. dwelling type and age to define broad dwelling archetypes. Knowledge of distributions from the English Housing Survey (EHS) are then used to predict the likely fuel type, boiler type, insulation levels and other key variables which are required to calculate levels of energy efficiency.

Variables such as 'SimpleSAP' (an estimate of the Government's energy efficiency rating known as SAP) and Excess Cold are direct outputs of the calculations performed by the model. For the other indicators a top down methodology was adopted, similar in many respects to the approach used by the previous set of models (the full list indicators is provided later in this section). This method uses data from the EHS and Experian to establish relationships between the housing standards and various dwelling and social characteristics using logistic forms of regression analysis. Once these relationships are established, they are used to create a regression model which calculates the likelihood of a dwelling failing a given standard.

There are therefore, in effect, two methodologies being used. The first deals with the lack of information required to undertake an energy efficiency calculation by modelling missing input data such as insulation levels. The second models the probability of a dwelling failing a standard by using formulae derived from the EHS which are then applied to the national Experian dataset. The probabilities are then converted into pass or fail values based on the expected pass/fail level in the census output area (COA) in which the dwelling is found. These approaches ensure indicative values are provided for each variable and each dwelling i.e. pass/fail for a standard or an actual value e.g. for 'SimpleSAP'. The probabilistic models used to reach these values mean that the individual dwelling data can only be indicative but in our view this makes as full a use as is possible of the dwelling level input data.

Integrating Local Data Sources

The cornerstone of the Integrated Housing Stock Database is the integration of local data into the BRE models. Consequently, it is important that we successfully identify those sources of local data that can best contribute to our understanding of the housing stock in Oxford City Council.

Oxford City Council are in possession of a number of additional local data sources with the potential to be integrated into the integrated database. These data sources are as follows ;

- The Oxford Local Land and Property Gazetteer
- Benefits data
- Energy Performance Certificates (EPCs)
- Building Control Data
- Housing Assistance data

The LLPG has been used to form the backbone of the database and the UPRN field should allow the Council to merge any additional data they require into the BRE stock model database.

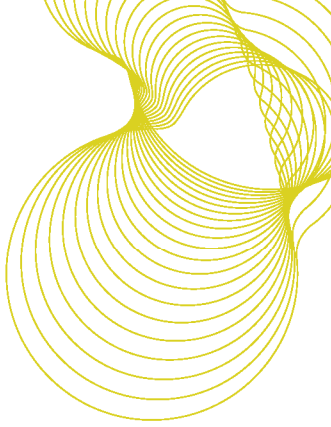
The benefits data identifies households which are in receipt of Council Tax Support or Housing Allowance. Households in receipt of at least one of these two benefits make up 62% of all low income households. This greatly improves the ability of the model to identify low income households.

The EPC data has been used to update a number of key energy characteristics of the dwelling which can be used as inputs in the BRE SimpleCO_2 model. This will in turn allow us to model energy demand and HHSRS Category 1 Hazards for Excess cold, and to produce the SimpleSAP rating, an estimate of CO_2 emissions (SimpleCO_2) as well as estimates of energy and heat demand and fuel costs.

The building control data provided by the authority provided very valuable information from theFENSA and gas safe schemes. Both of these schemes exist to record where work has been carried out to either glazing or gas systems by a registered competent person. In some cases the exact nature of the work was given, allowing us to improve the input data used in the BRE SimpleCO_2 model.

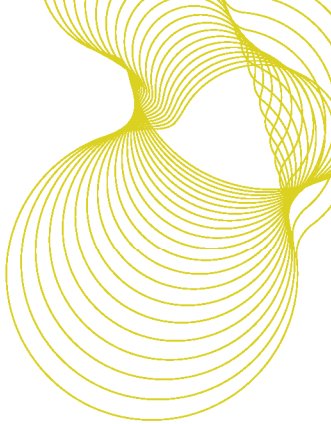
The Housing Assistance data records detail of work carried out with the benefit of additional funding from the council. Due to the wide variety of different works carried out, it is not possible to use the data to identify exactly what features a dwelling may possess, but the data does allow for the modification of the disrepair indicator. Where a dwelling has benefitted from housing assistance, it is assumed that that dwelling will not have significant disrepair issues.

Additionally BRE have matched the local authority data from the Ordnance Survey (OS) Mastermap into the database. This allows us to measure the footprint of the building, to know how many residential addresses there are within the building, and to see which other buildings each address is attached to or geographically close to.



The most valuable use of the OS data is the ability to determine the dwelling type with much greater confidence. This information can then also be used to reconcile discrepancies, such as wall type, within blocks of flats, terraced and semi-detached houses.

Additional information on ther methodology and how the local data sources have been integrated into the database is included in Appendix A.



Results from the BRE Housing Stock Models

Table 1 and 2 provide the estimated percentage and stock totals, from the BRE Housing Stock Model, at ward and authority level for the following indicators:

- The presence of a Category 1 Rating System Hazard
- 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)
- The presence of a Category 1 Hazard for Falls (including falls associated with baths, falling on the level, falling on stairs and falling between levels)
- Dwellings in Disrepair (based on the former Decent Homes Standard criterion for disrepair)
- Fuel Poverty (this is based on the full fuel poverty measure based on 10% of earnings being spent on heating costs)
- Dwellings occupied by a Low Income Household
- An estimate of the SAP rating which, to emphasise its origin from a reduced set of variables, is referred to as 'SimpleSAP'[7]

Before considering the results of the models it is important to note that some of the indicators provided will be enhanced through the use of local data sources. Data from the EPCs and Building Control Data has been used to replace modelled data for certain characteristics, improving the reliability of the models for those dwellings. The indicators revised due to the availability of reliably sourced local data are:

- 'SimpleSAP' (due to the likely availability of Energy Performance Certificate data)
- Category 1 Hazard for Excess Cold (due to changes in 'SimpleSAP')
- Fuel Poverty (due to changes in 'SimpleSAP' and availability of benefit data)
- Category 1 Hazards (solely due to the likely change in Excess Cold)

Definitions for all of the modelled indicators are provided in Appendix B.

[7] Important note: while we can provide 'SimpleSAP' ratings from the 'SimpleCO_2' software, under no circumstances must these be referred to as SAP as the input data is insufficient to produce an estimate of SAP or even RdSAP for an individual dwelling that meets the standards required by these methodologies.

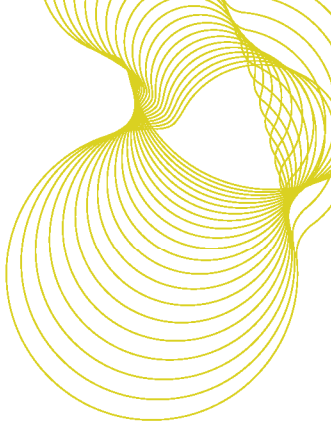


Table 1: Modelled data, all stock

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Barton and Sandhills	3,217	381 (12%)	92 (3%)	254 (8%)	136 (4%)	321 (10%)	1,266 (39%)	56
Blackbird Leys	2,572	246 (10%)	63 (2%)	162 (6%)	45 (2%)	235 (9%)	1,240 (48%)	57
Carfax	1,307	209 (16%)	94 (7%)	101 (8%)	107 (8%)	117 (9%)	335 (26%)	58
Churchill	2,828	345 (12%)	105 (4%)	213 (8%)	137 (5%)	288 (10%)	1,027 (36%)	57
Cowley	2,790	443 (16%)	124 (4%)	297 (11%)	201 (7%)	353 (13%)	811 (29%)	53
Cowley Marsh	2,945	458 (16%)	174 (6%)	263 (9%)	191 (6%)	331 (11%)	809 (27%)	54
Headington	3,015	466 (15%)	151 (5%)	286 (9%)	217 (7%)	337 (11%)	639 (21%)	54
Headington Hill and Northway	2,073	306 (15%)	91 (4%)	194 (9%)	129 (6%)	222 (11%)	605 (29%)	54
Hinksey Park	2,850	479 (17%)	103 (4%)	335 (12%)	242 (8%)	289 (10%)	743 (26%)	56
Holywell	218	46 (21%)	21 (10%)	22 (10%)	20 (9%)	26 (12%)	50 (23%)	52
Iffley Fields	2,504	515 (21%)	132 (5%)	347 (14%)	249 (10%)	316 (13%)	691 (28%)	53
Jericho and Osney	3,364	617 (18%)	181 (5%)	400 (12%)	321 (10%)	363 (11%)	808 (24%)	55
Littlemore	2,966	413 (14%)	110 (4%)	274 (9%)	157 (5%)	315 (11%)	915 (31%)	56
Lye Valley	2,920	415 (14%)	99 (3%)	291 (10%)	185 (6%)	302 (10%)	765 (26%)	55
Marston	2,914	432 (15%)	137 (5%)	276 (9%)	154 (5%)	304 (10%)	645 (22%)	54
North	2,222	466 (21%)	180 (8%)	264 (12%)	218 (10%)	274 (12%)	364 (16%)	51
Northfield Brook	3,012	203 (7%)	41 (1%)	141 (5%)	29 (1%)	180 (6%)	1,368 (45%)	62

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Quarry and Risinghurst	2,907	436 (15%)	114 (4%)	302 (10%)	193 (7%)	313 (11%)	605 (21%)	54
Rose Hill and Iffley	2,733	421 (15%)	132 (5%)	251 (9%)	140 (5%)	325 (12%)	907 (33%)	53
St Clement's	2,647	508 (19%)	164 (6%)	310 (12%)	284 (11%)	307 (12%)	627 (24%)	52
St Margaret's	2,279	513 (23%)	191 (8%)	299 (13%)	245 (11%)	265 (12%)	326 (14%)	53
St Mary's	2,129	534 (25%)	200 (9%)	291 (14%)	295 (14%)	283 (13%)	546 (26%)	51
Summertown	3,363	593 (18%)	185 (6%)	366 (11%)	276 (8%)	387 (12%)	721 (21%)	53
Wolvercote	2,977	419 (14%)	109 (4%)	295 (10%)	183 (6%)	319 (11%)	564 (19%)	54
Oxford	62,752	9,864 (16%)	2,993 (5%)	6,234 (10%)	4,354 (7%)	6,772 (11%)	17,377 (28%)	55
2009 EHS (all stock)		(21%)	(8%)	(12%)	(6%)	(18%)	(30%)	53

Summary of results: all stock

Table **2** summarises the key statistics at the authority level for all stock.

Table 2: Modelled data, all stock: authority level summary

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Oxford	62,752	9,864 (16%)	2,993 (5%)	6,234 (10%)	4,354 (7%)	6,772 (11%)	17,377 (28%)	55
2009 EHS (all stock)		(21%)	(8%)	(12%)	(6%)	(18%)	(30%)	53

The house condition indicators suggest the housing stock in Oxford to be superior to the national average in most regards:

- For HHSRS Category 1 Hazards which includes matters affected by both condition and thermal efficiency the model estimate of 16% is notably better than the 2009 national average, 21%.

- Falls hazards, including falls on stairs, between levels, on the level and associated with baths and showers, are slightly less common in Oxford compared with England (10% vs.12%).
- Excess Cold, which is the most common single Category 1 Hazard in England, is lower in Oxford (5% compared with a national figure of 8%).
- Oxford's disrepair figures are slightly higher than the national average of (7% vs. 6%).
- Fuel poverty is considerably less likely in Oxford compared to England (11% vs. 18%). Some of this may be due to the difference in the time frames to which the data refers (the models for Oxford incorporate EPC data which will include energy improvements carried out over the last 4 years while the EHS data reflects the situation in 2009).
- The sole indicator of purely socio-economic conditions, Low Income Households (28%), shows Oxford to have marginally fewer households on low income than the national average (30%).

It is important to remember, as noted under the fuel poverty comments, that the local data that has been used to enhance the Oxford database should reflect the current condition of the stock, while the EHS data is for 2009. This may account for some of the differences observed.

The stock totals in the Database are taken from the LLPG data provided by Oxford, minus any cases that could not be matched using the address given in the LLPG file. By purchasing the tenure variable from Experian it is possible to break the housing stock model information down by tenure. The stock totals are provided by tenure in Table 3 below.

Table 3: Database stock totals by tenure

Tenure	Number of dwellings	% of all stock
Owner Occupied	27,144	43%
Private Rented	25,560	41%
Social	10,048	16%
Total	62,752	-

The stock totals were compared to the reported 2011 Census figures[8] shown in Table **4** as a way of validating the Database information.

Table 4: 2011 Census stock totals by tenure

Tenure	Number of dwellings	% of all stock
Owner Occupied	26,832	49%
Private Rented	16,715	30%
Social	11,828	21%
Total	55,375	-

[8] http://www.ons.gov.uk/ons/datasets-and-tables/index.html

The BRE Housing Stock Database demonstrates a 13% difference in the total number of dwellings reported by the Census data, this equates to an additional 7,377 dwellings. The largest difference, in terms of tenure distribution, between the Census and the BRE Housing Stock Model is for privately rented properties which the Census reported at 30% and the database at 41% of the total number of dwellings. This represents a discrepancy of 8,845 households for the privately rented stock. The additional private rented dwellings therefore account for the majority of the difference in stock totals, indeed the additional number of private rented dwellings is larger than the overall increase in dwellings, meaning that dwellings must be being lost from another tenure. When compared with the Census, the database under-predicts the number of social rented dwellings by 1,780, but over-predicts the number of owner occupied dwellings by 312.

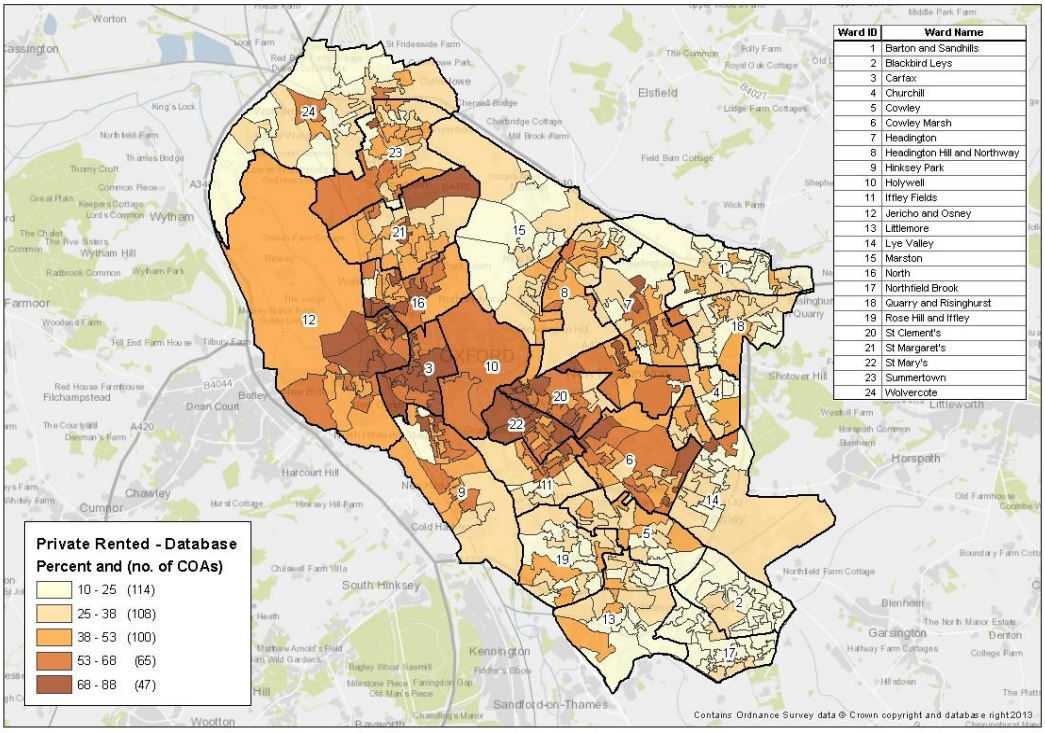
ONS publications on census response rates[9] show that the response rates for students is lower than the rest of the population. It is possible that the differences in the number of dwellings reported in the census and the number in the database is due under-reporting in the census by a portion of the large amount of student accommodation in Oxford.

The Census information is published down to census output areas (COAs) through the Office for National Statistics (ONS) Neighbourhood Statistics tables. By mapping the proportions of privately rented dwellings at this level it is possible to ascertain if the distribution of privately rented dwellings is similar for the Experian and Census data (Maps 1 and 2).

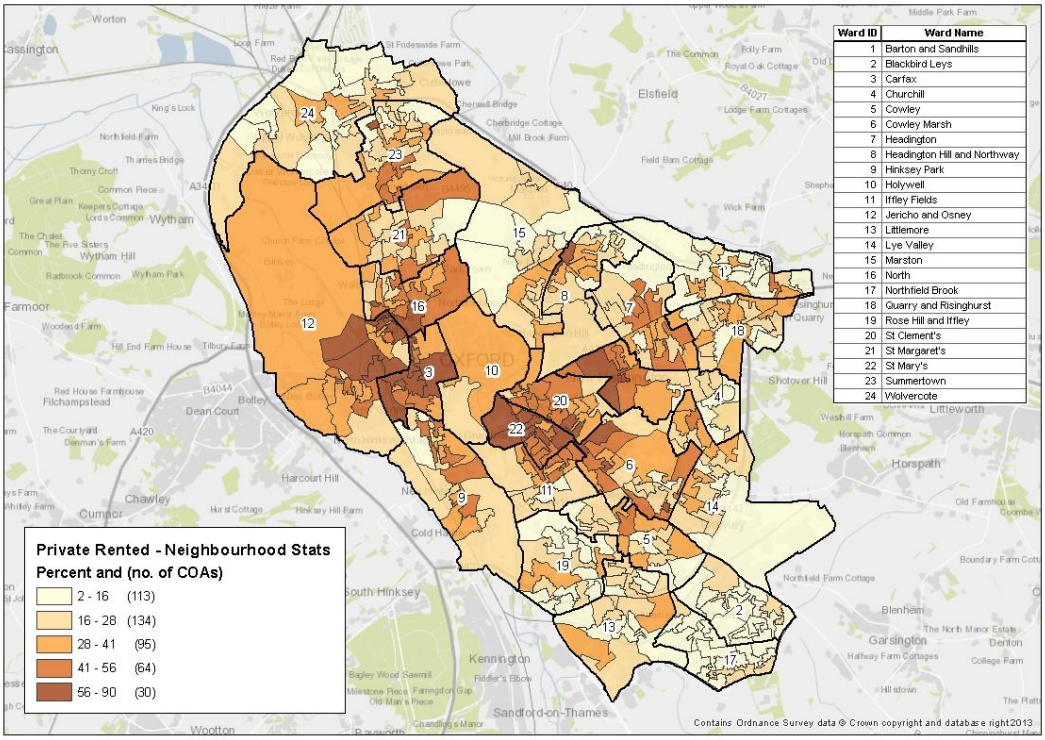
Although the database stock total exceeds the 2011 Census total for the privately rented stock, the distribution of privately rented dwellings in Oxford City Council is similar with concentrations being found in Carfax, Marston, Headington Hill and Northway, and St Mary's. The difference lies in the intensity of those concentrations, with the database showing greater concentrations of private rented stock due to the increased number of private rented dwellings. As it is possible for a privately rented dwelling to become owner occupied and vice versa relatively easily it is difficult to accurately predict these at any given time. However, the consistency between the Experian and Census information on the location of concentrations of privately rented dwellings suggests that the database should still provide a good overview of the stock in Oxford City Council.

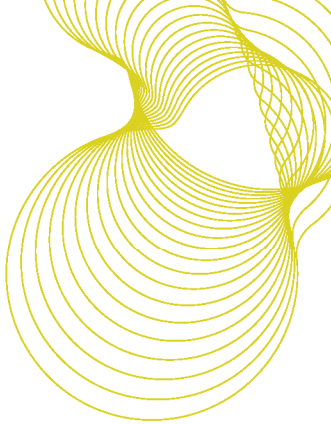
[9] Table 4, "Response rates in the 2011 Census", Office for National Statistics ,

Map 1(i): Percentage of privately rented dwellings (Database)



Map 1(ii): Percentage of privately rented dwellings (2011 Neighbourhood Statistics)





Summary of results: by tenure

Table 5 summarises the key statistics at the authority level by tenure.

Table 5: Modelled data by tenure: authority level summary

Tenure	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Owner occupied	27,144	5,387 (20%)	1,108 (4%)	4,173 (15%)	892 (3%)	2,769 (10%)	4,531 (17%)	54
Private rented	25,560	3,817 (15%)	1,645 (6%)	1,806 (7%)	3,218 (13%)	3,047 (12%)	6,822 (27%)	54
Social	10,048	660 (7%)	240 (2%)	255 (3%)	244 (2%)	956 (10%)	6,024 (60%)	59

The differences between the tenures generally reflect the position at national level with the private rented stock being in poorest condition, with the owner occupied stock being slightly better; and then the social rented stock in the best condition. The notable exception to this is the HHSRS where, unusually, the owner occupied stock is worse than the private rented stock (20% vs. 15%). Looking at the components of the HHSRS it becomes apparent that the owner occupied stock has far more falls hazards than the private rented stock (15% vs 7%). This might be a reflection of the unusual nature of the private rented stock in Oxford, where student accommodation blocks make up a large proportion of the private rented stock. Falls hazards are more likely to occur in houses than flats, so when purpose built flats start to account for a large proportion of private rented dwellings rather than houses, the likelihood of falls hazards being present drops. It might be the case that a number of halls of residence have been incorrectly classified as private rented. Such accommodation is likely to have fewer falls hazards. Furthermore, if the halls of residence were particularly old then the incidence of other hazards might be higher, explaining why 15% of the private rented stock has hazards even though Excess cold and falls on stairs are fairly low. The SimpleSAP score for the private rented stock is also, unusually, the same as the owner occupied stock. This is also likely to be due to the larger than average number of purpose built flats in the private rented stock (most likely university accommodation).

The social data should be treated with some caution as the social rented stock, particularly when largely comprising stock owned by a single landlord, is more difficult to model than the private sector. This is because the decisions of an individual property owner usually only affect a single dwelling out of the thousands of private sector stock whereas the policies and decisions of a single landlord can have a very great effect on a large proportion of the social stock. The social rented results are therefore best considered as a benchmark which takes account of the age, type, size and tenure against which the landlord's own data could be compared.

As the focus of this report is the private sector stock the next set of results provided are the housing stock information at ward and local authority level data for the private sector stock (Table 6 and 7), followed by Census Output Area (COA) level information presented in map format.

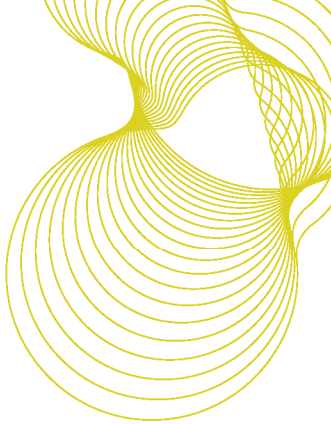


Table 6: Modelled data, private sector stock

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Barton and Sandhills	2,060	308 (15%)	63 (3%)	230 (11%)	128 (6%)	203 (10%)	511 (25%)	55
Blackbird Leys	1,283	171 (13%)	39 (3%)	124 (10%)	43 (3%)	121 (9%)	534 (42%)	56
Carfax	1,208	201 (17%)	90 (7%)	97 (8%)	101 (8%)	111 (9%)	293 (24%)	58
Churchill	2,058	304 (15%)	92 (4%)	198 (10%)	126 (6%)	210 (10%)	533 (26%)	56
Cowley	2,432	415 (17%)	113 (5%)	286 (12%)	189 (8%)	317 (13%)	561 (23%)	52
Cowley Marsh	2,639	431 (16%)	165 (6%)	253 (10%)	179 (7%)	299 (11%)	650 (25%)	54
Headington	2,805	452 (16%)	145 (5%)	280 (10%)	208 (7%)	320 (11%)	543 (19%)	54
Headington Hill and Northway	1,708	281 (16%)	81 (5%)	187 (11%)	117 (7%)	184 (11%)	340 (20%)	53
Hinksey Park	2,489	449 (18%)	92 (4%)	326 (13%)	236 (9%)	255 (10%)	532 (21%)	55
Holywell	193	42 (22%)	20 (10%)	19 (10%)	16 (8%)	23 (12%)	45 (23%)	51
Iffley Fields	2,157	485 (22%)	123 (6%)	333 (15%)	235 (11%)	271 (13%)	459 (21%)	52
Jericho and Osney	3,122	591 (19%)	169 (5%)	390 (12%)	305 (10%)	342 (11%)	666 (21%)	54
Littlemore	2,390	377 (16%)	96 (4%)	264 (11%)	148 (6%)	258 (11%)	537 (22%)	55
Lye Valley	2,611	397 (15%)	97 (4%)	280 (11%)	173 (7%)	273 (10%)	547 (21%)	54
Marston	2,733	416 (15%)	133 (5%)	267 (10%)	150 (5%)	285 (10%)	537 (20%)	54
North	2,149	458 (21%)	174 (8%)	263 (12%)	216 (10%)	268 (12%)	348 (16%)	51
Northfield Brook	1,600	159 (10%)	32 (2%)	120 (8%)	27 (2%)	95 (6%)	534 (33%)	61

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Quarry and Risinghurst	2,644	418 (16%)	107 (4%)	294 (11%)	178 (7%)	288 (11%)	441 (17%)	53
Rose Hill and Iffley	2,074	390 (19%)	121 (6%)	241 (12%)	134 (6%)	249 (12%)	516 (25%)	52
St Clement's	2,500	489 (20%)	156 (6%)	304 (12%)	269 (11%)	293 (12%)	573 (23%)	52
St Margaret's	2,176	498 (23%)	182 (8%)	296 (14%)	229 (11%)	255 (12%)	300 (14%)	53
St Mary's	1,974	511 (26%)	190 (10%)	281 (14%)	265 (13%)	266 (13%)	481 (24%)	50
Summertown	3,031	566 (19%)	173 (6%)	358 (12%)	266 (9%)	347 (11%)	512 (17%)	53
Wolvercote	2,668	395 (15%)	100 (4%)	288 (11%)	172 (6%)	283 (11%)	360 (13%)	54
Oxford	52,704	9,204 (17%)	2,753 (5%)	5,979 (11%)	4,110 (8%)	5,816 (11%)	11,353 (22%)	54
2009 EHS (private stock)		(22%)	(9%)	(13%)	(6%)	(18%)	(22%)	51

Summary of results: private sector stock

Table 7 summarises the key statistics at the authority level by tenure.

Table 7: Modelled data, private sector stock: authority level summary

Ward	Dwellings	HHSRS Category 1 Hazards			Disrepair	Fuel Poverty	Low Income Households	SimpleSAP Score
		All Hazards	Excess Cold	Fall Hazards				
Oxford	52,704	9,204 (17%)	2,753 (5%)	5,979 (11%)	4,110 (8%)	5,816 (11%)	11,353 (22%)	54
2009 EHS (private stock)		(22%)	(9%)	(13%)	(6%)	(18%)	(22%)	51

The house condition indicators suggest that the private sector housing stock in Oxford is better than the national average with regard to health and safety and energy efficiency, though slightly worse in terms of disrepair:

- For HHSRS Category 1 Hazards Oxford is lower than the national level (17% compared with 22%); Fall Hazards are lower than the 2009 EHS average (11% compared with 13%) and there are less homes that suffer from excess cold (5% vs 9%).
- Levels of disrepair in Oxford are slightly higher than the national average (8% vs 6%) possibly due to the older stock that can be found in Oxford (50% of Oxford's housing stock was built before 1944, compared to 38% for England overall).

The energy efficiency indicators suggest that the private sector housing stock in Oxford is slightly better than the national average:

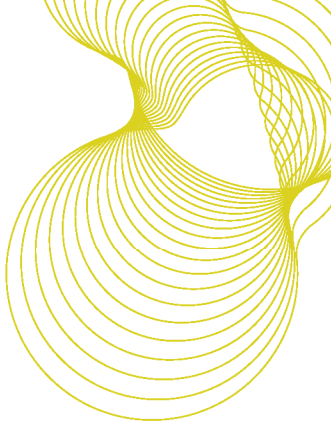
- Excess Cold, which is the most common single Category 1 Hazard in England, is less common in Oxford's housing stock (5% compared with 9%).
- The average SimpleSAP rating for Oxford is 54 which is higher than the England average of 51 . As previously mentioned the housing stock in Oxford is older than the England average and therefore it might be expected that the SimpleSAP rating would be worse; however, it is possible that the high proportion of purpose built flats – most likely student accommodation – is improving the rating.
- Fuel Poverty was estimated to occur in 11% of private sector households which is better than the 2009 national average of18%.
- The sole indicator of purely socio-economic conditions, Low Income Households, is 22%, which is the same as for England as a whole.

Housing Stock Model outputs by Census Output Area

Outputs from the models for the private sector stock are also produced in map form at the level of the COA[10]. These typically comprise around 125 households and usually include whole postcodes, which have populations that are largely similar.

The maps show the percentages of private sector homes in each output area that are, for example, estimated to have a HHSRS Category 1 Hazard. The ranges are defined based on the Jenks' Natural Breaks algorithm of the COA statistics (natural breaks classes are based on natural groupings inherent in the data). The outputs in the lightest and darkest colours on the maps are the extreme ends of the range, which therefore highlight the best and worst areas.

[10] The COA level maps have been produced using Esri ArcGIS for Desktop and the colour symbols used are from ColorBrewer.org

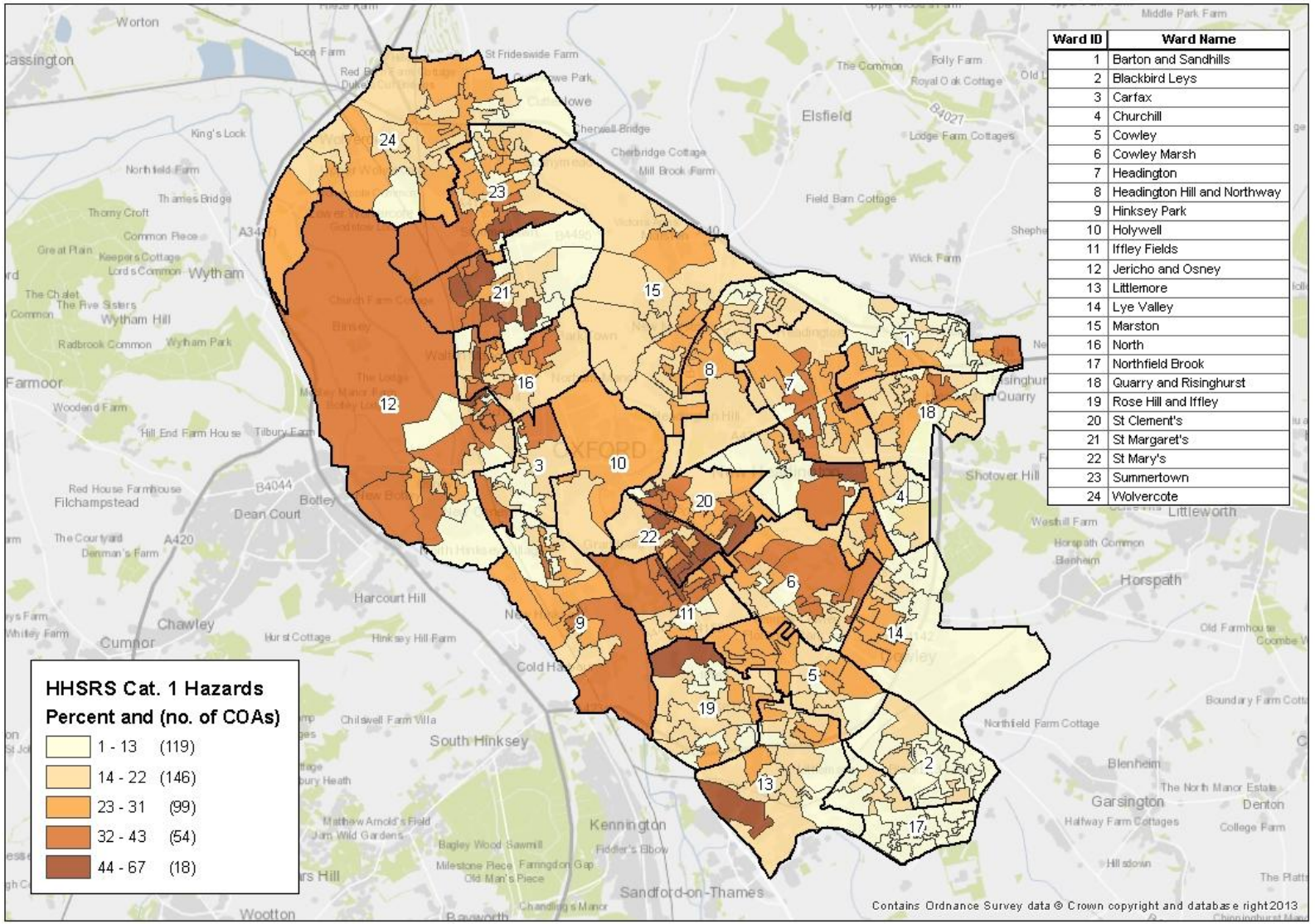


The COA data in map format is provided below for the following indicators:

- The presence of a Category 1 Rating System Hazard
- The presence of a Category 1 Hazard for Excess Cold
- The average 'SimpleSAP'[11] rating
- Levels of Fuel Poverty
- Dwellings occupied by Low Income Households

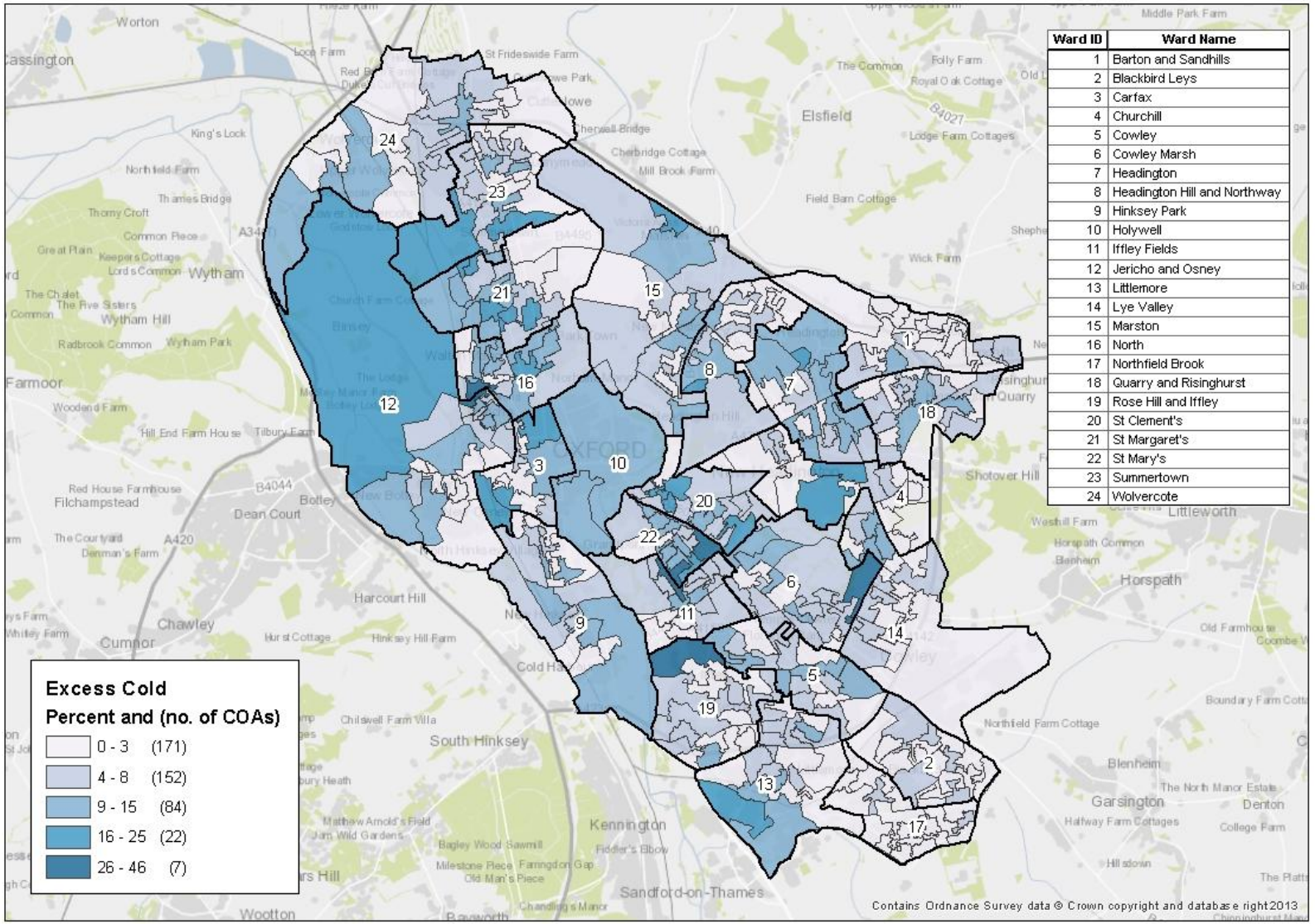
[11] Important note: while we can provide 'SimpleSAP' ratings from the 'SimpleCO_2' software, under no circumstances must these be referred to as SAP as the input data is insufficient to produce an estimate of SAP or even RdSAP for an individual dwelling that meets the standards required by these methodologies.

Map 2: Percentage of private sector dwellings with the presence of a HHSRS Category 1 Hazard



Ward ID	Ward Name
1	Barton and Sandhills
2	Blackbird Leys
3	Carfax
4	Churchill
5	Cowley
6	Cowley Marsh
7	Headington
8	Headington Hill and Northway
9	Hinksey Park
10	Holywell
11	Iffley Fields
12	Jericho and Osney
13	Littlemore
14	Lye Valley
15	Marston
16	North
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Map 3: Percentage of private sector dwellings with the presence of a HHSRS Category 1 Hazard for Excess Cold



Ward ID	Ward Name
1	Barton and Sandhills
2	Blackbird Leys
3	Carfax
4	Churchill
5	Cowley
6	Cowley Marsh
7	Headington
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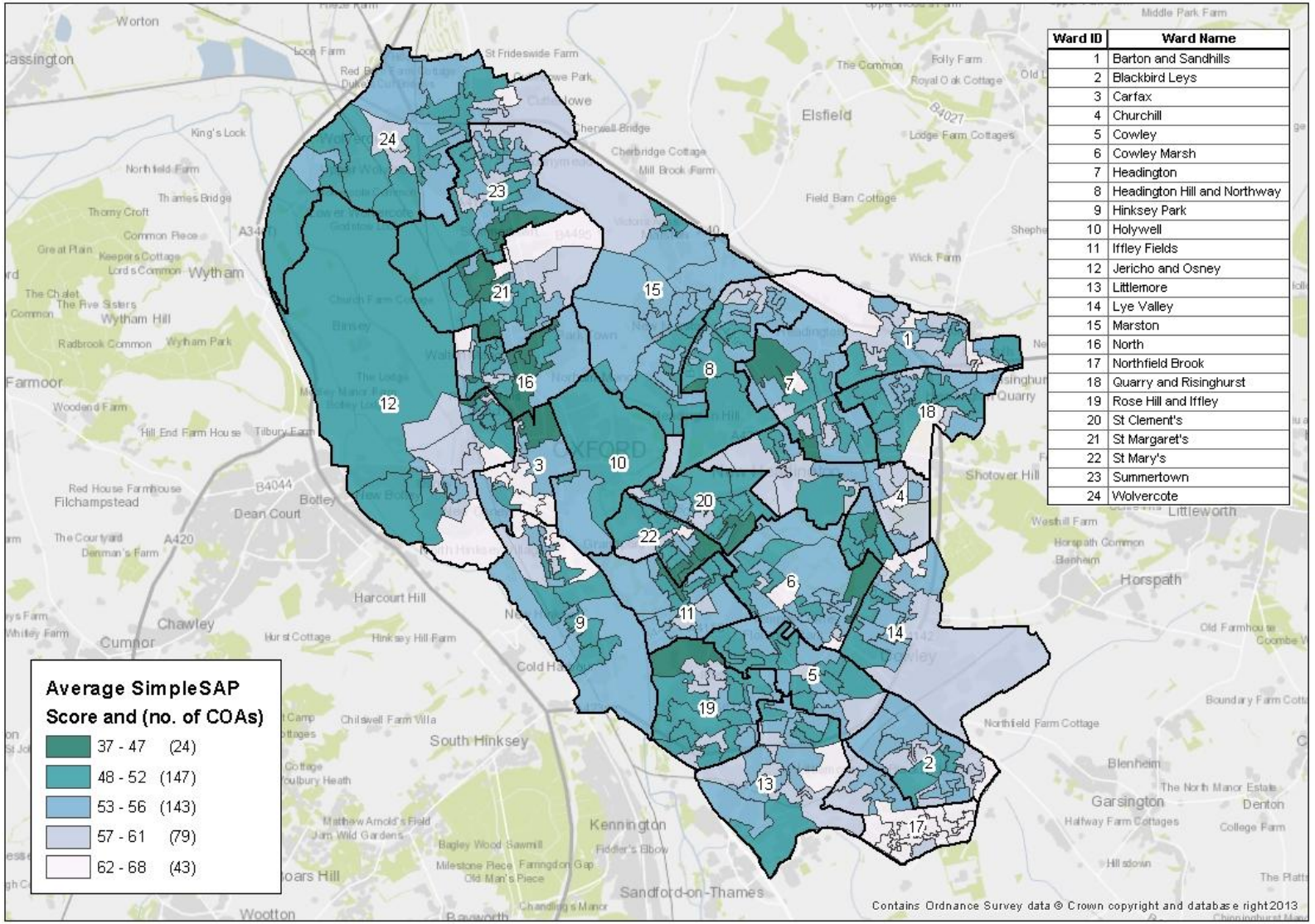
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Map 4: Average 'SimpleSAP' Ratings per dwelling, private sector



Ward ID	Ward Name
1	Barton and Sandhills
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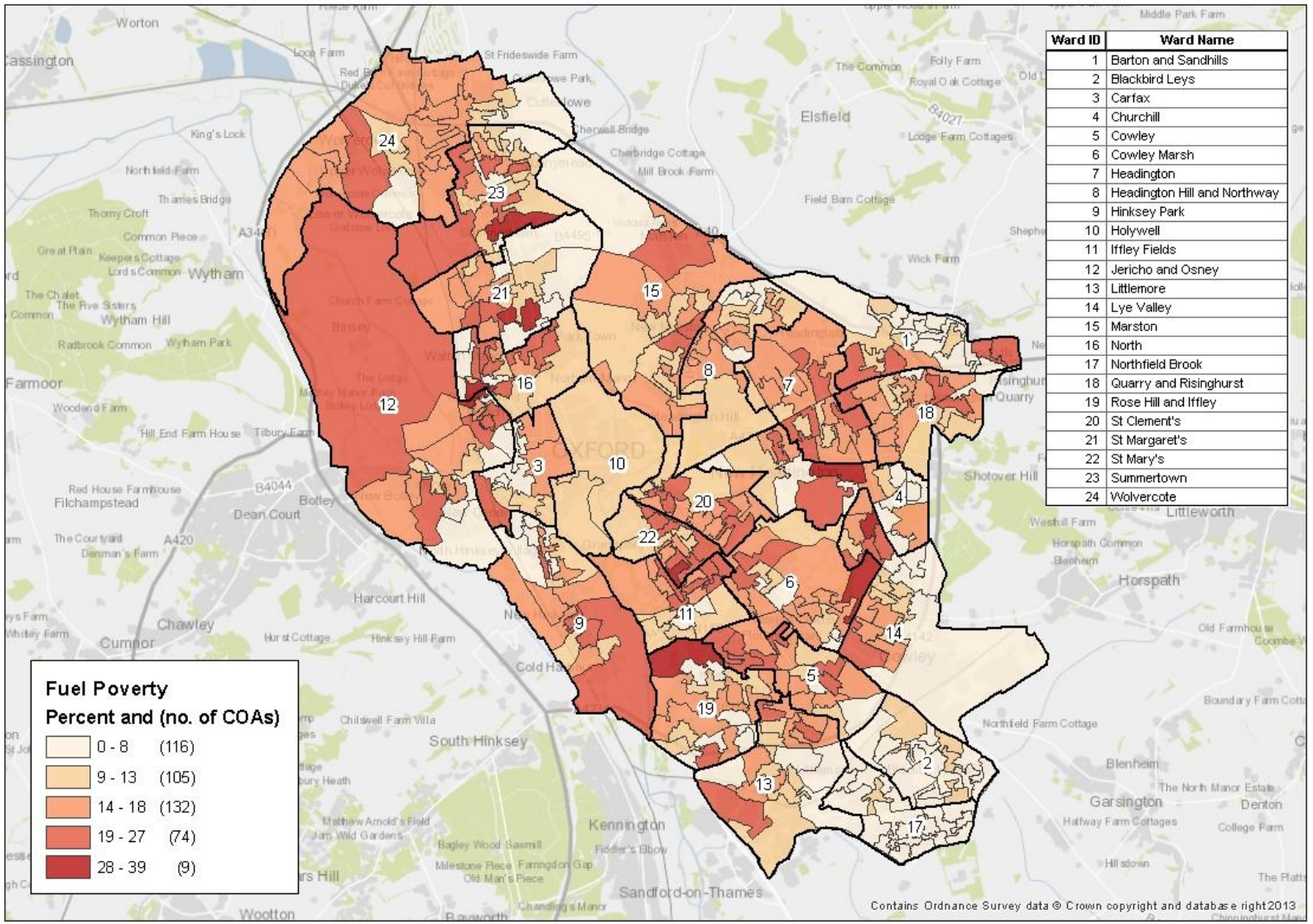
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Map 5: Percentage of private sector dwellings occupied by households in fuel poverty



Ward ID	Ward Name
1	Barton and Sandhills
2	Blackbird Leys
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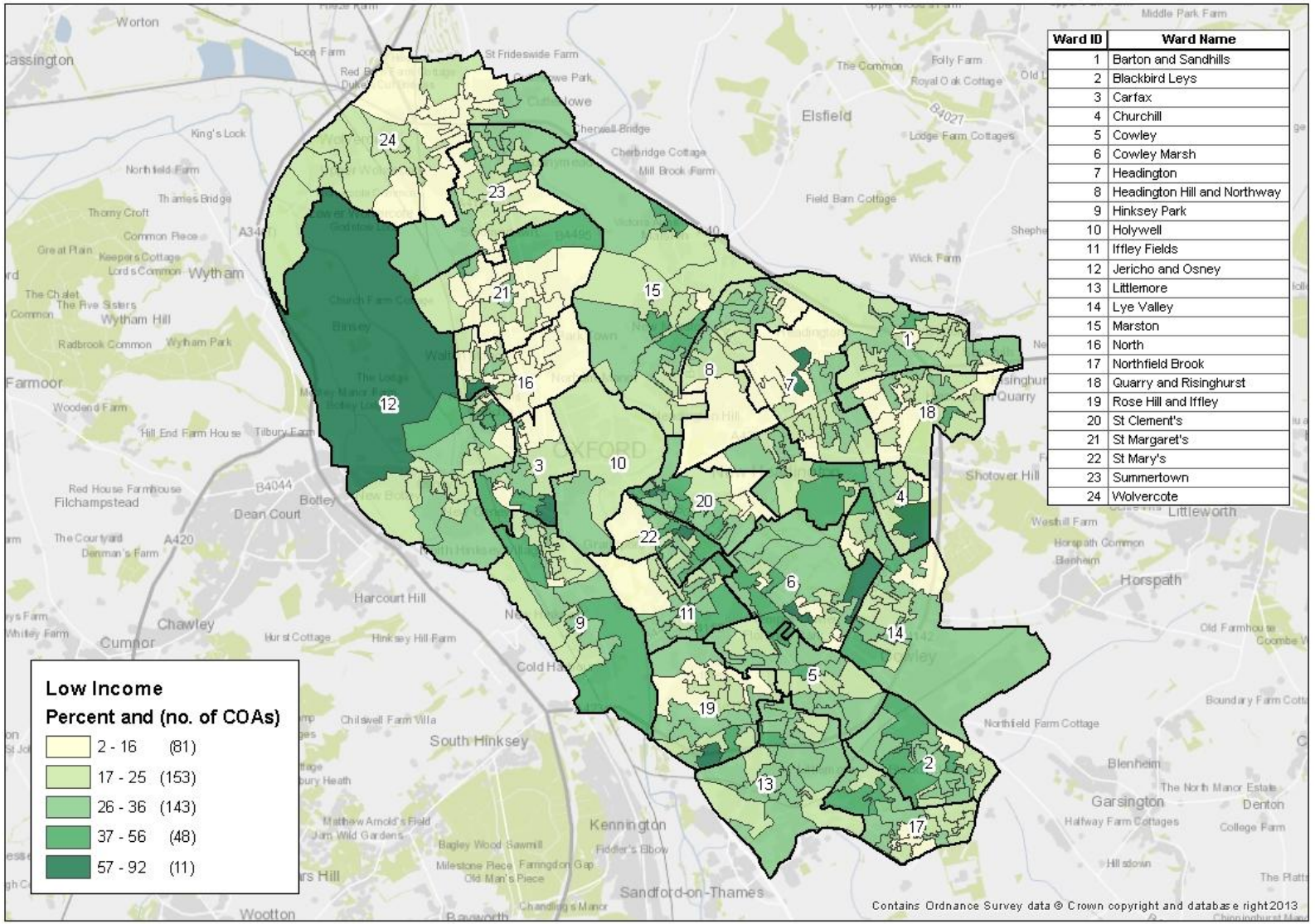
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Map 6: Percentage of private sector dwellings occupied by Low Income Households



Ward ID	Ward Name
1	Barton and Sandhills
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3	Carfax
4	Churchill
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19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Energy Efficiency Variables and Improvement Scenarios

For the SimpleCO_2 model to generate a SimpleSAP score a number of other energy related outputs need to be calculated. These include the annual energy and heat demand of the dwelling. From these outputs it is also possible to generate other useful indicators such as estimates of the total CO_2 emissions and energy costs. These energy related variables can be useful in planning infrastructure projects such as district heating schemes and for more low key projects seeking to lever in ECO funding.

Table 8 demonstrates the average energy efficiency variables per dwelling for the modelled data for the current condition of Oxford's housing stock broken down by tenure for the following indicators:

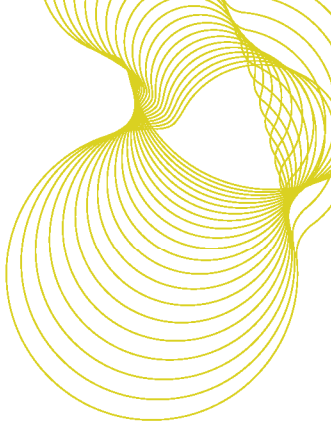
- SimpleSAP
- Notional CO_2 Emissions (SimpleCO_2)
- Notional Energy Demand
- Notional Energy Cost
- Notional Heat Demand
- Notional Cost of Heat

Table 8: Integrated data by tenure for average energy output variables: authority level summary

Tenure	Dwellings	SimpleSAP	SimpleCO_2 (Tonnes / year)	Energy Demand (KWh / year)	Energy Cost (£ / year)	Heat Demand (KWh / year)	Heat Cost (£ / year)
Owner Occupied	27,144	54	6.09	26,952	1,463	13,119	893
Private Rented	25,560	54	5.58	22,958	1,301	10,905	760
Social	10,048	59	4.29	18,098	1,023	8,034	538

As shown earlier in the report the owner occupied and private rented stock have SimpleSAP scores of 54 whilst the social rented stock has a higher score of 59. However, when considering the annual carbon emissions the owner occupied stock has a higher level of emissions than the private rented stock, despite having the same SimpleSAP. This is because SimpleSAP is a standardised measure and therefore does not take the size of the dwelling into account. On average, owner occupied dwellings are larger than private rented dwellings, and therefore produce more carbon.

The social rented dwellings have a superior SimpleSAP score to the other tenures, produce less carbon, require less energy and cost less to run. Social rented properties are often flats, which tend to be more energy efficient as they have fewer surfaces exposed to the outside air, and tend to be smaller than houses, and therefore require less energy to heat.



To estimate the impact of potential energy efficiency improvements; a set of eight different scenarios were modelled which ranged from low cost measures (which included cavity wall, loft and hot water tank insulation) to comprehensive improvements that built upon these basic measures with improved heating, double glazing, solid wall insulation and solar hot water systems. The effect of photovoltaic panel installation was also modelled as the final improvement scenario. The purpose of the improvement scenarios is to allow Oxford City Council to identify an effective program of energy efficiency improvements and to locate the areas of the County which will benefit most. The six improvement measures which have been used are detailed below:

1. **Low Cost Measures (LCM)**

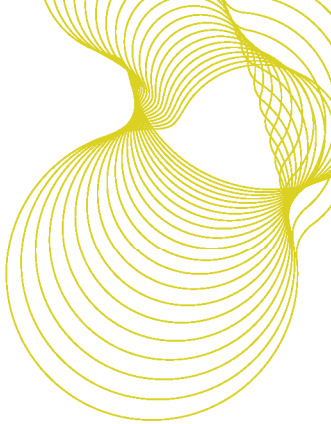
- Cavity wall insulation
    - All properties with uninsulated cavity walls were modelled to have full cavity wall insulation.
- Loft insulation
    - All properties with less than 200mm loft insulation were modelled to have 250mm insulation.
- Hot water tank insulation
    - All properties with an uninsulated hot water tank were modelled to have a hot water tank jacket.

2. **Double Glazing (DG)**
    - All properties with less than 100% double glazing were modelled to have 100% double glazing.
3. **Solid Wall Insulation (SWI)**
    - All properties with stone or solid walls were modelled to have full insulation.
4. **Heating**
    - Properties where improvements could be made to the heating systems were upgraded. This included, switching properties where the main fuel was not gas but on the gas network to mains gas. For properties off the gas network, where applicable these where changed to use off peak electricity or oil (depending on the size of the dwelling). Upgrading boilers and heating controls.
5. **Solar Hot Water (SHW)**
    - All properties were equipped with a solar hot water panel.
6. **Photovoltaic Panels (PV)**
    - All properties were equipped with photovoltaic panels.

From these 6 improvement measures, 8 different improvement scenarios have been constructed. Using the abbreviations given above for the improvement measures and the term ‘Baseline’ to represent the current condition, Table 9 illustrates how these 8 improvement scenarios are applied to the housing stock in Oxford.

Table 9 Improvement Scenarios

Improvement Scenario	Description	Low Cost Measures			Optimised Heating System	Double Glazing	Insulated Solid Walls	Installed Solar Hot Water Panel	Installed Photovoltaic array
		Insulated Cavity Wall	Fully Insulated Loft	Insulated Hot Water Tank					
0	Baseline								
1	LCM	✓	✓	✓					
2	LCM+Heating	✓	✓	✓	✓				
3	LCM+Heating+DG	✓	✓	✓	✓	✓			
4	LCM+Heating+DG+SWI	✓	✓	✓	✓	✓	✓		
5	LCM+Heating+DG+SWI+SHW	✓	✓	✓	✓	✓	✓	✓	
6	LCM+DG	✓	✓	✓		✓			
7	LCM+DG+SWI	✓	✓	✓		✓	✓		
8	PV								✓



Summary of results – Improvement Scenarios

As the focus of this report is the private sector stock the results in the report have been provided for the private sector stock only (Table 10.

It should be noted that the baseline model assumes zero installation of photovoltaic panels which is almost certainly an underestimate of the actual housing situation. Similarly the model does not consider the practicalities of applying measures such as solid wall insulation or new central heating systems.

Table 10: Energy output variables for modelled data following improvement scenarios: private stock

Improvement Scenario	Description	SimpleSAP	SimpleCO_2 (Tonnes / year)	Energy Demand (KWh / year)	Energy Cost (£ / year)	Heat Demand (KWh / year)	Heat Cost (£ / year)
0	Baseline	54	5.84	25,015	1,384	12,045	828
1	LCM	60	4.97	21,018	1,197	9,317	642
2	LCM+Heating	65	4.26	17,702	1,024	9,225	530
3	LCM+Heating+DG	66	4.17	17,306	1,006	8,906	512
4	LCM+Heating+DG+SWI	69	3.74	15,363	916	7,345	422
5	LCM+Heating+DG+SWI+SHW	70	3.64	14,936	894	7,345	422
6	LCM+DG	60	4.87	20,555	1,175	8,998	620
7	LCM+DG+SWI	64	4.38	18,285	1,068	7,449	513
8	PV	60	5.31	24,015	1,253	12,045	828

The improvement scenario which demonstrated the greatest benefit to Oxford's private housing stock, when compared to the baseline level, was improvement scenario 5 which indicated the following:

- 49% reduction in the average annual heating costs per dwelling (£422 compared with £828).
- 40% reduction in the average annual energy demand per dwelling (14,936 KWh compared with 25,015 KWh).
- 38% reduction in annual SimpleCO_2 emissions per dwelling (3.6 tonnes compared with 5.8 tonnes).
- 16 point increase in the average SimpleSAP score per dwelling (70 compared with 54).

This result is unsurprising given that it involves the most comprehensive improvement strategy: LCM + Heating + DG + SWI + SHW. It is, however, also worth considering improvement scenario 4 which, despite lacking solar hot water panels, the results are very close to improvement scenario 5.

The standout figures for scenario 4 are:

- 39% reduction in the average annual heating costs per dwelling (identical to improvement scenario 5).
- 39% reduction in the average annual energy demand per dwelling (compared with 40% for improvement scenario 5).

- 36% reduction in average annual SimpleCO_2 emissions per dwelling (compared with 38% for improvement scenario 5).
- A 15 point increase in the average SimpleSAP score per dwelling (identical to the gain in SimpleSAP from scenario 5).

This would suggest that the installation of solar hot water panels would have minimal impact on the performance of Oxford's housing stock. Table 11 has been constructed from the modelled data, using simple mathematical operations, to provide an estimate for the impact of each improvement method in isolation. For example, LCM is compared to the baseline situation whereas heating is compared to the LCM to isolate the heating component from improvement scenario 3. The improvements have also been ranked in terms of the average percentage improvement, of all six energy output variables, relative to the baseline.

Table 11: Average change in energy output variables following individual improvements: private stock

Individual Improvements	Average change per property					
	SimpleSAP	SimpleCO2 (Tonnes / year)	Energy Demand (KWh / year)	Energy Cost (£ / year)	Heat Demand (KWh / year)	Heat Cost (£ / year)
(Baseline)	54	5.84	25,015	1,384	12,045	828
LCM	6	-0.87	-3,997	-187	-2,728	-187
Heating	6	-0.72	-3,316	-173	-92	-111
SWI	3	-0.46	-2,107	-98	-1,555	-98
PV	6	-0.53	-1,000	-132	0	0
DG	1	-0.09	-429	-20	-319	-20
SHW	1	-0.11	-428	-22	0	0

Table 13 reveals that the most beneficial individual improvement to Oxford's private housing stock would be the Low Cost Measures. The standout figures for this improvement are:

- 23% reduction in average annual heating cost per dwelling (-£187).
- 16% reduction in average annual energy consumption per dwelling (-3,997KWh).
- 15% reduction in average annual SimpleCO_2 emissions per dwelling (-0.87 tonnes).
- A 6 point increase in average SimpleSAP score per dwelling.

One of the major advantages of having improvement scenario data available is the potential it provides for estimating the impact of targeted campaigns or programs. By combining scenarios seeking to maximise energy cost savings with data on low income private sector dwellings, the impact of the Home Heating Cost Reduction Obligation (a key element of ECO) can be simulated. This could be used to identify locations of potential target dwellings and their value in terms of cost savings to a Green Deal provider. The availability of such data should make Oxford an attractive partner to those charged with seeking out those eligible for such schemes. The following section describes how some of the variables provided by BRE can be combined to explore such possibilities.

Energy Efficiency Improvement Scenarios, The Green Deal and ECO

The Green Deal is a finance framework which provides the upfront capital to make energy efficiency improvements to dwellings from autumn 2012. The framework is designed so that householders make the repayments through their energy bill by attaching a Green Deal charge to the electricity meter. The "Golden Rule" of the Green Deal is that the expected savings from the energy efficiency measures must be greater than the charge attached to the meter.

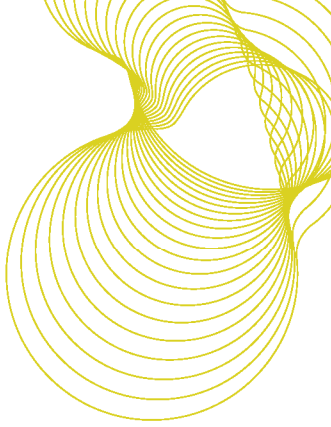
The role of a Green Deal provider is to provide the finance and to organise the improvement works – either themselves or through sub-contractors. The provider can be a commercial company, social enterprise or a local authority and they may act alone or in partnership.

In cases where additional financial support is required for householders, the Energy Companies Obligation (ECO)[12] has been designed to sit alongside the Green Deal. The ECO requires energy companies to assist in the installation of energy efficiency measures in Great Britain to low income and vulnerable households or those living in hard-to-treat[13] properties. Under the ECO, energy companies are obliged to meet targets expressed as lifetime carbon or costs saved (from 1 January 2013 - 31 March 2015 and recently extended to March 2017[14]):). The 3 different ECO obligations and their associated overall savings targets are as follows:

- Carbon Emissions Reduction Obligation (CERO) – covering measures which can't be financed solely through the Green Deal, e.g. solid wall insulation, hard-to-treat cavities (20.9 $MtCO_2$ savings – recent Government proposal is to reduce this by 33% to 2015 and then set a target for the period to 2017[15])
- Carbon Saving Community Obligation (CSCO) – insulation measures to low income households and ensures 15% of the obligation is used in rural areas (6.8 $MtCO_2$ savings)
- Home Heating Cost Reduction Obligation (HHCRO) or Affordable Warmth – insulation and heating measures to vulnerable low-income groups living in private tenure dwellings (£4.2 billion savings)

The estimated annual spend on the measures required to achieve these targets is £1.3 billion. It should be noted that recent government proposals for changes to the Green Deal and to ECO have been put forward for consultation in 2014 which may change some of the above targets, dates and allowable measures.

[12] The Electricity and Gas (Energy Companies Obligation) Order 2012, Statutory Instrument No. 3018, 4 December 2012 (http://www.legislation.gov.uk/uksi/2012/3018/part/4/made)
[13] Where standard cost effective energy efficient fabric measures are not possible (e.g. dwellings with solid walls).
[14] Although energy companies have been able to count measures delivered since October 2012 against their targets.
[15] https://www.gov.uk/government/news/govt-action-to-help-hardworking-people-with-energy-bills



The latest statistical data[16] gives provisional estimates that there have been 115,723 measures installed under ECO up to the end of May 2013. The majority of measures were loft insulation, cavity wall insulation and boiler upgrades.

In their November ECO Compliance Update[17] Ofgem advised that there are issues with c.44,000[18] of these cases, there are a further 78,000 awaiting approval and 122,960 measures they had approved up to August. Based on this analysis, Ofgem report progress towards the individual targets as follows:

- CERO 3.0%
- CSCO 16.3%
- HHCRO 24.7%

Ofgem's comment on this performance is telling - 'the run rate will need to increase in order for suppliers to meet their obligations'.

The Green Deal and ECO present opportunities for the Council to improve the energy efficiency of their private sector housing stock. To maximise the benefits it is important for the Council to gain an understanding of where these opportunities lie across their borough. Such insight will also provide the Council with a strong evidence base, enabling them to liaise with Green Deal and ECO financing bodies.

Furthermore, the information provided in this report can be used to contribute to the evidence base required for competitive funding bids to central Government – e.g. the DECC Green Deal Communities Local Authority Fund[19], which has recently been increased from £20 million to £80 million[20]. The information can also be used to support reporting requirements of the Home Energy Conservation Act (HECA) on how the council will engage with Green Deal and ECO.

An understanding of the condition of the ECO criteria is pivotal to building a strategy for levering in finance to improve the energy efficiency of the stock. Of particular interest are properties with hard-to-treat (HTT) cavities and their role in the Carbon Emissions Reduction Obligation. This obligation has by far the greatest savings target attached to it and HTT cavities are the principal focus of Energy Company interest due to their relatively low cost to install improvements compared to solid wall insulation which is the other key criterion for CERO eligibility.

Under the ECO Order 2012[12], hard-to-treat cavities are defined as being:

(a) a cavity wall -

i. in a building with 3 or more stories where each storey has cavity walls,

[16] Domestic Green Deal and Energy Company Obligation in Great Britain, Monthly report, Statistical Release: Experimental Statistics, DECC, 18 July 2013 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224020/stat_release_green_deal_eco_june_2013.pdf)

[17] ECO Compliance Update Issue 15 November 2013 (https://www.ofgem.gov.uk/ofgem-publications/84448/ecocomplianceupdate15november2013v1.pdf)

[18] Note that this refers to the DECC October report.

[19] Green Deal Communities – Local Authority Fund: Application Pack, DECC, 25 July 2013

[20] https://www.gov.uk/government/news/govt-action-to-help-hardworking-people-with-energy-bills

ii. which a chartered surveyor has reported is not suitable to insulate with standard insulation material or techniques; or

iii. which a chartered surveyor has reported is not suitable to insulate without substantial remedial works to the building;

(b) a cavity within a cavity wall which is less than 50mm wide

(c) a cavity found in homes of prefabricated concrete construction or with metal frame cavity walls; or

(d) an uneven cavity formed in walls constructed of natural stone or from natural stone outer leaf and block or brick inner leaf

Oxford may wish to consider the BRE hard to treat model if they plan to pursue such a strategy.

Additional requirements

The current English Local Authority Statistics on Housing (ELASH) report required by CLG includes information regarding the private sector stock. A number of these outputs are already provided in earlier summary tables. Additional information required includes EPC ratings and cost of mitigating Category 1 hazards.

The average SimpleSAP rating for the private sector stock in Oxford is 54 which corresponds with an estimated EPC rating of E. (though a value of 55 would correspond to D, 54 is the very top end of band E) The number of private sector dwellings with an EPC rating below E is estimated to be 6,429 (12%). The breakdown of SimpleSAP into the 7 EPC bandings is provided in Table 12.

Table 12: Energy Efficiency Rating (based on SimpleSAP), private sector stock

	Count	Percent
(92-100) A	0	0%
(81-91) B	248	0%
(69-80) C	7,376	14%
(55-68) D	19,100	36%
(39-54) E	19,551	37%
(21-38) F	5,415	10%
(1-20) G	1,014	2%

The estimated cost of mitigating Category 1 hazards in Oxford is provided in Table 13. These costs are based on the average cost of mitigating Category 1 hazards for the North East using 2009 EHS data.

Table 13: Cost of mitigating Category 1 Hazards, private sector stock

	Average Cost	Total Number in the Authority	Total Cost (£000)
HHSRS Category 1 Hazards	£2,740	40,149	£110,008,260

There are several caveats about the use of these costs since the method used is based on standardised cost assumptions intended for comparison purposes. It might be preferable to use local data on costs, such as information on grant or loan aided works, however these are not without their own issues (as they are rarely an unbiased sample of the affected stock). In the absence of these, however, the above sums provide useful starting points.

The Energy Act 2011

Under the Energy Act 2011 new rules will be brought into force so that from 2016 onwards landlords will not be able to refuse a tenants reasonable request for consent to install Green Deal measures. Furthermore, from 2018 Landlords must ensure that their properties meet a minimum energy efficiency standard, likely to be set at EPC rating Band E (unless they have already installed the full range of measures possible under the Green Deal).

The number of private rented dwellings in Oxford with a rating below E is estimated to be 3,560 (14%) using SimpleSAP as a means of estimating EPC bands.

Table 14 below shows the breakdown of SimpleSAP into the 7 EPC ratings bands for private rented stock only.

Table 14: Energy Efficiency Rating (based on SimpleSAP), private rented stock

	Count	Percent
(92-100) A	0	0%
(81-91) B	182	1%
(69-80) C	4,117	16%
(55-68) D	8,738	34%
(39-54) E	8,963	35%
(21-38) F	2,952	12%
(1-20) G	608	2%

Applying the dwelling level housing stock model information

The analysis provided on the dwelling level housing stock models in this report is displayed as local authority and ward level tables or COA level maps. All of these figures have been calculated by aggregating dwelling level information from the database which has been provided. While these results are valuable outputs, the main strength of this project is the dwelling level database which can be used by Council officers to manipulate, amalgamate and extract information from the database to aid Oxford City Council's Housing Services projects and reporting.

To give one example, if looking to target energy improvement measures; one of the indicators which may be useful is the presence of Excess Cold Category 1 Hazards. Map 7 below is a copy of a COA map provided earlier in the report on the presence of Excess Cold Category 1 Hazards at COA level. This map shows that the presence of Excess Cold Category 1 Hazards is spread throughout the local authority although there are concentrations within the authority. For targeting purposes the local authority may want to focus on dwellings occupied by Low Income Households as these households are more likely to be eligible for assistance to improve their homes (Map 8).

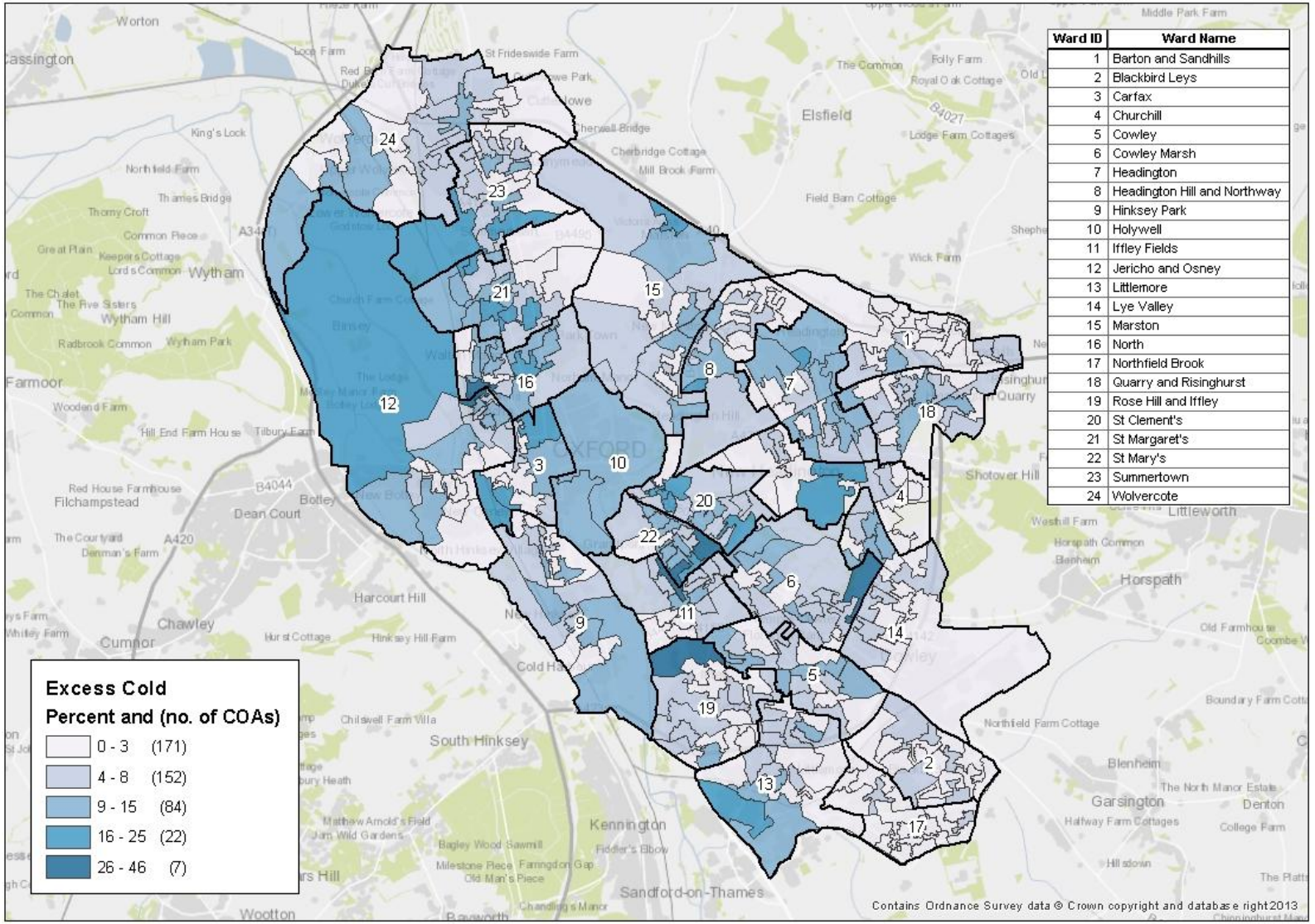
Within the database it is possible to create a variable which combines Excess Cold Category 1 Hazards and dwellings occupied by Low Income Households which can then be mapped in the same way at COA (Map 9). This map provides a potentially more useful representation of areas within the local authority on which officers may wish to target energy saving measures, as it picks out areas of Excess Cold that are on low incomes, whilst ignoring more affluent areas.

This is an example of where the data within the database can be manipulated to provide a useful variable which can be used by the authority, by combining two variables to target resources. We have shown that, by displaying the aggregated information at COA level, maps can quickly and effectively give an idea of where higher levels of the targeted demographic can be found.

The dwelling level information can then be used to extract a list of addresses which the models have estimated as being in that targeted demographic, for example, dwellings most likely to have Excess Cold Category 1 Hazards and be occupied by Low Income Households. Figure 1 is a screenshot of the database providing this information for the first seven addresses (with building names and street numbers obscured).

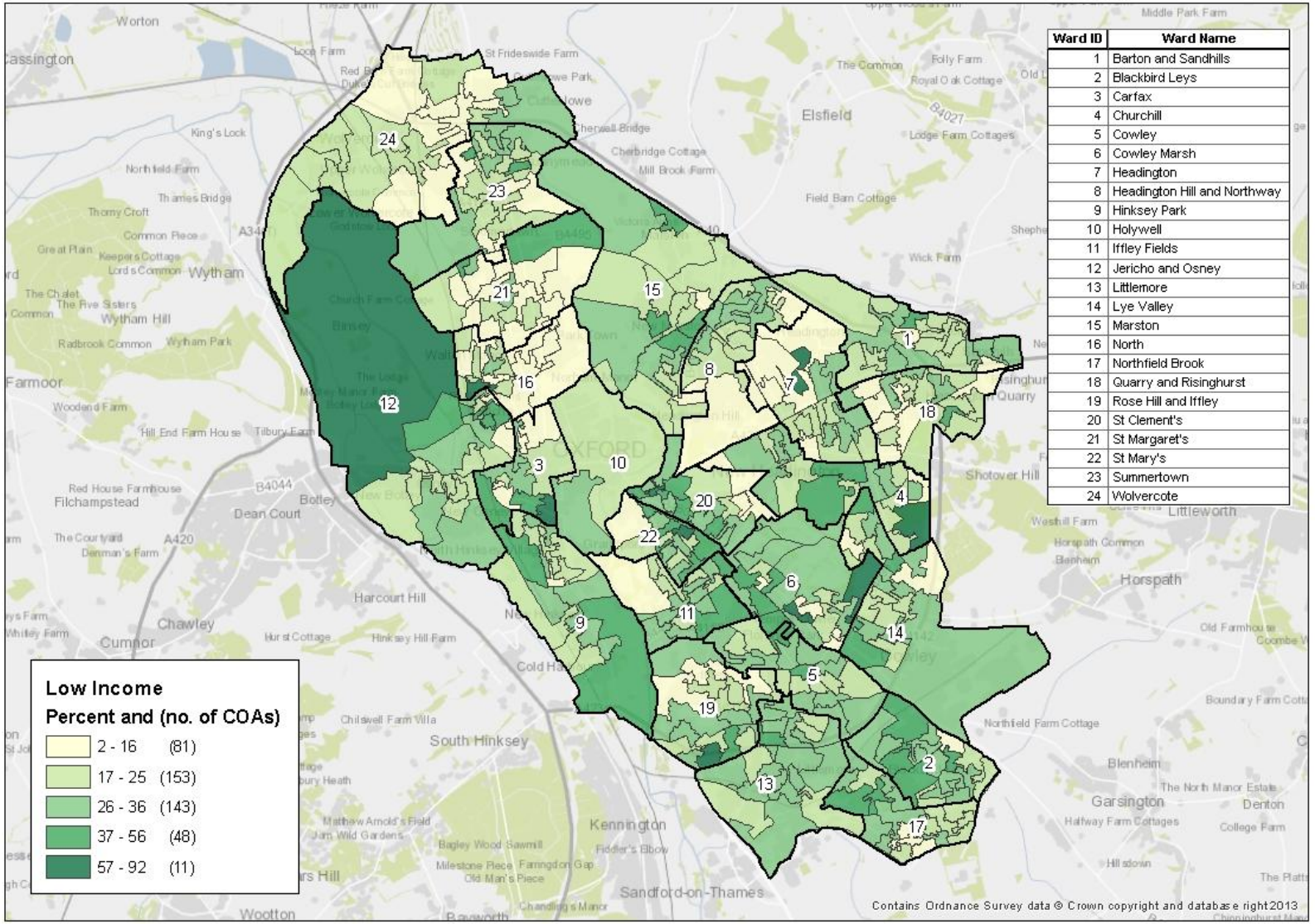
A user guide for the database, including this example, is provided in Appendix C.

Map 7: Percentage of private sector dwellings with the presence of a HHSRS Category 1 Hazard for Excess Cold



Ward ID	Ward Name
1	Barton and Sandhills
2	Blackbird Leys
3	Carfax
4	Churchill
5	Cowley
6	Cowley Marsh
7	Headington
8	Headington Hill and Northway
9	Hinksey Park
10	Holywell
11	Iffley Fields
12	Jericho and Osney
13	Littlemore
14	Lye Valley
15	Marston
16	North
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Map 8: Percentage of private sector dwellings occupied by Low Income Households



Ward ID	Ward Name
1	Barton and Sandhills
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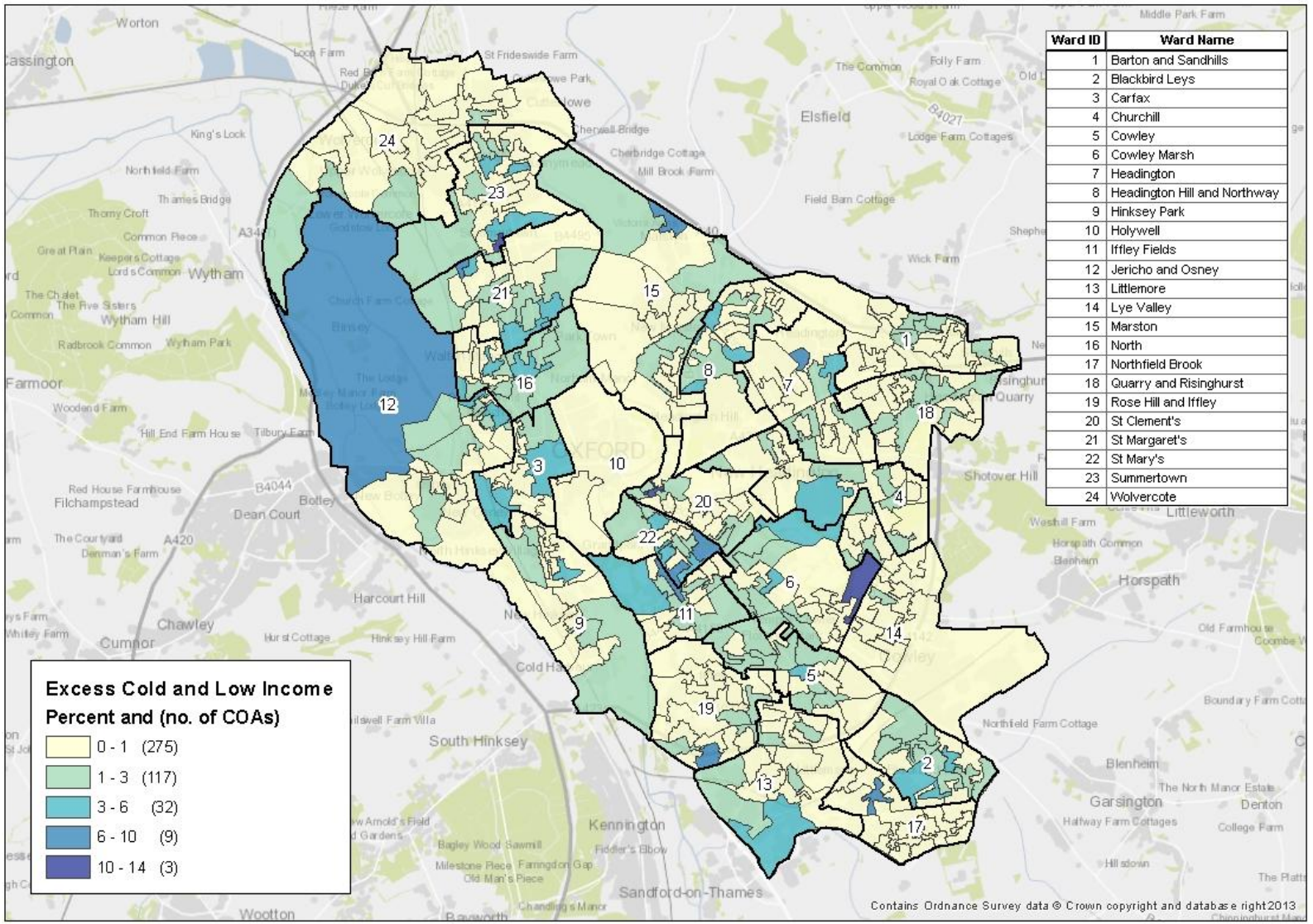
10	Holywell
11	Iffley Fields
12	Jericho and Osney
13	Littlemore
14	Lye Valley
15	Marston
16	North
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Map 9: Percentage of private sector dwellings with the presence of a HHSRS Category 1 Hazard for Excess Cold and occupied by Low Income Households



Ward ID	Ward Name
1	Barton and Sandhills
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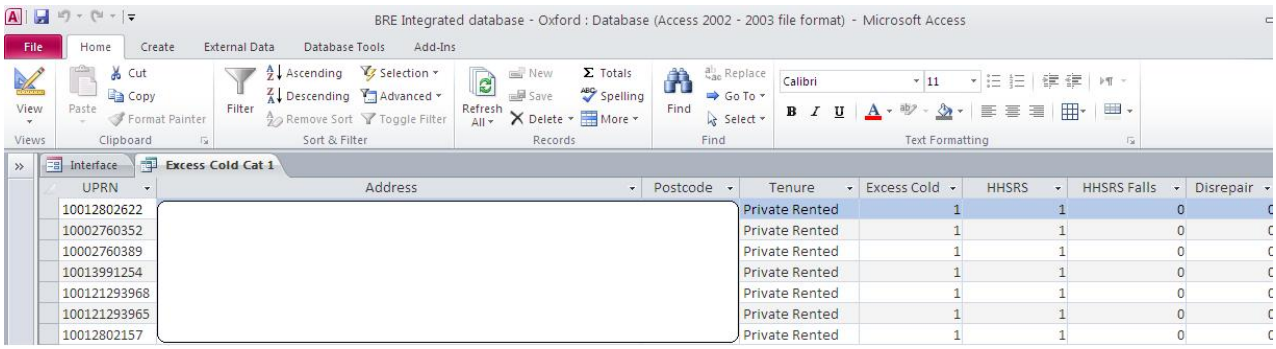
3	Carfax
4	Churchill
5	Cowley
6	Cowley Marsh
7	Headington
8	Headington Hill and Northway
9	Hinksey Park
10	Holywell
11	Iffley Fields
12	Jericho and Osney
13	Littlemore
14	Lye Valley
15	Marston
16	North
17	Northfield Brook
18	Quarry and Risinghurst
19	Rose Hill and Iffley
20	St Clement's
21	St Margaret's
22	St Mary's
23	Summertown
24	Wolvercote

Figure 1: Extract from database of addresses estimated to be most likely to have Excess Cold Category 1 Hazards and be occupied by Low Income Households



UPRN	Address	Postcode	Tenure	Excess Cold	HHSRS	HHSRS Falls	Disrepair
10012802622			Private Rented	1	1	0	0
10002760352			Private Rented	1	1	0	0
10002760389			Private Rented	1	1	0	0
10013991254			Private Rented	1	1	0	0
100121293968			Private Rented	1	1	0	0
100121293965			Private Rented	1	1	0	0
10012802157			Private Rented	1	1	0	0

Basic Green Deal Variables

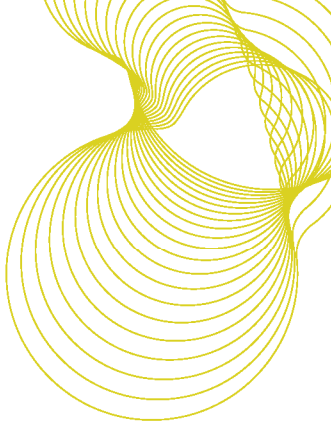
The Green Deal and ECO both focus on improving SAP scores and reducing carbon emissions of the stock. Being able to identify areas where energy improvements can be made will be useful for targeting areas which may benefit from Green Deal and ECO funding. The availability of small area datasets for targeting can reduce time and resources used for authority wide surveys or marketing which may otherwise be required to identify such areas.

The SimpleCO_2 model, as described earlier in the report, was originally devised for modelling carbon emissions. The model inputs include dwelling type, age and tenure as well as a number of energy efficiency variables including fuel type, boiler type, cavity wall insulation and levels of loft insulation. Two relatively simple improvements which can be made to a dwelling to improve the energy performance are cavity wall insulation and installing or increasing the level of loft insulation.

Table 9 provides the BRE Basic Green Deal Variables estimated percentage and stock totals at authority level for the following indicators:

- Wall Type and presence of cavity wall insulation
    - Solid Wall
    - Insulated Cavity Wall
    - Uninsulated Cavity Wall

- Presence and level of loft insulation
    - No Loft
    - Loft with no insulation
    - 50mm loft insulation
    - 100mm loft insulation
    - 150mm loft insulation
    - 200mm loft insulation
    - 250mm + loft insulation



Summary of results: private sector stock

Table 15(i-ii) summarises the Basic Green Deal variables at the authority level

Table 15(i): Modelled data for wall type, private sector stock: authority level summary

Ward	Dwellings	Wall Type		
		Solid Wall	Insulated Cavity Wall	Uninsulated Cavity Wall
Oxford	52,704	15,149 (29%)	17,978 (34%)	19,577 (37%)
2009 EHS (private stock)		(33%)	(32%)	(35%)

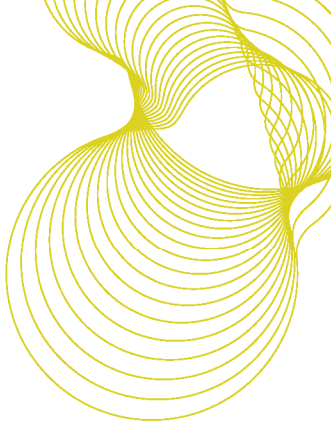
Table 15(ii): Modelled data for loft insulation level, private sector stock: authority level summary

Ward	Levels of Loft Insulation						
	No Loft	Loft but no Insulation	50mm	100mm	150mm	200mm	250mm plus
Oxford	6,641 (13%)	5,084 (10%)	10,533 (20%)	18,119 (34%)	5,213 (10%)	3,829 (7%)	3,285 (6%)
2009 EHS (private stock)	(8%)	(3%)	(11%)	(37%)	(17%)	(13%)	(11%)

The modelled results for Oxford City Council suggest that a sizeable proportion of the private sector stock could benefit from energy efficiency improvements with an estimated 19,577 dwellings having uninsulated cavity walls. The model also estimates that while the majority of the housing stock in Oxford has some level of loft insulation, there are still 5,084 dwellings (10%) with uninsulated lofts, and a further 6,641 (13%) having no loft to insulate. There are also some 10,533 dwellings (20% of the private rented stock) with only 50mm of loft insulation, which could benefit from topping up. These types of dwellings are likely to be of particular interest to Green Deal providers. The maps below also provide an illustration of the distribution of dwellings with uninsulated cavity walls, solid walls and dwellings with loft insulation less than 100mm at a local level.

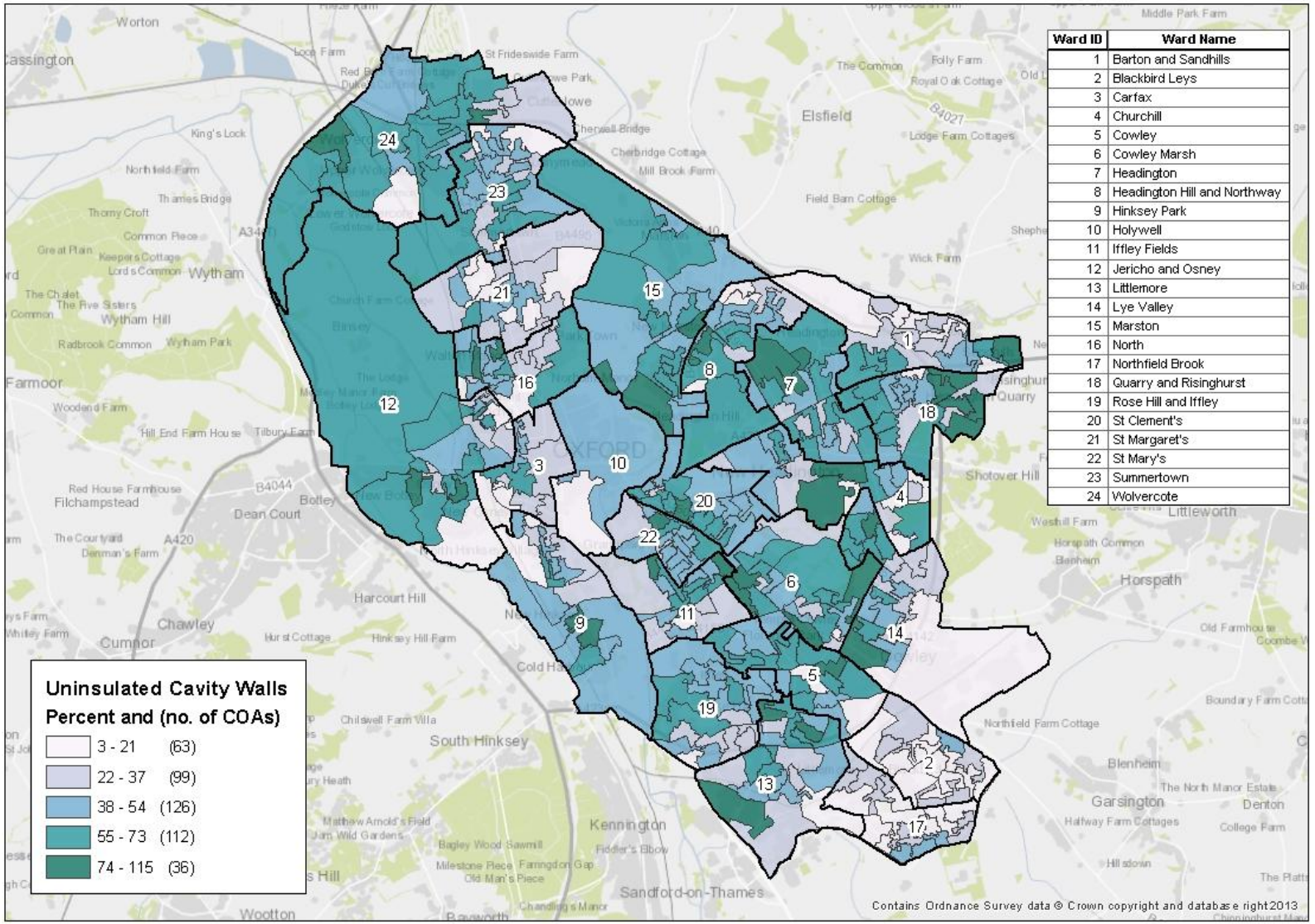
In 2011 data was published on the number of dwellings which benefited from having cavity wall insulation and/or loft insulation installed under the Carbon Emissions Reduction Target (CERT) scheme[21]. Over the four years of the CERT scheme over 1.6 million dwellings had cavity wall insulation installed while over 2.2 million had loft insulation installed. This equates to 7% and 10% respectively, of all dwellings nationally. The CERT data, at a local level, reports that 7% of dwellings in Oxford County Council had cavity wall insulation installed and 3% had loft insulation installed under the four year scheme. It is surprising that the incidence of work for loft insulation is only 3% compared to a national average of 10% when Oxford appears to have such high levels of uninsulated or under-insulated lofts.

[21] http://www.energysavingtrust.org.uk/scotland/Publications2/Housing-professionals/HEED-PDFs/HEED-publications-for-UK/CERT-summary-report-Q12-by-Local-Authority

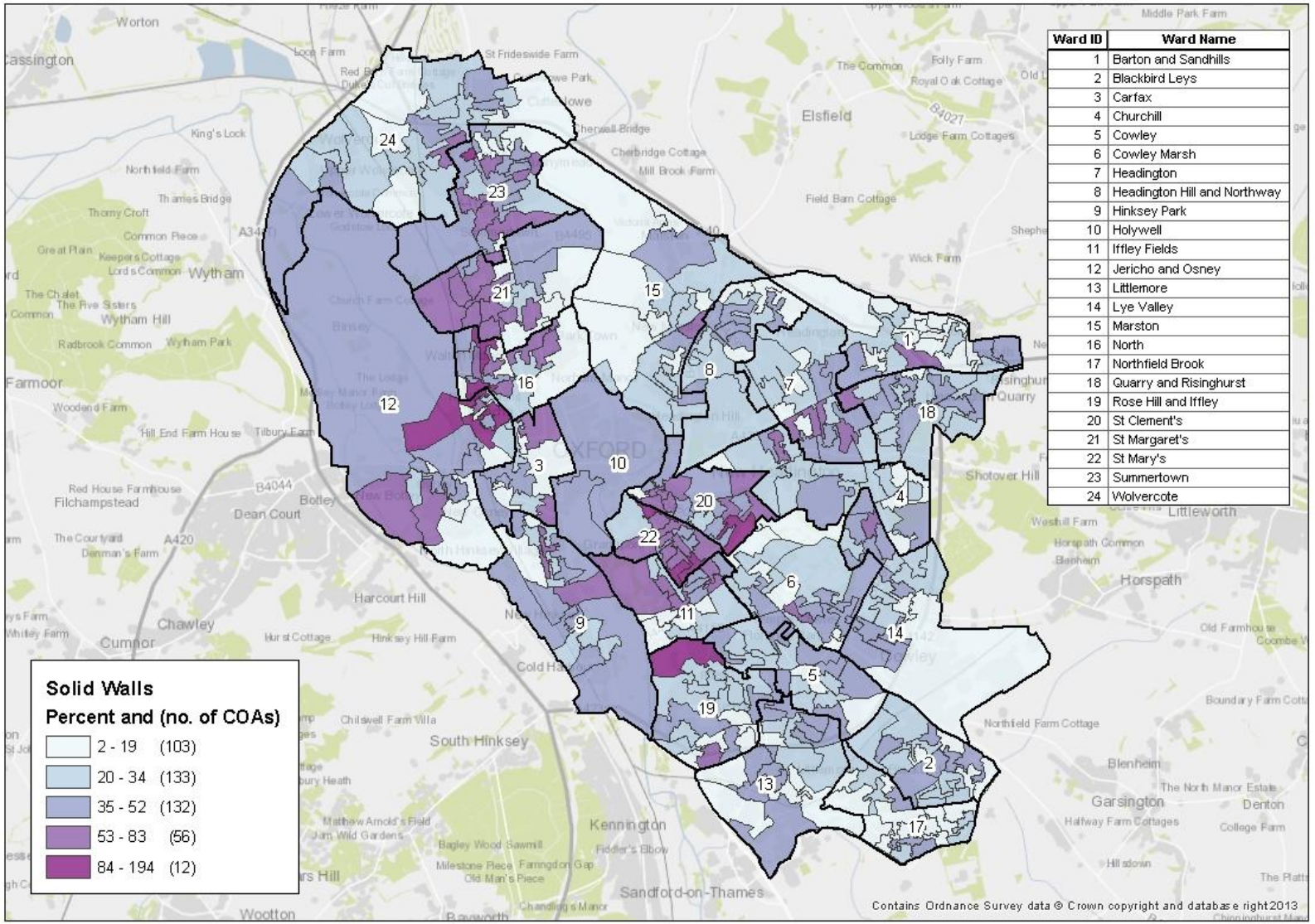


In Oxford City Council, it is estimated that 71% of the housing stock have cavity walls (compared to 63% nationally) and that just under half of these cavities have been insulated. This demonstrates another opportunity to improve the energy performance of the stock in Oxford , with 17,978 properties that could benefit from cavity wall insulation, and are likely to be of interest to Green Deal providers.

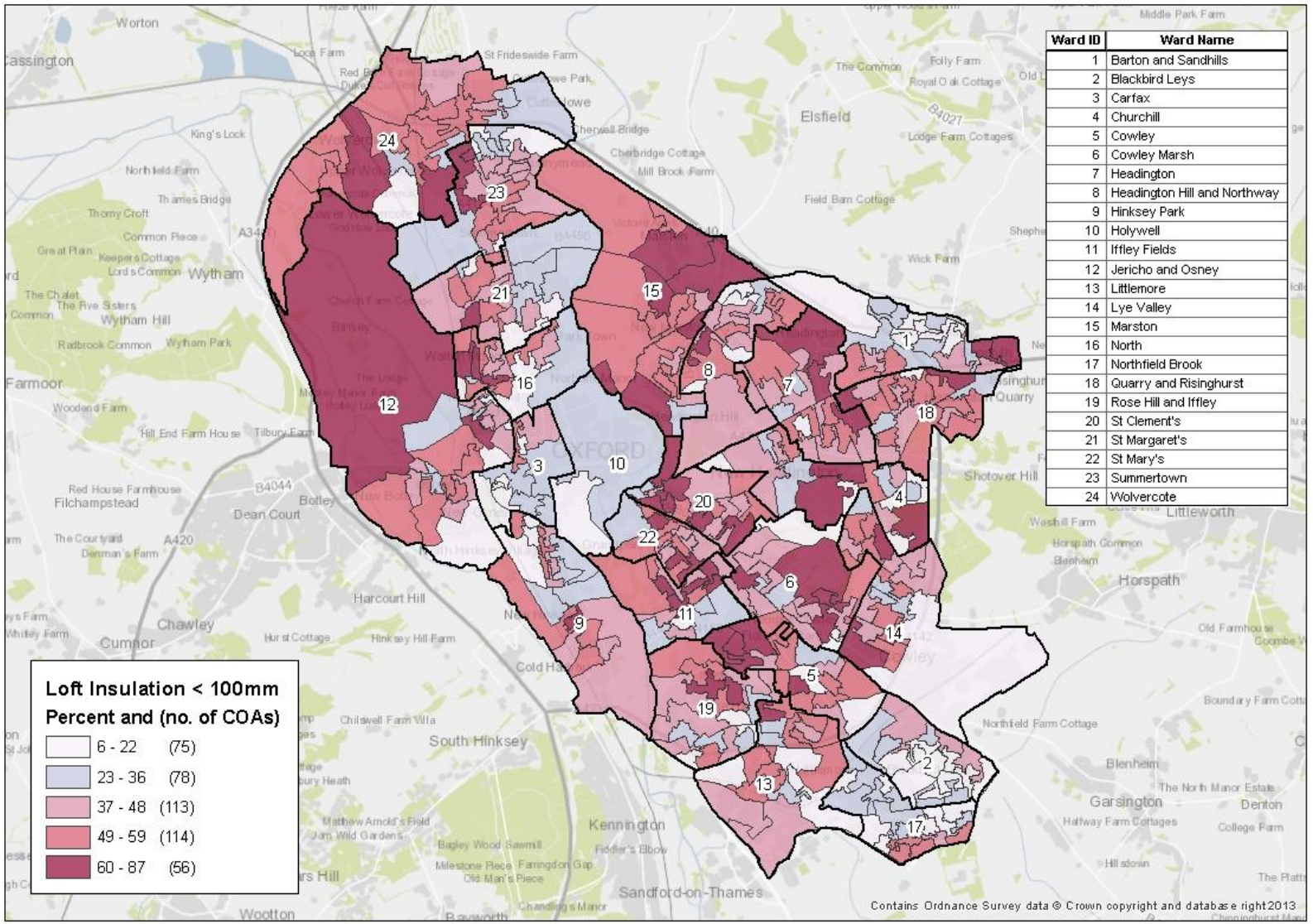
Map 10: Percentage of private sector dwellings with uninsulated cavity walls



Map 11: Percentage of private sector dwellings with solid walls



Map 12: Percentage of private sector dwellings with no or less than 100mm of loft insulation



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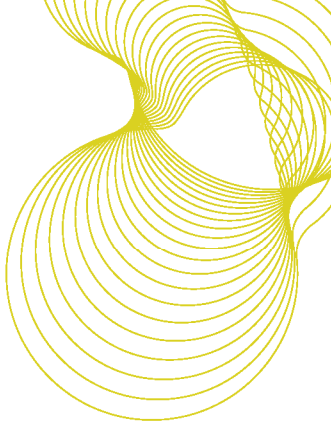


Appendix A – Dwelling level housing stock modelling methodology

The 'SimpleCO$_2$' Model

BRE are the original developers of the Building Research Establishment Domestic Energy Model. The model calculates from measures of building characteristics the energy costs of a dwelling assuming a standard heating and living regime. The model has a number of outputs including an estimate of the SAP rating and carbon emissions.

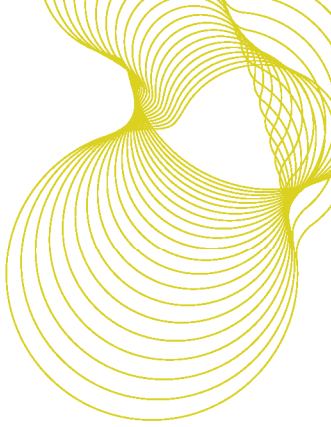
BRE have developed a variant of the BREDEM software ('SimpleCO$_2$') that can calculate outputs that are indicative of the full BREDEM outputs described above from a reduced set of input variables. The minimum set of variables the software can accept is information on:

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

BRE are using the Experian UK Consumer Dynamics Database as a source of these variables. BRE take the above variables from this database and convert them into a suitable format for the 'SimpleCO$_2$' software.

The above variables are insufficient on their own for the software to calculate a 'SimpleSAP' rating or carbon emissions estimate. Additional variables are required and as these values cannot be precisely inferred then a technique known as hot deck imputation is undertaken. This is a process of assigning values in accordance with their known proportions in the stock. One area where this technique is used is for predicting heating fuels as the Experian data can only tell us whether a dwelling is on the gas network or not. We do not know what fuel might be used by dwellings not on the gas network, so in most cases this information will be assigned using probabilistic methods to dwellings known to be off the gas grid. 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). While 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.



While 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. Mindful of this all variables where hot deck imputation has been applied by BRE are identified.

It is important to note that some variables have been entirely assigned using hot 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 'SimpleCO$_2$' 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 in a later section.

The estimates of 'SimpleSAP' etc. cannot be guaranteed due to their being calculated from modelled data which may itself be inaccurate. 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
- in its depth of coverage for example by providing more detailed information on age of dwellings or
- in its breadth by providing additional input variables such as insulation.

Improving any of these would enhance the accuracy of the output variables. For this reason it is always worth considering utilising additional information sources where they are available.

The approach described above can provide estimates for the variables we are offering to supply where they:

1. are produced by the 'SimpleCO$_2$' software i.e. 'SimpleSAP'
2. can be derived from the outputs i.e. Excess Cold (using the SAP <31.5 surrogate) or
3. can be derived from the imputed input variables e.g. HHSRS Category 1 Hazard from Excess Cold.

The other variables we are offering to supply estimates of, however, are not based solely (or in most cases not at all) on the thermal characteristics of the dwelling and these include:

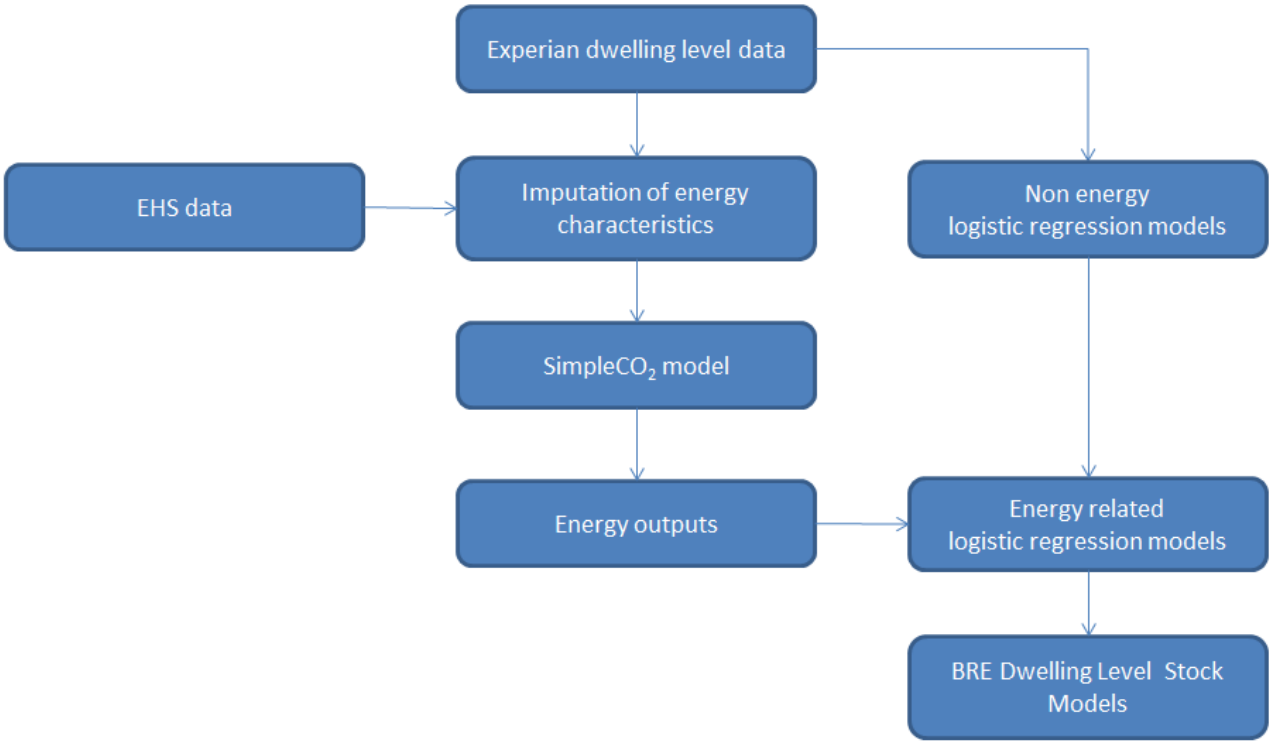
- The presence of a Category 1 Rating System Hazard
- The presence of a Category 1 Fall Hazard
- The presence of a household in Fuel Poverty (this is the full fuel poverty measure based on 10% of earnings being spent on heating costs)
- Disrepair (using the Decent Homes standard definition of disrepair)
- The presence of a low income households (defined as a dwelling likely to be in receipt of a means tested benefit)

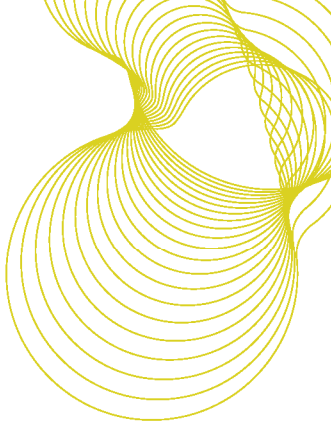
These present a different challenge and a top down methodology has been adopted, similar in many respects to the approach used by the previous set of models. Data from the English Housing Survey and statistical techniques such as logistic regression are then used to determine the combination of variables that are most strongly associated with failure of a particular standard. A formula is developed to predict the likelihood of failure and then applied to the variables in the national Experian dataset to provide a likelihood of failure for each dwelling. This is then assigned a failure/compliance to standard value on an area basis. 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.

Figure A1 shows a flow diagram outlining the process for the stock models as described above.

Figure A1: Dwelling level stock model methodology flow diagram





Integrating local data sources

As mentioned in the main report, Oxford identified five sources of data which were used to update the BRE dwelling level models to provide an integrated database. There data sources were:

1. The Oxford Local Land and Property Gazetteer
2. Benefits data
3. Energy Performance Certificates (EPCs)
4. Building Control Data
5. Housing Assistance data

To allow some of these data sources to be linked to the BRE Dwelling Level Stock Models, an address matching exercise was required to link each address to the Experian address key. Address matching is rarely 100% successful due to a number of factors including:

- Incomplete address or postcodes
- Variations in how the address is written e.g. Flat 1 or Ground floor flat
- Additions to the main dwelling e.g. annexes or out buildings

From experience, for address files in good order, it has been found that match rates vary between 75% and 95%. Table A1 provides the address matching results for the two data sources that were matched on the address field that were provided by Oxford, with notes on resulting impact to the modelling process.

Table A1: Address matching results

Data Source	Total number of records	Number (and %) of address matched	Impact on the modelling process
LLPG	65,557	49,543 (75%)	The model results for the remaining 13,209 addresses were imputed based on cases within the same postcode, where available. The data was then screen using a revised LLPG file to reduce the total number of addresses to 62,752
EPC data	21,520	18,652 (87%)	The remaining cases were dropped from the modelling process

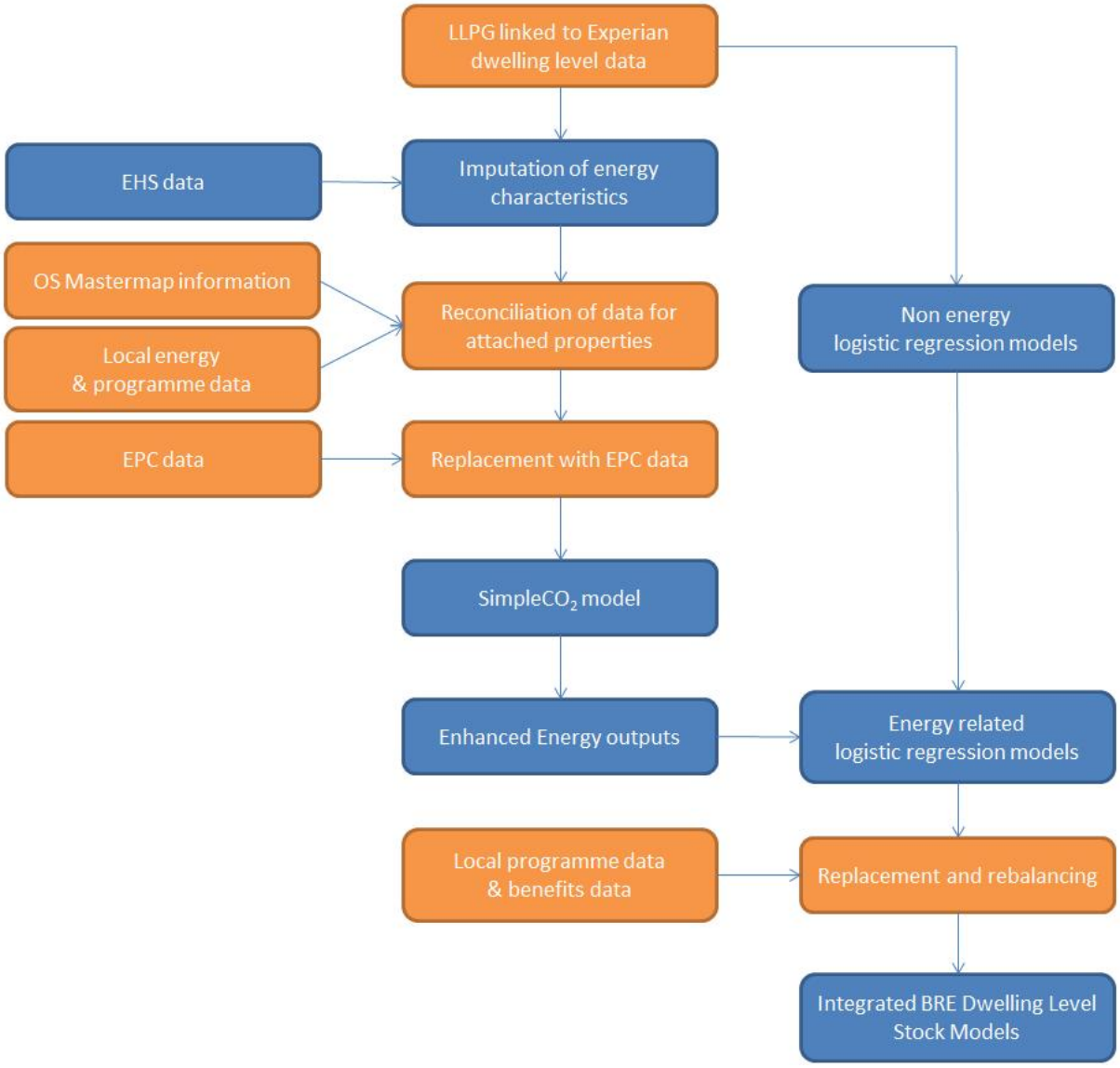
The Benefits, Building control and Housing Assistance data were matched to the LLPG using the Unique Property Reference Number.

The database was also updated using the Ordnance Survey (OS) Mastermap data which allows us to measure the footprint of the building, to know how many residential addresses there are within the building, and to see which other buildings each address is attached to or geographically close to.

The stage at which the data sources are included in the modelling process depends on whether or not the data includes information which can be used as an input into the SimpleCO_2 model.

Figure A2 illustrates how and when the data sources are included in the modelling process.

Figure A2: Integrated dwelling level stock model methodology flow diagram



The LLPG has been used to form the backbone of the database and the UPRN field should allow the Council to merge any additional data they require into the BRE stock model database.

The following section considers each of the data sources and how they are used to updated the SimpleCO_2 inputs and/or Stock Model outputs.

OS MasterMap Information

The OS data has been used to update a number of the SimpleCO_2 model inputs. The most valuable use of the OS data is the ability to determine the dwelling type with much greater confidence. This information can then also be used to reconcile discrepancies, such as wall type, within blocks of flats, terraced and semi-detached houses.

Dwelling type

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 1 residential address point, blocks of flats have two or more.

Where the dwelling is a house, the number of other buildings it is attached to can be observed. If there are none, the house is detached, as show in blue in figure 1.

Figure 3: Detached house

If two dwellings are joined to one another, but to no other dwellings, they are semi-detached, as shown in blue in figure 2.

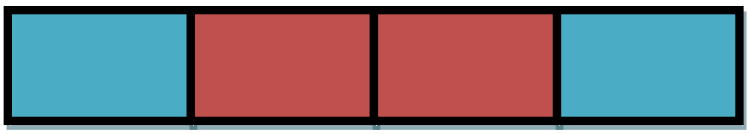
Figure 4: Semi-detached houses

Dwellings are classed as being mid terrace if they are attached to two or more other dwellings, as shown in blue in figure 3 below.

Figure 5: Mid terrace houses

Dwellings are classed as End terrace if they are attached to only one dwelling, but that dwelling is a mid-terrace, as shown in blue in figure 4 below.

Figure 6: End terrace houses



If the building is a block of flats then it's exact nature is determined by the age and the number of flats in the block.
If there are between 2 and 4 flats in the block (inclusive) and the dwelling was built before 1980 then we will assume it is a conversion. Otherwise it is assumed to be purpose built.

Location of flat in block

The location of the flat in the block will be changed if the OS data reveals that dwelling type is significantly different from the original value – specifically if a house becomes a flat, or vice versa.

If this is the case a new location for the flat within the block will be imputed using the same method as before, but taking into account the revised dwelling type.

Dwelling age

Although the OS does not itself provide any data on age, it does allow us to reconcile 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 would be logical to assume that they were built at the same time. Therefore, the the age of each building is changed to be the most common age among those present. Any ties are 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.

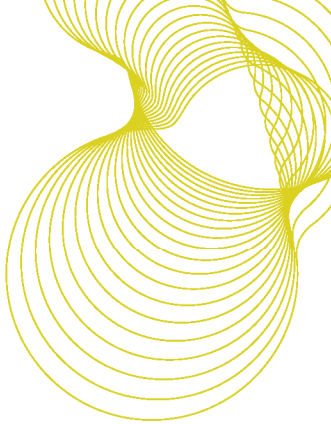
Number of storeys

The number of storeys will be changed 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.

If this is the case a new number of storeys will be imputed using the same method as before, but taking into account the new dwelling type.

Loft insulation

If the location of flat within block changes as a result of OS data such that a dwelling that did have a loft space no longer has one, or a dwelling that did not have a loft space now does have one, then the loft insulation thickness may also change. If the dwelling no longer has access to a loft then the loft insulation thickness will be set to indicate no loft present. If the dwelling does now have a loft a level of insulation thickness will be calculated using the same method of imputation as the original models, but taking into account the new dwelling type.



Wall type

Where the dwelling is part of a terrace or block of flats, all EPC data for that terrace / block is examined, and the predominant type of wall structure is used for any dwellings in the terrace or block which do not have EPC data.

Where the dwelling is semi-detached, the wall types should be the same. Where two attached properties have differing wall types the most common wall type found in the postcode is used to determine which is the more likely.

Wall insulation

For blocks of flats, the wall insulation is rationalised so that either the whole block is insulated, or none of it is insulated. In order to determine which, the most common status across all flats in the block is used.

Floor area

In the original models the floor area is imputed using the property value, type and number of bedrooms. This imputed value may be changed if it is discovered that the dwelling type as derived from the OS MasterMap data is significantly different from the original value – specifically if a house becomes a flat, or vice versa.

In the event that the dwelling type changes significantly, a new floor area is imputed using the same methods as before, but taking into account the corrected dwelling type.

EPC data

Tenure

Although the EPC data does not include tenure it does include the reason for the EPC. If the reason given was a sale then the dwelling was assumed to be owner occupied. If the reason given was re-letting and the tenure of the let was specified (i.e. private or social) then the tenure was changed to that indicated. If the reason for the sale did not indicate tenure then the tenure was left unchanged.

It is important to note that the modified tenure created from the EPC data should only ever be used for work relating to energy efficiency and carbon reduction. This is legal requirement stemming from the collection of the data, and is a licence condition of the data suppliers, Landmark.

Dwelling type

OS data is considered to be superior to the EPC data in terms of dwelling type, therefore the EPC data is not used to modify dwelling type.

Location of flat in block

Where the EPC provides information on the location of a flat within a block, this information will be used in favour of any imputed information, so along as the OS data shows the dwelling to be a flat.

Loft insulation

Where EPC data is provided on the level of loft insulation this is used over any imputed values, so long as the dwelling type is in agreement. If the EPC provides loft insulation data but the OS data indicates that the dwelling is not a house or a top floor flat then the EPC data will be ignored and the dwelling is treated as

having no loft. If the EPC data indicates no loft, but the OS data indicates that the dwelling is a house or a top floor flat, then insulation levels will be imputed.

Wall type and insulation

Where EPC data on wall type is present for a dwelling in a block of flats, terrace or semi-detached, that data is extrapolated to the rest of the block or terrace. If multiple dwellings with EPCs are present then the most common wall type is used. If the dwelling is a flat, the same principles are applied to wall insulation for other flats in the block.

Note that where an EPC indicates a wall type that is not the predominant one, this data will not be overwritten with the predominant type –the data reported in the EPC will always be used even if this results in two different wall types being present in a terrace or a block of flats.

Wall type is also extrapolated to neighbouring dwellings where possible using the techniques detailed under storeys.

Extent of double glazing

For flats it is assumed that all flats in the block will have the same level of double glazing as the case for which there is EPC data. If there are multiple flats in the block with EPC data showing different levels of double glazing, an average will be used.

Heating system, boiler type, fuel, controls

Heating systems are not imputed for houses. It is assumed that all flats in a block share the same heating type, boiler type if present, fuel type and heating controls. Where there are multiple types present, the predominant type is used.

For houses, fuel type is also extrapolated to neighbouring dwellings where possible using the techniques detailed under storeys.

Water heating and water tank insulation

Flats are assumed to have the same hot water source, and if one flat benefits from solar hot water it is assumed that all flats in the block do. Insulations levels for the cylinder or hot water tank are assumed to be individual.

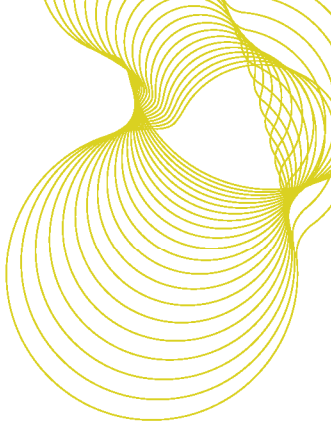
Floor areas

Where EPC floor area is available this has be used instead of any imputed values.

Benefits data

The Benefits data provides a list of dwellings occupied by a household in receipt of either Council Tax Support (CTS) or Housing Allowance (HA), the two most common means tested benefits. Given that these benefits are means tested, it is quite reasonable to assume that a household receiving them is on low income. The definition of low income, for the purposes of the stock model, is provided in Appendix B. As Council Tax Support and Housing Allowance are only two of the benefits used in the low income model it is not possible to rely solely on the Benefits data provided to identify all low income households. Therefore, the original models are taken and assigned the addresses in the following manner;

- All addresses that appear in the benefits file, and are indicated to receive either CTS or HA are set as low income
- All addresses that appear in the benefits file, and are indicated to NOT receive either CTS or HA have their likelihood of being low income (as determined by the BRE model) reduced by 62% (the proportion of low income households receiving either CTS or HA)
- All cases not yet determined to be in receipt of benefits are then ordered according the likelihood of containing a low income household following any modifier for not being flagged up in the benefits file as being in receipt of CTS or HA.
- Starting with the address most likely be low income, and working down, the remaining addresses in the file are set as low income until the total number of addresses containing low income reaches 17,377 (the original number estimated by the BRE model)



Appendix B – Definitions of the modelled indicators

HHSRS Category 1 Hazards

Homes posing a Category 1 Hazard under the Housing Health and Safety Rating System (HHSRS). HHSRS includes 29 hazards in the home categorised into Category 1 (serious) or Category 2 (other) based on a weighted evaluation tool.

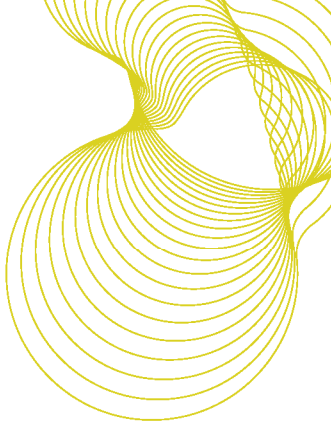
Excess Cold (HHSRS Category 1 Hazard)

Households living in homes with a threat to health arising from sub-optimal indoor temperatures. The assessment is based on the most vulnerable group, who for this hazard are those aged 65 years or more (the assessment does not require a person of this age to be an occupant). The EHS does not measure the achieved temperatures in the home and therefore this hazard is based on homes with an energy rating of less than 35 based on the SAP 2001 methodology. Under the SAP 2005 methodology, the comparable threshold was recalculated to be 31.5 and the latter is used when providing statistics for the HHSRS Category 1 Hazard.

Fall Hazards (HHSRS Category 1 Hazard)

The HHSRS Falls model includes the following hazards:

- 19. Falls associated with Baths etc
- 20. Falling on the level etc
- 21. Falling on stairs etc
- 22. Falling between levels etc



Disrepair

Included in the previous Decent Homes standard a home is said fail this criteria if it is not found to be in a reasonable state of repair (assessed from the age and condition of a range of building components including walls, roofs, windows, doors, electrics and heating systems).

Households in Fuel Poverty

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 degrees for the main living area, and 18 degrees 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:

$$\textit{Fuel Poverty Ratio} = \frac{\textit{Fuel Costs (usage * price)}}{\textit{Full Income}}$$

If this ratio is greater than 0.1 then the household is counted as being in Fuel Poverty.

Full Income definition is the official headline figure. 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).

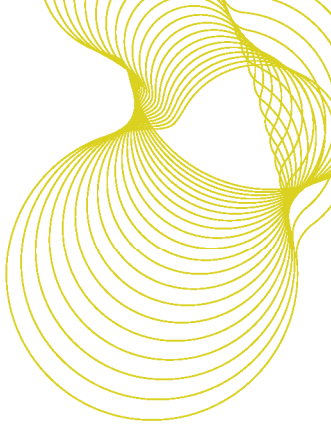
Fuel costs are modelled, rather than based on actual spending. They are calculated by combining the fuel requirements of the household with the corresponding fuel prices. The key goal in the modelling is to make sure that the household achieves the adequate level of warmth set out in the definition of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

Low Income Households

A household in receipt of at least one of the principle means-tested or disability related benefits.

The definition of a low income household is 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 or 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.

The definition also includes households in receipt of council tax benefit and income based job seekers allowance.



'SimpleSAP' Rating, an estimate of SAP[22]

SAP (Standard Assessment Procedure) 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 three 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.

SAP is not affected by the individual characteristics of the household occupying the dwelling or by the geographical location.

[22] **Important note: while we can provide 'SimpleSAP' ratings from the 'SimpleCO_2' software, under no circumstances must these be referred to as SAP as the input data is insufficient to produce an estimate of SAP or even RdSAP for an individual dwelling that meets the standards required by these methodologies.**

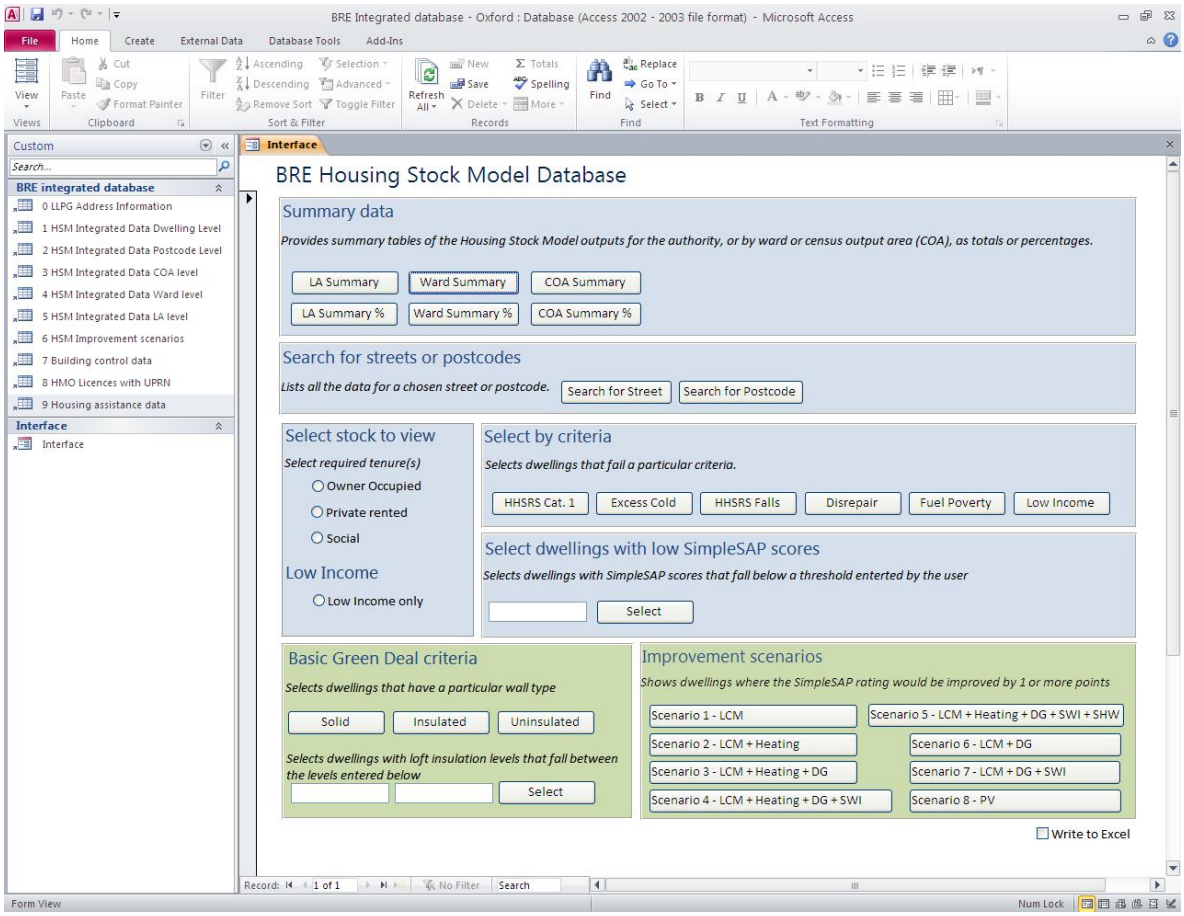
Appendix C – BRE Integrated Dwelling Level Database

The BRE Integrated Dwelling Level Database has been designed to provide the BRE Housing Stock Models in a useable format to local authority officers. The database offers the officers a number of different options for summarising or investigating their data, and generating lists of properties of interest.

Interface

The database will open on the interface screen as shown in Figure A1.

Figure A1: BRE Dwelling Level Database, Interface



On the left hand side of the database is a vertical column known as the 'navigational pane'. Under the heading 'BRE Integrated Models' there are seven tables which hold the BRE Housing Stock Model data and data provided by the Local Authority. These are as follows:

- 0 LLPG Address Information

  This table holds address details as provided in the Local Authority LLPG. It also indicates which census output area (COA) and ward which the address is in.

- 1 HSM Integrated Data Dwelling Level

  This table holds the dwelling level housing stock model data. SimpleSAP is provided as a score out of 100. The rest of the indicators are either 0 or 1. 0 indicates that a dwelling is predicted as passing the standard and 1 indicates that the dwelling is predicted to fail the standard.

  This table also indicates where an record has EPC data (EPC Flag, 0 - no EPC data, 1 –EPC data available) and how many data points could be used from the EPC data (EPC Count, 0 – no data to 15 possible data inputs for the SimpleCO_2 model).

- 6 HSM Improvement Scenarios

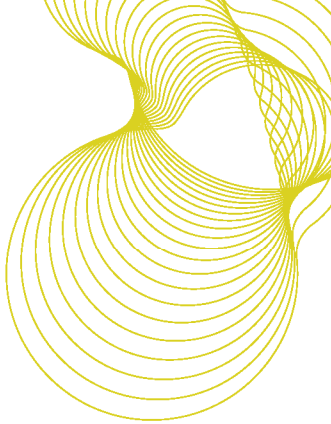
  This table holds the dwelling level improvement scenario results data.

The three tables above contain the UPRN in the first column which can be used to match the address details to the Housing Stock Model data if required.

The following four tables above provide summary information and statistics at the aggregated level specified:

- 2 HSM Integrated Data Postcode Level
- 3 HSM Integrated Data COA level
- 4 HSM Integrated Data Ward level
- 5 HSM Integrated Data LA level

Within these tables, if the Experian tenure variable has been purchased there are five 'stock levels' which are provided; all stock, private stock, owner occupied, private rented and social. There are, therefore potentially five records for each COA/ward.



The final three tables contain the raw data provided by the Local Authority:

- 7 Building control data

  This table contains the data from the Gas safe and FENSA competent persons schemes which has been used to update the inputs of the energy model

- 8 HMO licenses with UPRN

  This table contains the list of licensed HMOs provided by Oxford. It has been assumed that a licensed HMO will have no category 1 hazards under the HHSRS.

- 9 Housing assistance data

  Where a dwelling has received a housing assistance grant or loan it is assumed that any disrepair issues will have been dealt with, hence the dwelling will not be in disrepair.

The rest of the screen is the main interface which has been equipped with a number of standard queries that will present the user with information likely to be of use when reviewing data in order to design a housing stock strategy. There are four sections to the interface: Summary data, Search for a postcode, Select by criteria and Select dwellings with a low SimpleSAP scores.

Summary data

These options allow the user to generate summaries of their data at different levels of aggregation. The three different levels of aggregation are;

- Local Authority
- Ward
- COA

There are two types of summaries available at each level, totals and percentages.

- Totals give the user the total number of dwellings that fail a particular standard, for example, the total number of dwellings that have a HHSRS Category 1 Hazard in the authority.
- Percentages tell the user the percentage of dwellings that fail a criterion, for example, the percentage of dwellings suffering from HHSRS Category 1 Excess Cold hazards.

Search for postcode

This option allows the user to search for particular postcode. By clicking on a search button the user will be asked to type the postcode required. A table will then been shown providing a list all dwellings in the postcode given.

If the full name of the Postcode is not known, wildcard characters can be used to search for close matches. A wildcard character is one that can stand in for any other letter or group of letters. Access uses an asterisk (*) as the wildcard character. For example entering “BN15*” will find all dwellings whose postcode begins with BN15. Wildcard characters can be used at both the beginning and the end of the search text.

Note: you will need to close the results of an existing search before starting a new one. Clicking the button when the results of an existing search are still open will simply take you back to the results of that search. A search, or any other table, can be closed by clicking the “x” in the top right corner of the table window.

Selecting by criteria

It is also possible to select dwellings based on their criteria.

First, the user needs to select which tenure(s) they are interested in by using the ‘Select by tenure’ box on the left of the ‘Select by criteria’ title. This contains three radio buttons used to select which tenures are active.

The default setting is that no tenures are active, so the user will need to select at least one in order to get any results. Multiple tenures can be selected, so if you are interested in all the private stock you can select both owner occupied and private rented.

Note: If the authority has not brought the tenure variable from Experian the ‘Select stock to view’ section will be locked to provide details of the private sector stock only.

Once one or more of the tenures has been selected you may then choose which housing standard you are interested in. Clicking any of the buttons will bring up a list of all dwellings that fail that standard, and are of the pre-selected tenure. For example, if private rented has been chosen as the tenure, and you click the “HHSRS Cat.1” button then the database will show all dwellings that are private rented and fail HHSRS (e.g. have a Category 1 Hazard).

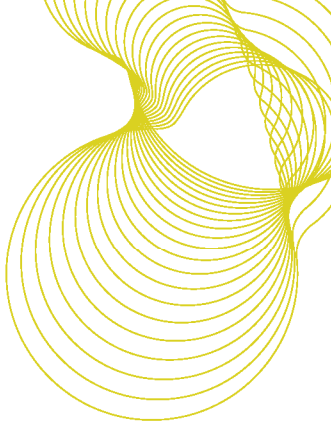
As will the searches, you will need to close the results of an existing selection before starting a new one.

Selecting by criteria – low income only

Below the ‘Select stock to view’ section there is a ‘Low Income’ option. By selecting this radio button for low income only and then one of the housing standards will return dwellings which fail the given standard and are occupied by a low income households. For example, setting the tenure to owner occupied and clicking the ‘Excess Cold’ button in this section will bring up a list of all low income owner occupiers who are at risk from Excess Cold.

Basic Green Deal Criteria

In addition to being able to select dwellings using housing indicators such as HHSRS, it is also possible to select dwellings that may be of interest due to their suitability for improvement under ECO or the Green Deal. A user may select the stock to view in the same way as when selecting by criteria, and may then choose to look at dwellings with a particular wall type, or with a particular level of loft insulation. To define a range of loft insulation the user must enter the minimum and maximum thickness in millimetres before clicking the “select” button.



Improvement Scenarios

This section allows the user to identify properties which may benefit from energy improvement measures. Again a tenure option needs to be selected for this selection. The low income criteria can also be used if required. The selections will return properties where the SimpleSAP score has been improved a score of 1 or more. If looking at Low Cost Measures (LCM) or PV the difference is from the baseline result is used. For improvements, such as LCM + Double Glazing (DG) the difference is from the LCM only result.

Creating Excel Files

While it is possible to copy the data from any of the queries accessed from the interface screen, an option has been added to make this process easier. If you wish to output results to Excel simply click the 'Write to Excel' check box at the bottom of the screen. As long as this box is checked, clicking any of the summary data, search or criteria selection buttons will cause the resulting data to be written to Excel instead of being displayed.

If this option is selected; on clicking any button you will be prompted to choose a format for your output data. Once you have selected the appropriate file format, click "OK". You will then be prompted for a file name and location. Choose the directory where you want to save the file and the name you want to call it, and click "OK" to save the file.

In this manner it is possible to rapidly export summary tables for inclusion in reports or lists of dwellings which can be used to target improvement programmes.