



Quantifying rural fuel poverty

Final report

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EXECUTIVE SUMMARY

This report describes the findings of the ‘quantifying rural fuel poverty’ research project carried out by the Centre for Sustainable Energy (CSE) for eaga Partnership Charitable Trust. The report provides evidence on the extent and characteristics of rural fuel poverty in England. It also compares rural fuel poverty with urban fuel poverty and with deprivation in general. The report concludes with recommendations for rural and fuel poverty policy.

Methodology

The research set out to address the following research questions:

- What is the relationship between housing characteristics, access to gas and other indicators of rural fuel poverty?
- What is the overall extent of rural fuel poverty as opposed to urban fuel poverty within England?
- Which rural areas have the highest instances of fuel poverty and why?
- Is it possible to produce a simple classification of rural areas according to their fuel poverty characteristics?
- Is take-up of Warm Front grants significantly lower in rural areas than urban?

CSE first gathered a number of small area datasets to carry out its analysis. These included the ONS ‘urban and rural area classification’, distribution of Warm Front grants, gas connectivity, solid wall properties and ‘incidence of fuel poverty’, as shown by the University of Bristol/CSE Fuel Poverty Indicator (FPI). The datasets were converted to Census Output Area to ensure a common geographical unit could be used for analysis. The data was then mapped, using Geographical Information Systems (GIS), and mounted on a dedicated website (www.ruralfuelpoverty.org.uk).

Statistical analysis was carried out of the small area distribution of fuel poverty and related factors (take-up of Warm Front grants, incidence of solid wall properties and incidence of properties off the gas network), including comparisons of urban and rural areas. The analysis focused on Warm Front because “Warm Front is the Government’s main tool for tackling fuel poverty in the private sector in England” (Defra & DTI, 2006, p11). The analysis also compared fuel poverty with general deprivation, again focussing on any urban/rural differences.

Findings

The research found that the extent of solid walled properties is much higher in rural areas than urban. There is a significant step upwards in the extent of solid walled properties from urban areas to towns, from towns to villages and from villages to hamlets. The one urban exception is London, which has a high proportion of solid walled properties. Solid walled properties represent a significant fuel poverty risk factor since they have higher fuel costs than properties built with cavities. They are also much more expensive to insulate than cavity walls.

The research found that the extent of ‘off-gas’ properties is much higher in rural areas than urban, with the problem increasing as settlements become more dispersed (i.e. from ‘urban’ areas to ‘hamlets’). Lack of connection to the gas network also represents a significant fuel poverty risk factor because households without gas have to rely on more expensive fuels. The overall picture, therefore, is that ‘hard to treat’ problems (i.e. properties built with solid walls and/or off the gas network) are much more extensive in rural areas than urban, with the problem increasing as settlements become more dispersed.

The research found that different definitions of fuel poverty influenced the comparative rates of fuel poverty between urban and rural areas. Thus, fuel poverty was higher in rural areas than urban under the 'full income' definition but the reverse was the case under the 'basic' and 'basic equivalised' definitions¹. These differences arose because of the different treatment of housing costs and household size under the different definitions. However, certain common features occurred under all definitions. Thus, of the four settlement types (urban, towns, villages, hamlets), fuel poverty was lowest in 'towns' and of the three rural settlement types (towns, villages, hamlets), fuel poverty was highest in hamlets. The relatively low fuel poverty rate in 'towns' tended to deflate the rate for 'all rural' areas. Fuel poverty therefore appears to be most pronounced in 'urban' areas and 'hamlets'.

The research found that urban/rural differences in fuel poverty, general deprivation, income deprivation and 'indoor environment' deprivation followed similar trends under the 'basic equivalised income' definition, i.e. all forms of deprivation are higher in urban areas than rural². By contrast, fuel poverty differs from other forms of deprivation when a 'full income' definition is used in that it is higher in rural areas than urban. The research also found a fairly high correlation between the distribution of general deprivation and the distribution of fuel poverty under the 'basic' and 'basic equivalised' definitions of fuel poverty. There was little relationship between the distribution of general deprivation and 'full income' fuel poverty.

While there is a good correlation between 'basic equivalised' fuel poverty and general deprivation, important differences still remain. For example, fuel poverty is more pronounced in private housing than general deprivation, due to the generally higher energy efficiency standards found in social housing. Fuel poverty is particularly pronounced among older people because of their higher heating needs due to physiology and greater time spent in the home. Rurality, particularly in relation to village and hamlets, represents a significant fuel poverty risk factor because of the nature of housing stock in rural areas i.e. 'hard to treat' is much more extensive.

The research found that the correlation between Warm Front grants delivered between 2000 and 2008 and levels of fuel poverty³ was strongest in 'urban' areas and weakest in 'hamlets'. However, 'hamlets' have similar levels of fuel poverty to 'urban' areas, suggesting that Warm Front is not reaching fuel poor households in 'hamlets'.

The research also found that the distribution of Warm Front grants in rural areas improved considerably from the 2000-05 period to the 2005-08 period, although differences still existed. Warm Front take-up appears to have improved considerably in 'towns' in the more recent period but less so in 'villages' and 'hamlets'.

¹ Three definitions of fuel poverty were used for the research: 'full income' where income includes Housing Benefit and Council Tax Benefit, 'basic income' where income does not include Housing Benefit and Council Tax Benefit and 'basic equivalised' income, where income is equivalised to take account of household size and composition.

² The 'Indices of Deprivation' were used to provide small area information on deprivation. The composite Index of Multiple Deprivation was used to define 'general deprivation'.

³ The analysis used the 'basic equivalised income' definition because it represented a closer approximation to means-tested benefit eligibility criteria than other fuel poverty definitions.

A number of possible explanations are offered for low Warm Front take up in remote rural areas. They include lower take-up of Warm Front passport benefits due to lack of information, few appropriate measures within the Warm Front 'package' and the possibility that 'high fuel costs' represent a more significant contributor to fuel poverty than 'low income' in remote rural areas.

Recommendations for policy

The report concludes with a number of recommendations for policy. In summary, these include:

1. Defra should recognise the additional costs of delivering Warm Front in remote rural areas due to longer travelling times and dispersed populations etc. It should set targets for delivery of Warm Front in 'villages' and 'hamlets' proportionate to fuel poverty levels in these settlement types.
2. DWP and Defra should jointly fund community development and other outreach activities in rural areas to improve take-up of benefits and Warm Front grants. Increased benefit take-up will both improve incomes and increase access to Warm Front, both of which will contribute to the reduction of fuel poverty.
3. Defra should introduce more flexible eligibility criteria for Warm Front in cases where there is a clear demonstration of need. For example, certain front-line staff, such as health workers, could refer clients for help following a simple assessment of need.
4. Defra should include suitable measures for hard to treat properties within Warm Front and related schemes, such as solid wall insulation, ground and air source heat pumps, biomass boilers, solar thermal and, for larger rural settlements, communal biomass CHP/district heating. It should raise grant maxima for cases where such measures are suitable. This will have a major impact on reducing fuel poverty in rural areas.
5. CLG should recognise the additional costs of achieving affordable warmth in hard to treat social housing, and make sure sufficient funds are available for social housing providers to install the more expensive measure options required. Setting a SAP81 target within the successor to the Decent Homes Standard would help ensure properties are 'fuel poverty proofed' for almost all occupants. This could require the installation of low/zero carbon technologies in a large number of properties, particularly hard to treat, with consequent environmental benefits.
6. The Treasury should re-consider its rejection of the former DTI's 2006 £95m spending proposal to extend the gas network to 200,000 households. This would have a major impact on reducing fuel poverty among rural households.
7. Given the reliance of many current rural households on oil and LPG, there is a strong case for regulation of these sectors, including improved consumer protection, transparent pricing and the establishment of easy pay schemes to enable bulk purchase of oil.
8. The Government should develop both 'After Housing Costs' (AHC) and equivalised definitions of fuel poverty. This would enable more meaningful comparison of fuel poverty in different geographic areas (since variations in housing costs will not affect fuel poverty rates); better evaluation of the targeting effectiveness of fuel poverty programmes (since equivalised incomes more closely approximate benefit eligibility criteria); and improved comparison of fuel poverty with other forms of deprivation (which tend to use both equivalised and AHC definitions of income).

1 INTRODUCTION

This is the final report of the 'Quantifying rural fuel poverty' research project, undertaken by the Centre for Sustainable Energy (CSE) for eaga Partnership Charitable Trust. The project was set up to address the following aim:

"To quantify and report on the extent and characteristics of rural fuel poverty in England, make comparisons with urban fuel poverty and rural deprivation and make recommendations appropriate to both rural policy and anti-fuel poverty policy."

The research questions defined for meeting this aim were as follows:

- What is the overall extent of rural fuel poverty as opposed to urban fuel poverty within England?
- Which rural areas have the highest instances of fuel poverty and why?
- What is the relationship between housing characteristics, access to gas and other indicators of rural fuel poverty?
- Is it possible to produce a simple classification of rural areas according to their fuel poverty characteristics?
- Is take-up of Warm Front grants significantly lower in rural areas than urban?

This report represents the final stage of the research. It supersedes the interim report, produced in 2006 (available at www.cse.org.uk/pdf/pub1091.pdf), and is accompanied by a rural fuel poverty website (www.ruralfuelpoverty.org.uk) which presents maps and data relating to the research findings.

The report and website include the following elements:

- Analysis of the urban and rural distribution of solid walled properties, properties off the gas network and Warm Front take-up (factors considered particularly relevant to rural fuel poverty).
- Analysis of the urban and rural distribution of Warm Front take-up relative to need, as defined by the CSE/University of Bristol Fuel Poverty Indicator (FPI)⁴.
- County maps of the distribution of solid walled properties, properties off the gas network and Warm Front take-up⁵ at Census Output Area level.
- Urban/rural comparisons between fuel poverty and general deprivation the countryside, using the 2007 Indices of Deprivation (Communities and Local Government, 2007).

The research did not produce a 'classification of urban and rural areas according to their fuel poverty characteristics' (fourth research question) because of the Office for National Statistics's subsequent development of the 'rural and urban area classification' (ONS, 2004 – see section 2.1.1). The classification is designed to provide a framework for analysis and reporting of a wide variety of statistical information (including fuel poverty) using residential land use, population density and settlement pattern as the standard reference point.

⁴ The FPI is based on a predictive model in which the vulnerability of different groups of households to fuel poverty is estimated from English House Condition Survey (EHCS) data. The model was applied to the 2001 Census to predict the level of fuel poverty at small area level (see Annex 2 for a brief description of the FPI methodology).

⁵ Please note that Warm Front maps on the website are based on grants awarded up until 2003 (the only data available at the time of producing the interim report). The analysis presented in this report is based on grants awarded up until 2008.

The analysis presented in this report, together with the maps presented on the website, should help improve understanding of some of the factors associated with fuel poverty in rural areas. The report, maps and data are designed to help policy makers and practitioners address fuel poverty and hard to treat housing in rural areas more effectively.

The report is structured as follows:

Chapter 2 outlines the research methodology.

Chapter 3 presents the findings of the research.

Chapter 4 presents the main conclusions and recommendations for policy.

2 METHODOLOGY

The research, in brief, involved the following tasks:

1. Regional comparisons of the small area distribution of urban and rural fuel poverty, plus comparison of rural fuel poverty with general rural deprivation.
2. Gather datasets, namely:
 - Urban and rural area classification
 - Distribution of Warm Front grants
 - Access to gas
 - Solid wall properties
 - 'Incidence of fuel poverty', as revealed by the Fuel Poverty Indicator (FPI)
3. Determine the most appropriate geographic unit for analysis and convert all datasets to this unit; followed by GIS extraction of data to allow statistical analysis
4. Development of a website to present, in map format, geographical data collected
5. Statistical analysis of the small area distribution of rural fuel poverty and related factors, i.e. take-up of Warm Front grants and incidence of solid wall properties and properties off the gas network, focussing on any urban/rural differences.

These tasks are described in more detail below.

2.1 Gather datasets

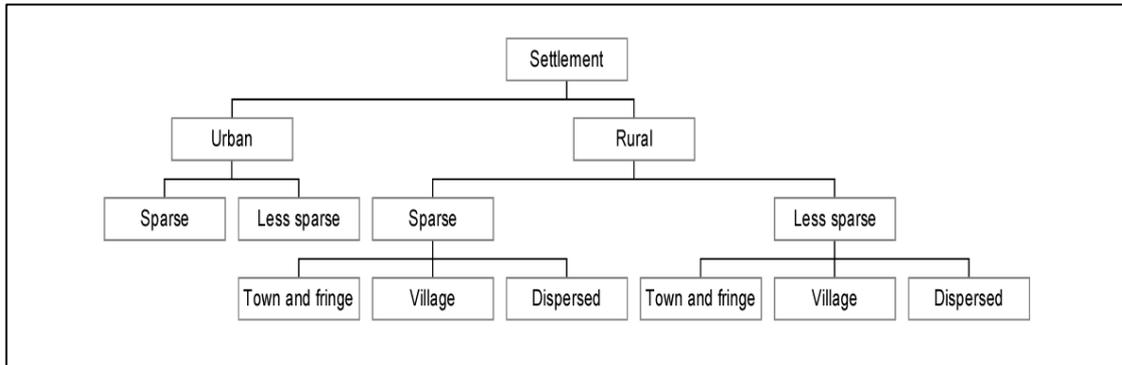
The following datasets were collated for the research.

2.1.1 Urban and rural area classification

In 2004, the Countryside Agency, Department for Environment, Food and Rural Affairs (Defra), Office for National Statistics (ONS), Office of the Deputy Prime Minister and Welsh Assembly Government produced a new urban and rural area classification (ONS, 2004). The classification provided a single statistical framework for defining different settlement types and context categories. The classification is based on population densities across the whole spectrum of 'settlements' or 'built-up' areas. It therefore does not include any socio-economic variables in its construction but is rather meant to provide a common standard for interpreting socio-economic issues, as they affect people living in urban and rural areas.

The classification is available at the level of Census Output Area (see section 2.3 for further explanation of Output Areas). Figure 1 below illustrates the broad structure of the classification:

Figure 1: Urban and rural areas classification



The research uses this classification for its analysis of rural fuel poverty and related issues. All analyses use the following 4 categories:

- Urban > 10k households
- Town and fringe
- Village
- Hamlet and isolated dwellings

The ONS classifies all Output Areas (OAs) according to one of these four categories. It uses a separate and combined classification according to whether OAs are 'sparse' or 'less sparse'⁶. The 'sparse' classification was not used by this research due to the small number of OAs that fall into the category in England – only 0.2% of all OAs and 1.2% of rural OAs are classified as 'sparse' in England.

2.1.2 Access to gas

Lack of access to gas is an important predictor of 'hard to treat' housing, i.e. it results in higher fuel costs because gas is the cheapest mainstream heating fuel. Other heating fuels, such as electricity, LPG and oil are considerably more expensive due to their higher unit costs. However, it is also the case that LPG and oil are not regulated, unlike gas and electricity, and consumer protection mechanisms are minimal (e.g. prohibitive costs in buying tanks of oil, lack of visibility of prices, lack of price comparison).

Heating systems with lower heating running costs are available in off-gas areas, e.g. ground and air source heat pumps, biomass boilers, solar thermal (hot water only). However, the installation costs for these technologies are prohibitively expensive, in part because the equipment is more complex and in part because their markets are very undeveloped.

Lack of gas connectivity is a problem particularly associated with rural areas, although it also occurs in certain urban areas (e.g. areas that traditionally used solid fuel as the main heating source) and property types (e.g. high rise).

⁶ 'Sparsity' refers to the density of a population within a broad area. The ONS classification measures sparsity by calculating for every 1ha cell the density of households across areas of 10km, 20km and 30km. A weighted total of 1ha cells within each OA was then calculated. OAs are classified as 'sparse' if they fall within the sparsest 5% of OAs at all 3 scales (Bibby & Shepherd, 2004).

We obtained gas connectivity data from Transco's Demand & Generation Forecasting Department in 2003. The database lists 6 digit postcode areas with a gas supply in 2003 (there are 1.2m postcode areas in England). The database is more detailed than that made publicly available on Transco's website.

For the purpose of this research, it was assumed that all properties within listed postcodes receive gas, although this may not always be the case. This will therefore lead to a slight overestimate of gas connectivity. There may also be some properties that are connected to gas but do not use it. The database does not include postcodes supplied by independent gas operators in 2003 (while this number has grown significantly over the past 2 years, it was still relatively small in 2003). This will therefore lead to a slight under-estimate of gas connectivity.

The number of households receiving gas at Output Area level was estimated by applying the following ratio:
$$\frac{\text{no. of postcodes with gas in OA}}{\text{total no. of postcodes in OA}}$$

We acknowledge that this is only an approximate guide to gas connectivity and probably represents an over-estimate. Both the 'estimated % of households with gas' and the '% of postcodes with gas in OA' indicators were used for the analysis and mapping work conducted for this research.

2.1.3 Solid wall housing

A higher proportion of rural properties than urban are built with solid walls (see Section 3.1). Properties built with solid walls construction is another predictor of 'hard to treat' in that they, on average, have lower SAP values than those built with cavities. While insulation options are available for solid walls, they are much less cost effective than that available for properties built with cavities.

We originally intended to use the simple English multiplier recommended by the Association for the Conservation of Energy (ACE) for constructing the small area database of solid wall properties (ACE, 2002). ACE suggests that the number of solid wall properties in any given area in England can be estimated by multiplying the number of pre-1919 properties by 1.44. The English House Condition Survey provides property age data according to 5 broad categories: pre-1919, 1919-1944, 1945-1964, 1965-1980 and post 1980 (ODPM, 2004a). The multiplier is designed to give a broad reflection of the fact that properties built before 1919 do not contain cavities but a proportion of properties built between 1919 and 1945 do⁷.

Building upon the ACE approach, CSE developed a set of regional multipliers, derived from the 2003 EHCS, which could be applied to small area data on property age to produce a proxy for solid wall properties. This is because there are considerable regional variations in the distribution of solid wall properties. The regional multipliers were further differentiated according to the urban/rural categories used within the EHCS. This still leads to inaccuracies when applied at the small area level, although it does provide a more accurate guide than use of a simple all-England multiplier.

We used RESIDATA to provide post code area data on age of property. RESIDATA is a commercial database produced for the building insurance industry which is updated annually. It provides good quality and reasonably accurate data on a range of property characteristics, including property age. We applied

⁷ It is not always possible to fill the cavities of some pre-1945 properties built with cavities; however, even without cavity wall insulation, properties containing cavities are more energy efficient than solid wall properties.

the urban and rural regional multipliers to the numbers of pre-1919 properties in each postcode to produce small area estimates of solid wall properties.

2.1.4 Fuel poverty indicator

In 2002, CSE and the University of Bristol developed a methodology for predicting the level of fuel poverty in small areas (Baker et al 2002). In brief, the work involved modelling the 1991 Census and 1996 English House Condition Survey (EHCS) to produce a 'proxy' indicator of fuel poverty based on Census variables. The resultant fuel poverty indicator (FPI) was used to predict the fuel poverty level for every ward in England. In 2007, CSE and the University of Bristol developed a new FPI model based on the 2001 Census, the 2003 EHCS and the property database, RESIDATA. A summary of the FPI methodology is given in Annex 2.

2.1.5 Distribution of Warm Front grants

We have carried out a detailed analysis of the distribution of Warm Front by rurality because "Warm Front is the Government's main tool for tackling fuel poverty in the private sector in England" (Defra & DTI, 2006, p11). However, it is worth noting that other elements of the Government's fuel poverty policies also have implications for rural areas. For example, the Government has encouraged gas and electricity suppliers to develop social programmes, principally social tariffs, for low income consumers to help cushion the substantial rise in fuel prices that has occurred over the recent period. This amounted to an additional £225m (to the £50m already spent) over the 2008-2010 period (HM Treasury, 2008). However, there is no such obligation on oil suppliers, meaning low income oil consumers will not benefit from an equivalent social tariff to help with their oil costs. Oil is a much more common heating fuel in rural areas than urban. It has also risen in price at an even higher rate than the rise in gas and electricity prices.

Similarly, the CERT programme is designed to encourage gas and electricity suppliers to provide the most cost effective carbon saving measures to householders. Suppliers have therefore focused on offering cavity wall and loft insulation because these measures deliver the highest carbon savings at the lowest cost. Given the high level of solid wall properties in rural areas (see section 3.1), many rural households will miss out. Extra uplift is provided for solid wall insulation to encourage suppliers to provide this measure. However, it is yet to be seen if this will lead to a substantial increase in installation rates.

For the first stage of the research (described in the 'interim report'), eaga supplied CSE with a database of all Warm Front grants awarded between 2000 and October 2003 by six digit postcode area. This did not include grants awarded in the East, East Midlands and Yorkshire & Humber regions since the Powergen Warm Front team was responsible for administering the scheme in this region at the time of data collection.

For the second stage of the research, eaga supplied CSE with a database of all Warm Front grants awarded between 2000 and March 2008 at OA level. This presented data annually and for all regions, including the Eastern region, for the period 2005 – 2008 (the dataset prior to 2005 only covered the six original eaga regions). The data included information on the type of measures delivered. CSE therefore excluded all Warm Front grants that were awarded for minor measures only (CFLs and tank insulation) from its analysis. This was on the grounds that minor measures would only have a minimal impact on the level of fuel poverty within the beneficiary household.

It is important to note that significant improvements were made to the Warm Front scheme in 2005. These included:

- Warm Front aimed to achieve a target of SAP 65 for all properties supported through the scheme, wherever practical.
- Providing all eligible households with central heating, not just people over 60, as was the case in the first phase of Warm Front.
- Offering oil central heating, once other low carbon solutions had been considered (regarded as particularly useful to rural households off the gas network).
- Raising the grant maxima to £2,700, or £4,000 if an oil central heating system is installed.
- Offering Benefit Entitlement Checks to all households enquiring about Warm Front but not on a passport benefit and to households already on a passport benefit but whose property could not be brought up to SAP 65.
- The Benefit Entitlement Check service was later extended in 2007 to all households enquiring about Warm Front, regardless of whether or not they were already on a passport benefit.
- Requiring eaga to report on the delivery of Warm Front grants to households living in 'hard to treat' properties (defined as properties built with solid walls, older than 1929, off the gas network and/or without lofts) and to 'hard to reach' households (defined as rural, private landlord and ethnic minority).

We were therefore able to compare differences in Warm Front take-up prior to 2005 with that post 2005 in the statistical analysis. This included urban/rural differences in take-up rates between the two periods.

2.2 Determine common geographic unit

The databases collected by CSE provide data at a variety of geographies (postcode sector, Output Area etc). We decided to use Census Output Areas as the common unit for the rural analysis conducted. Output Areas (OAs) represent the smallest geographic unit at which Census data is outputted. They were defined by identifying socially homogenous housing areas, defined by housing type and tenure, and typically contain about 125 households (80% of OAs contain between 110 and 139 households). Further information on OAs is given in Annex 1.

The very method of constructing OAs lends itself well to analysing the distribution of rural fuel poverty and related factors, for the following reasons:

- Housing represents a key element of the 'fuel poverty problem'; the method of constructing OAs therefore increases the likelihood of OAs containing households with similar levels of fuel poverty.
- The small size of OAs is appropriate for analysis of rural problems; since it is more likely to identify 'pockets' of rural deprivation (although some elements of rural deprivation may still be more dispersed than is detectable at OA level).
- Because OAs contain similar numbers of households, it is easy to compare the extent of a problem across areas. By contrast, electoral wards, for example, can vary from 1200 to 12,000 households (usually according to whether they are located in rural or urban areas).

The disadvantage of Output Areas relates to their sheer number. There are some 175,500 OAs in England. Databases using this unit are therefore very large. It is also very difficult to present OA data in map format unless maps are confined to a fairly small area. OAs are purely a statistical unit. They are not 'named' and do not represent a political or administrative unit. However, they do tessellate with postcodes, electoral wards and other geographical units. Presentation of, for example, ward names in which OAs are located can therefore help with interpretation of OA data.

The datasets on Warm Front, solid wall properties and gas connectivity were converted from postcodes to Output Areas by using Structured Query Language (SQL) statements and OA 'look-up' tables. GIS Mapinfo software package was then used to combine the different datasets into one database which could be imported into SPSS. This allowed us to carry out statistical analysis and cross tabulations across the databases. The work required considerable data checking to ensure accuracy, for example:

- Checking the process of aggregating postcodes to OAs by manually selecting all the postcodes listed for a single OA and confirming that this correlated with the automation process. This was performed numerous times for both the Warm Front and off-gas data.
- Initially, errors occurred due to misalignment of the 'white space' in postcode fields. Once corrected, the automation was performed successfully.
- Updating the postcode-to-OA lookup table. Version Autumn 2005 was used for the research since earlier versions failed to select many postcodes.

2.3 Data mapping and website development

County maps of the 'off-gas' and 'solid wall' indicators for all of England's nine Government Office regions can be accessed at a 'rural fuel poverty' website: www.ruralfuelpoverty.org.uk. Ward level⁸ versions of the two databases can also be accessed from the website. The website includes maps of 'Warm Front take-up' for the six regions investigated for the first stage of this project and links to this research report and to the report produced for the Energy Efficiency Partnership for Homes Insulation Group.

The website's search function is contained within one menu for the site which directs the user to their area via combination boxes or 'clickable' maps. Maps are displayed at 'ceremonial county' level (this is slightly different to a county and unitary local authority classification). This is sufficient for identifying rural output areas; however, it is generally not possible to identify urban OAs, due to their small geographical size.

This report makes occasional reference to the website maps; readers may therefore find it useful to consult the website on such occasions.

2.4 Statistical analysis

The report presents summary statistics and charts for the following factors:

- Incidence of solid wall properties
- Incidence of 'off-gas' properties
- Warm Front grant take-up
- Relationship between the FPI and the above three factors

⁸ It was not possible to include the Output Area level databases on the website due to their considerable size.

One-way analysis of variance (ANOVA) was used to test whether the differences between pairs of categories of settlement type (i.e. 'urban', 'town & fringe', 'village' and 'hamlet & isolated dwellings') for each of the factors investigated were statistically significant. The Tukey 'post hoc' test was used to establish whether differences were significant at the $p=0.05$ level. Tukey is generally considered a fairly 'rugged' and conservative test, i.e. if it shows there is a difference, it is almost certain such a difference is 'real'.

It was therefore possible to investigate whether there were any differences with respect to the degree of rurality for each of the three factors (solid walls, off-gas and grant take-up), as well as between urban and rural in general. We also investigated whether Warm Front take-up, relative to need, varied between urban and rural areas. This represented further exploration of the finding reported in the interim report that there were significant differences in take-up between urban and rural areas for Warm Front grants delivered up to 2003. It was noted that this analysis did not account for any differences in levels of need that may exist between urban and rural areas.

Some analyses only cover six Government Office regions (GOR) and some cover all nine regions. This is because the original research was only carried out for the six regions in which eaga acted as Warm Front managing agent in the Phase 1 period (2000-2005), namely London, North East, North West, South East, South West and West Midlands. However, we have updated our Warm Front analysis with Warm Front Phase 2 data (2005-8) for all of England's regions. We were able to do this because Eaga was appointed Warm Front managing agent for all of England for the Phase 2 period in 2005.

3 RURAL AND URBAN AREAS: ANALYSIS

This chapter presents the findings of the urban and rural analysis. The analysis first considers two 'property characteristic' factors that are considered particularly relevant to rural fuel poverty, namely properties built with solid walls and properties off the gas network. The analysis then examines the distribution of fuel poverty between urban and rural areas and considers how this might differ from the distribution of general poverty. Finally, the analysis examines the delivery of Warm Front grants between urban and rural areas and comments on whether there are any urban/rural differences in its effectiveness at reaching its target group.

The results of the analyses are presented as follows:

- Solid wall properties by settlement type and region (five regions only)⁹
- Off-gas properties by settlement type and region (five regions only)
- Distribution of fuel poverty by settlement type and region (all English regions except London)
- Urban/rural comparisons between fuel poverty and general deprivation
- Take-up of Warm Front grants by settlement type and region (five regions for the Warm Front Phase 1 period and eight regions for the Warm Front phase 2 period)

3.1 Properties built with solid walls

County maps of solid wall properties are shown on the website for all of England's nine regions (see: www.ruralfuelpoverty.org.uk). Output Area (OA) boundaries are not included on the maps because they tend to cause a grey 'smudge' where OAs are small in size. The maps therefore do not distinguish coterminous OAs which have the same proportions of solid wall properties.

The maps clearly suggest that solid wall properties are more extensive in rural OAs¹⁰. We therefore investigated whether this impression was borne out by statistical analysis of the five regions investigated for this research. London was not included because it is almost entirely urban. East England, Yorkshire & Humber and East Midlands were not included because eaga was not the Warm Front managing agent in the Warm Front phase 1 period¹¹.

The total number and proportion of solid wall properties in each settlement type and for each region is given in Annex 3. Figure 2 overleaf shows the results plotted. The graph clearly shows a marked increase in the proportion of solid wall properties with each increase in settlement dispersal, with rates particularly high in 'hamlets'. This pattern occurs in all of the five regions. Table 1 overleaf gives the Tukey results for establishing whether the difference between each pair of settlement types is statistically significant. Differences between pairs of settlement types that are not statistically significant are highlighted.

⁹ London was not included in the analyses because it is almost entirely urban.

¹⁰ Since rural OAs tend to be geographically larger than their urban equivalents, rural OAs visually 'stand out' more than urban OAs. Even taking this factor into account, the maps suggest a strong association between rurality and solid wall properties. The statistical analysis investigates whether the differences between urban and rural areas are significant.

¹¹ The original analysis of solid walled and 'off-gas' properties was carried out when eaga only managed Warm Front for 6 of the 9 regions in England. Data analysis on these two factors was therefore only undertaken for the 6 regions.

Figure 2: Households with solid walls by region and settlement type

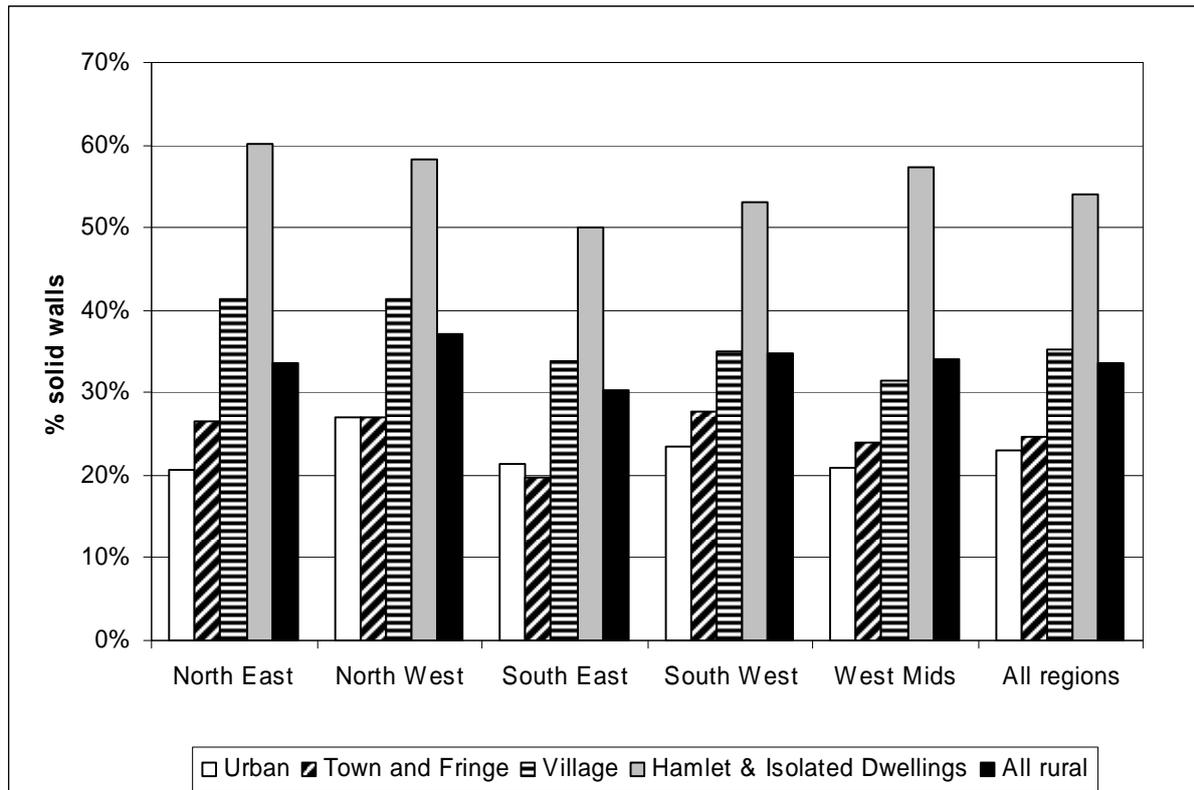


Table 1: Significance test results for solid wall properties by settlement type and region

		North East	North West	South East	South West	W Mids	All regions
Urban	Town	0.00	1.00	0.02	0.00	0.04	0.01
	Village	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00
Town	Urban	0.00	1.00	0.02	0.00	0.04	0.01
	Village	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00
Village	Urban	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00
Hamlet	Urban	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.00	0.00	0.00	0.00	0.00	0.00
	Village	0.00	0.00	0.00	0.00	0.00	0.00

Note: The difference between pairs of settlement types is significant at the 95% confidence level when $p < 0.05$.

Table 1 shows that the difference between each pair of settlement types is statistically significant for every individual region and for the five regions combined (i.e. $p < 0.05$). The only exception is the difference between the 'urban' and 'town & fringe' categories in the North West, where the proportions are very similar (see Figure 2). In effect, the extent of solid wall properties increases with increased settlement dispersal and this increase is significant.

Between 50 and 60% of properties in ‘hamlets’ are built with solid walls in the 5 regions combined. By contrast, the range in urban areas is between 21% and 27% (Annex 3, table 1). Although the analysis does not show results for London, Annex 3 shows that the capital is not typical of other urban areas in England in that it has a much higher proportion of solid wall properties (39%).

3.2 Households off the gas network

County maps of ‘proportion of postcodes with gas supply/proportion of all postcodes’ by Output Area (OA) are shown on the website for all of England’s nine regions (see: www.ruralfuelpoverty.org.uk). Output Area boundaries are shown for those OAs that do not have a gas supply. However, they are not shown for OAs that do have a gas supply. This means that the maps do not distinguish coterminous OAs that have the same proportion of postcodes with a gas supply. Again, boundaries were not shown to avoid the problem of ‘smudging’. The maps clearly show that many rural areas do not have a gas supply.

The total number and proportion of ‘off-gas’ properties in each settlement type and for each of the 6 regions investigated for this research is given in table 2, Annex 3. As noted in the methodology section, the figures are based on estimates derived from the ratio of postcodes without gas to the total number of postcodes in an Output Area. Figure 3 below shows the results plotted.

Figure 3: Households off the gas network by region and settlement type

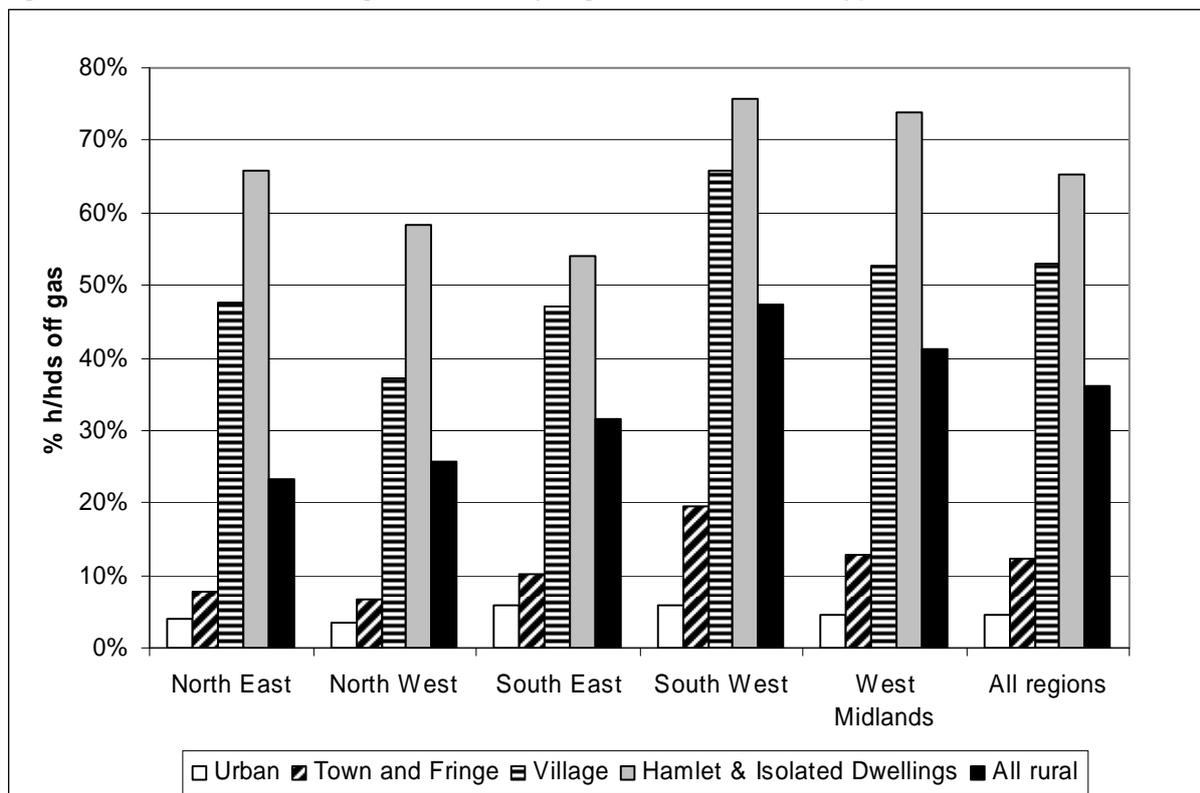


Figure 3 clearly shows a marked increase in the proportion of ‘off-gas’ properties with increased settlement dispersal. Again, there are particularly high proportions of ‘off-gas’ properties in ‘hamlets & isolated dwellings’. Table 2 in Annex 3 shows that ‘hamlets & isolated dwellings’ without access to gas

range from 54% of properties in the South East to 76% in the South West. By contrast, the figure for 'urban' areas lies at around the 5% level in all regions.

Table 2 below gives the Tukey results for establishing whether the difference between each pair of settlement types is statistically significant.

Table 2: Significance test results for 'off gas' properties by settlement type and region

		North East	North West	South East	South West	W Mids	All regions
Urban	Town	0.00	0.00	0.00	0.00	0.00	0.00
	Village	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00
Town	Urban	0.00	0.00	0.00	0.00	0.00	0.00
	Village	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00
Village	Urban	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00
Hamlet	Urban	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.00	0.00	0.00	0.00	0.00	0.00
	Village	0.00	0.00	0.00	0.00	0.00	0.00

Table 2 shows that the difference between each pair of settlement types is statistically significant at the $p=0.05$ level for every region. In effect, the extent of 'off-gas' properties increases with increased settlement dispersal and this increase is significant for each move upwards in dispersal level.

The analyses above illustrate that the problem of 'hard to treat' properties is much more extensive in rural areas than urban. Furthermore, the analyses show that the extent of 'hard to treat' problems increases with each increase in settlement dispersal.

3.3 Distribution of fuel poverty

3.3.1 Fuel poverty definitions

The results of the urban and rural analysis presented below are based on three definitions of fuel poverty: 'full income', 'basic income' and 'basic income equivalised'. The three definitions reflect different methods of measuring income when calculating fuel poverty. In summary, the three definitions are as follows:

- Full income Income includes Housing Benefit, Income Support for Mortgage Interest (ISMI) and Council Tax Benefit
- Basic income Income does not include Housing Benefit, Income Support for Mortgage Interest and Council Tax Benefit
- Basic income As basic, except income is 'equivalised' to take account of household size and composition

The 'full income' definition of fuel poverty is used by the Government for target setting. The Government also reports on the 'basic income' definition. The 'equivalised' definition uses a similar approach to

measuring income to other Government income statistics, for example the Household below Average Income series. The analysis presented in this report includes this third definition for two reasons ¹²:

1. The basic income (equivalised and non-equivalised) definitions are less influenced by variations in housing costs between small areas, although they are not the same as an 'After Housing Costs' definition in that they do not take into account all housing costs, e.g. mortgage payments not covered by ISMI. We considered it important that comparisons of fuel poverty between small areas were not overly influenced by variations in housing costs.
2. Eligibility for means-tested benefits is dependent on the level of household income. The use of an equivalised income fuel poverty definition produces a closer approximation to the means-tested benefit eligibility of a household than non-equivalised incomes. This is particularly important when considering Warm Front take-up levels and the extent to which Warm Front is reaching its target group since Warm Front eligibility is based on eligibility for certain benefits and tax credits.

The use of the 'basic equivalised' definition is therefore designed to illustrate whether Warm Front is reaching its target group according to 'geographical equity' principles (see Baker et al, 2007, for further discussion of the concept of geographical equity). However, while Warm Front is the "Government's main tool for tackling fuel poverty in the private sector", eligibility for Warm Front is not based on 'fuel poverty status' per se but rather on benefit status (Defra & DTI, 2006). This issue is further discussed in Section 3.5 below, which presents results on Warm Front take-up.

3.3.2 Summary fuel poverty statistics

Table 3 below presents summary statistics for the distribution of fuel poverty (based on the University of Bristol/CSE fuel poverty indicator) by settlement type and region.

Table 3: Fuel poverty by settlement type and region

Settlement type	Total hhlds	Number of fuel poor households			% Fuel poor households		
		Basic	Basic equiv.	Full	% Basic	% Basic equiv.	% Full
Urban	16,539,023	1,157,273	1,068,238	1,007,433	7.00%	6.46%	6.09%
Town & Fringe	1,870,252	118,976	97,594	112,211	6.36%	5.22%	6.00%
Village	1,427,212	95,170	77,973	91,488	6.67%	5.46%	6.41%
Hamlet	588,517	43,284	36,970	41,278	7.35%	6.28%	7.01%
All rural	3,885,981	257,430	212,537	244,977	6.62%	5.47%	6.30%
Total	20,425,004	1,414,703	1,280,775	1,252,410	6.93%	6.27%	6.13%

Note: The fuel poverty indicator is based on the 2003 English House Condition Survey. It is important to note that fuel poverty reached its historically lowest level in 2003. Fuel poverty has more than doubled since 2003 due to the impact of fuel price rises (Preston et al, 2008).

Table 3 shows how the definition of fuel poverty leads to variations in ranking between settlement types with respect to the proportion of households in fuel poverty. For example, fuel poverty is highest in 'hamlets & isolated dwellings' on the 'full' and 'basic' income definitions, whereas it is highest in 'urban areas' on the 'basic equivalised' definition. The fuel poverty rate is lowest in 'town & fringe' areas on all three definitions. Similarly, fuel poverty is slightly higher in rural areas than urban areas on the

¹² This approach was agreed with trustees of Eaga PCT.

Government's preferred 'full income' definition whereas the reverse is the case for the two other definitions.

The inclusion of 'town and fringe' in the 'all rural' definition tends to deflate the fuel poverty rate in the 'all rural' definition. It is notable that some researchers separate the 'town and fringe' category from 'rural', preferring to use the term 'suburban' (e.g. Palmer et al, 2008). In our view this is slightly misleading in that 'town and fringe' typically refers to market towns in rural areas, rather than suburban areas in cities. Nevertheless, it is likely that the characteristics of properties and households in market towns are quite different to those in more remote areas.

3.3.3 Distribution of fuel poverty (basic equivalised) by settlement type and region

Figure 3 below shows the distribution of fuel poverty by region and settlement type according to the 'basic equivalised' fuel poverty definition. Results are not given for London because the region is almost entirely urban.

Figure 3: Fuel poverty (basic equivalised) rates by settlement type and region

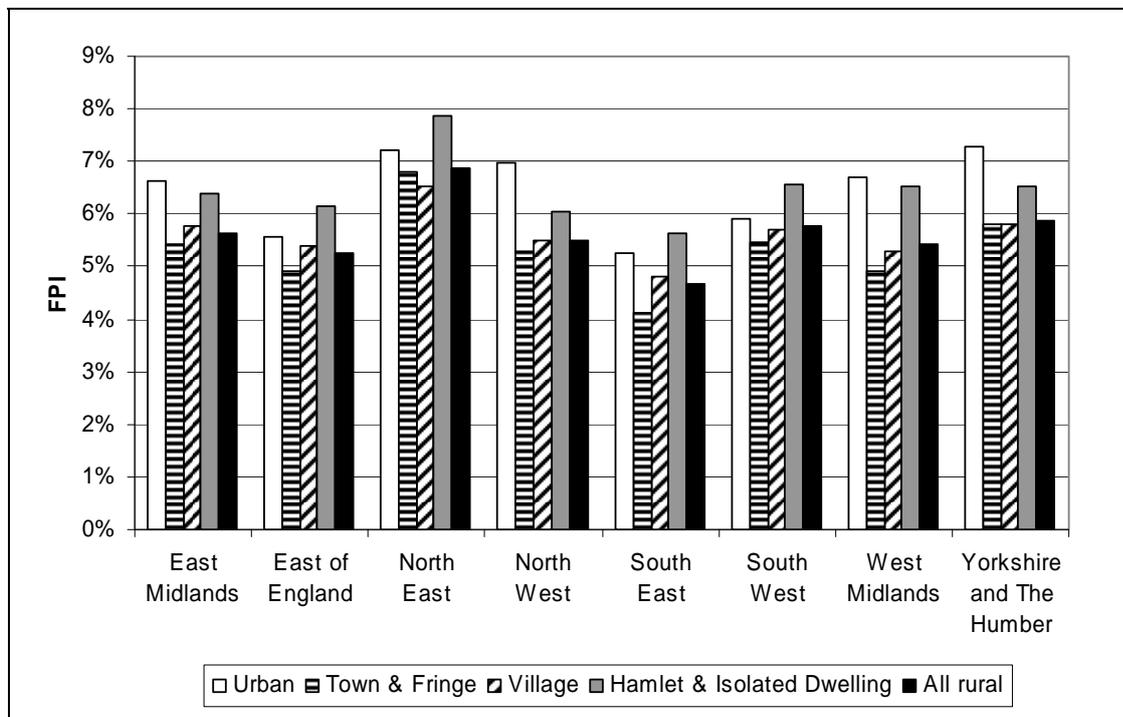


Figure 3 suggests that fuel poverty rates vary considerably between different settlement types in all of the nine regions. In all regions, rates are highest in either 'urban areas' or 'hamlets' and lowest in 'town and fringe' (with the exception of the North East). Figure 3 also illustrates the relatively high levels of fuel poverty across all settlement types in the North East and the relatively low levels in the South East.

Table 4 below shows whether these variations are statistically significant (using ANOVA and the Tukey 'post hoc' test). Differences between pairs of settlement types that are not statistically significant are highlighted.

Table 4: ANOVA results for fuel poverty (basic equivalised) rates by settlement type and region

		South East	East	West Mids	East Mids	South West	North West	North East	Y&H	
F- statistic		205.7	96.9	190.3	151.5	78.4	225.8	21.2	206.9	
Post-hoc tests	Urban	Town	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Village	0.00	0.15	0.00	0.00	0.01	0.00	0.00	0.00
		Hamlet	0.00	0.00	0.99	0.98	0.00	0.00	0.00	0.00
	Town	Urban	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Village	0.00	0.00	0.00	0.00	0.00	0.25	0.43	0.86
		Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Village	Urban	0.00	0.15	0.00	0.00	0.01	0.00	0.00	0.00
		Town	0.00	0.00	0.00	0.00	0.00	0.25	0.43	0.86
		Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	Urban	0.00	0.00	0.99	0.98	0.00	0.00	0.00	0.00
		Town	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Village	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: The difference between pairs of settlement types is significant at the 95% confidence level when $p < 0.05$.

Table 4 shows that on the 'basic equivalised income' fuel poverty definition:

- In the South East and South West the differences in fuel poverty rates between each pair of settlement types are significant for all pairs.
- In the East of England the only difference in fuel poverty rates between pairs of settlement types that is not significant is the difference between 'urban areas' and 'villages'.
- In the West Midlands and East Midlands the only difference in fuel poverty rates between pairs of settlement types that is not significant is the difference between 'urban areas' and 'hamlets & isolated dwellings'.
- In the North West, North East and Yorkshire & Humber the only difference in fuel poverty rates between pairs of settlement types that is not significant is the difference between 'town & fringe' and 'villages'.

3.3.4 Distribution of fuel poverty (full income) by settlement type and region

Figure 4 below shows the distribution of fuel poverty by region and settlement type according to the 'full income' fuel poverty definition (not including London). On this definition, the fuel poverty rate is highest in 'hamlets' in all eight regions. However, the settlement type with the lowest rate varies between the different regions. It is also notable that overall fuel poverty rates do not appear to vary so much between regions as under the 'basic equivalised' definition.

Table 5 below shows whether these variations are statistically significant. Differences between pairs of settlement types that are not statistically significant are highlighted.

Figure 4: Fuel poverty (full income) rates by settlement type and region

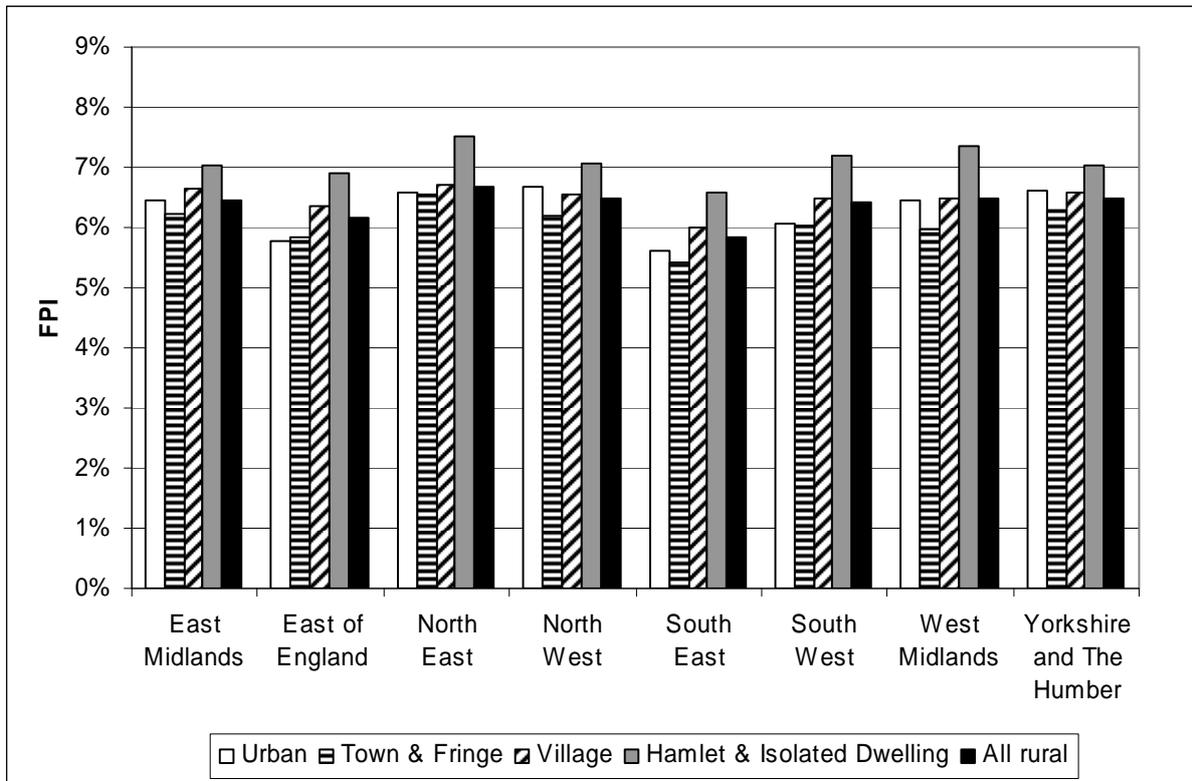


Table 5: ANOVA results for fuel poverty rates (full income) by settlement type and region

		South East	East	West Mids	East Mids	South West	North West	North East	Y&H
F- statistic		654.3	665.1	294.4	157.7	736.6	135.2	83.8	95.6
Post-hoc tests	Urban								
	Town	0.00	0.06	0.00	0.00	0.78	0.00	0.36	0.00
	Village	0.00	0.00	0.53	0.00	0.00	0.03	0.05	0.92
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Town								
	Urban	0.00	0.06	0.00	0.00	0.78	0.00	0.36	0.00
	Village	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Village								
	Urban	0.00	0.00	0.53	0.00	0.00	0.03	0.05	0.92
	Town	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hamlet									
Urban	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Town	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Village	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Note: The difference between pairs of settlement types is significant at the 95% confidence level when $p < 0.05$.

Table 5 shows that on the ‘full income’ fuel poverty definition:

- In the South East, East Midlands and North West the differences in fuel poverty rates between each pair of settlement types are significant for all pairs.
- In the East, South West and North East the only difference in fuel poverty rates between pairs of settlement types that is not significant is the difference between 'urban areas' and 'town & fringe'.
- In the West Midlands and Yorkshire & Humber the only difference in fuel poverty rates between pairs of settlement types that is not significant is the difference between 'urban areas' and 'villages'.

3.3.5 Fuel poverty definitions and fuel poverty rates

The above analysis illustrates how urban/rural differences in fuel poverty rates can vary according to different fuel poverty definitions. Thus, fuel poverty appears higher in rural areas than urban on the 'full income' definition – a trend that the interim report noted had persisted over the period between 1996 and 2005 (Baker & Preston, 2006). However, this difference is not observed under a 'basic' or 'basic equivalised' definition. Nevertheless, fuel poverty appears to be significantly higher in the more remote rural settlement types ('villages' and 'hamlets'), whichever definition is used. The 2005 EHCS found that fuel poverty (full income) in 'villages and hamlets' (the two most dispersed settlement types) was 14.6% - slightly more than twice the national average of 7.2%. The comparable figures under the basic income definition were 13.4% in 'villages and hamlets' and 8% in 'urban areas'.

Gordon and Fahmy also commented on the influence of fuel poverty definitions on the distribution of fuel poverty in their report of the fuel poverty indicator methodology (Gordon & Fahmy, 2007). They found that the use of an 'equivalised income' fuel poverty definition led to relatively high fuel poverty rates in urban and metropolitan areas (e.g. London, West Midlands, Greater Manchester) and in remote rural areas (e.g. Devon/Cornwall; East Anglia; Welsh Borders; Northumbria; Lincolnshire). In contrast, the 'full income' fuel poverty definition tended to emphasise fuel poverty in 'accessible rural' and suburban areas in preference to inner cities and more remote rural areas. Annex 4 to this report illustrates the effect of fuel poverty definitions on the distribution of fuel poverty in map format.

3.4 Comparing fuel poverty with other types of deprivation

3.4.1 Introduction

The interim report noted that in 2005 average household incomes were generally higher in rural areas than urban, although there were still significant levels of income disadvantage in rural areas (Baker & Preston, 2006). It also noted that unemployment rates and proportion of households claiming Income Support were higher in urban areas than rural. However, the proportion of households claiming State pension was higher in rural areas than urban – a reflection of the demographic composition of rural areas. The interim report went on to comment that fuel poverty therefore appears to be unusual in that it is a more significant problem in rural areas, compared to urban, in contrast to other forms of deprivation.

Palmer, MacInnes & Kenway found that households in 'income poverty' living in rural areas were much more likely to be in fuel poverty than those in urban areas: 44% of the 'income poor' in rural areas¹³ lived in fuel poverty in 2005, compared to 26% in urban areas (Palmer et al, 2008). The study concluded that the difference was due to higher fuel costs in rural areas. The 'income poor' in rural areas were found to spend 15% more on fuel than households elsewhere. This was due to larger properties and lower energy efficiency levels.

¹³ The study did not include 'town & fringe' in its definition of rural areas.

3.4.2 Comparing fuel poverty with the Indices of Deprivation

The analysis below further compares fuel poverty with ‘general deprivation’ and other selected types of deprivation, using the 2007 Indices of Deprivation¹⁴. The overall Index of Multiple Deprivation (IMD) is constructed from indices of seven domains, as follows:

Domain	Description
Income Deprivation	Proportion of the population living in low income families (reliant on means tested benefits)
Employment Deprivation	Working age population excluded from work
Health Deprivation and Disability	High rates of premature death or quality of life impaired by poor health or disabled
Education, Skills & Training Deprivation	Two sub-domains: i. Lack of educational attainment among children and young people ii. Lack of qualifications (skills) among working age adult population
Barriers to Housing and Services	Access to housing and key services (doctors, supermarkets, primary schools and post offices). Two sub-domains: i. Geographical barriers ii. Wider barriers
Living Environment	Two sub-domains: i. Indoor living environment – quality of housing ii. Outdoor living environment – air quality and road traffic accidents
Crime	Rate of recorded crime, covering: burglary, theft, criminal damage, violence

Each domain is measured independently and scores are then combined, with weightings, to generate an aggregated overall IMD. This study analysed the IMD, ‘income’ domain and ‘indoor living environment’ indicators on the grounds that the indicators are more relevant to fuel poverty than the other domains. A high score on each of these indicators represents a high level of deprivation. The IMD and ‘indoor environment’ scores are abstract measures in that the scores do not relate to real ‘units’. The ‘income domain’ is an actual measure of the proportion of households on means-tested benefits.

Table 6 below shows how general deprivation (IMD score), income poverty, ‘indoor environment deprivation’ and fuel poverty vary between urban and rural areas in England.

Table 6: Urban/rural comparisons between deprivation and fuel poverty

Area	IMD score	Income	Indoor env	% fuel poor households		
				Basic equiv.	Basic	Full
Urban	23.6	0.17	22.0	6.46%	7.00%	6.09%
Rural	13.1	0.09	20.2	5.45%	6.61%	6.29%

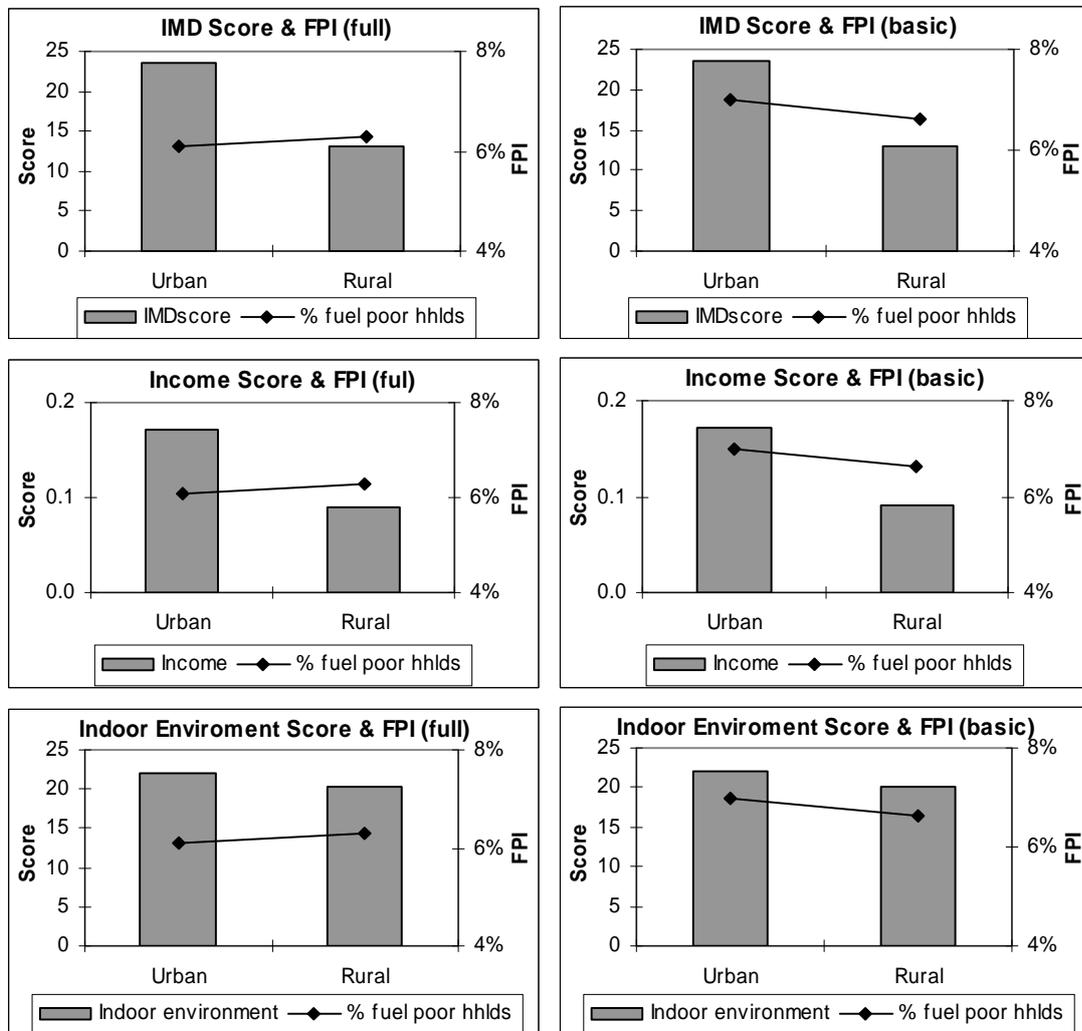
Table 6 shows that ‘general deprivation’ and ‘income poverty’ are both notably higher in urban areas than rural. The urban/rural difference for the ‘indoor environment’ deprivation score is much less pronounced. As commented earlier, fuel poverty is slightly higher in rural areas than urban areas on the ‘full income’ definition but slightly lower on the other two definitions.

¹⁴ The ‘Indices of Deprivation 2007’ are available to download at <http://neighbourhood.statistics.gov.uk>

3.4.3 Comparing 'full' and 'basic' income fuel poverty with deprivation

Figure 5 below compares the urban/rural differences in fuel poverty (using the 'full' and 'basic' definitions) with the three forms of deprivation selected for this analysis.

Figure 5: IMD scores and fuel poverty (full and basic definitions)

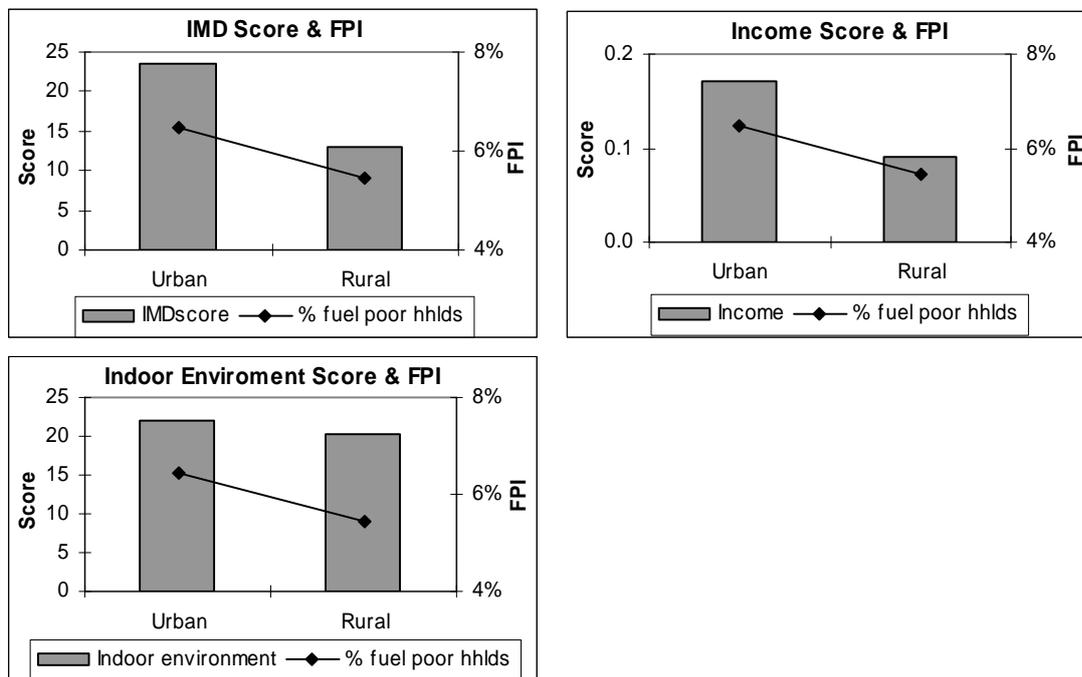


The graphs above illustrate the contrasting trends with respect to urban/rural differences in fuel poverty rates (full and basic income) and the three deprivation indicators considered. While the urban/rural trends in fuel poverty rates and the three deprivation indicators show the same trend on the 'basic income' definition, it is striking that the differences are much more pronounced for general deprivation and income poverty than for fuel poverty. The indoor environment trend appears fairly similar to the fuel poverty (basic income) trend.

3.4.3 Comparing 'basic equivalised' fuel poverty with deprivation

Figure 6 below compares the urban/rural trend between each of the three deprivation indicators and 'basic equivalised' fuel poverty.

Figure 6: IMD scores and fuel poverty (basic equivalised definition)



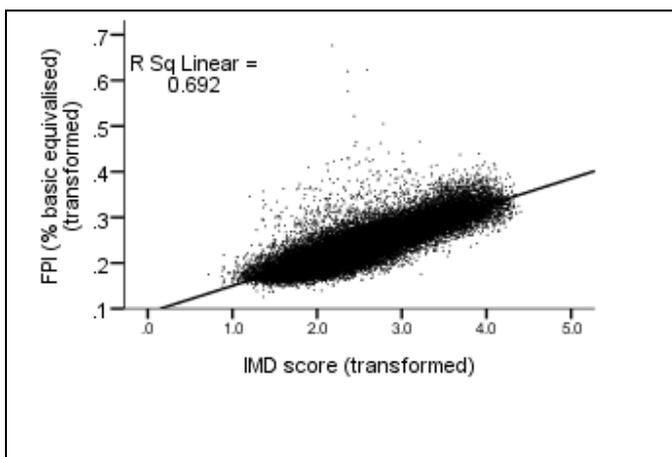
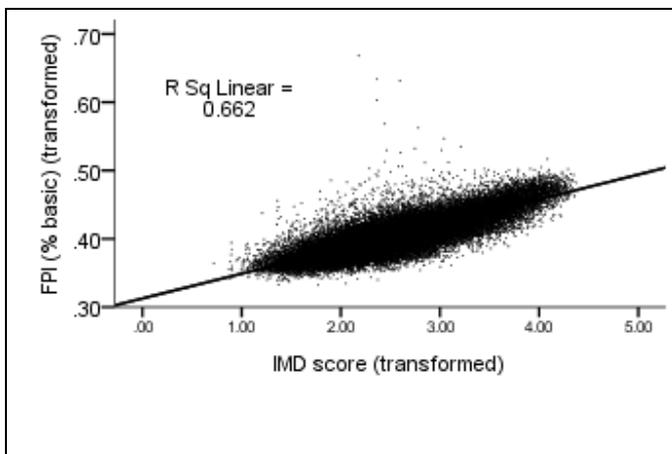
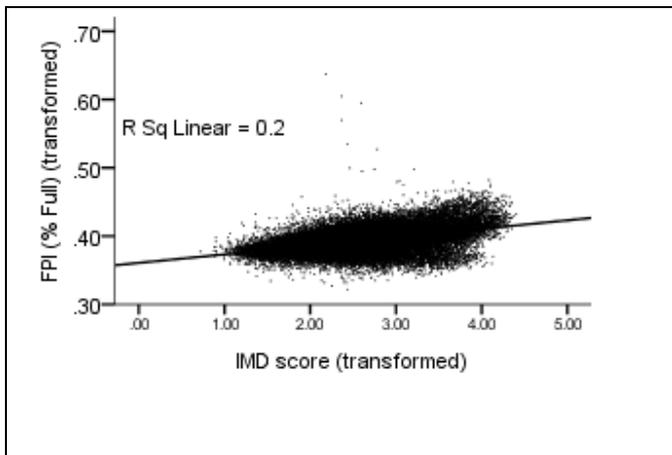
The graphs suggest that the urban/rural fuel poverty (basic equivalised) trend is fairly similar to the general deprivation and income deprivation trends. The urban/rural difference for the indoor environment trend is much less pronounced than for the fuel poverty trend.

3.4.4 Influence of fuel poverty definitions on the relationship between fuel poverty and general deprivation

Figure 7 below shows the correlation between fuel poverty and general deprivation according to each of the three fuel poverty definitions. The FPI and IMD scores were transformed to achieve normal distributions; hence the axis scales are not directly interpretable. Figure 7 shows that there is a strong correlation between fuel poverty and the IMD according to the 'basic' and 'basic equivalised' income definitions, whereas there is little correlation on the 'full income' definition.

The graphs illustrate the influence of housing costs on the relationship between fuel poverty and general deprivation. The basic income (equivalised and non-equivalised) definitions, although not the same as an After Housing Costs income definition (as noted earlier), are less influenced by variations in housing costs between small areas than the full income definition. Thus, the distribution of 'basic income' fuel poverty is fairly similar to the distribution of general deprivation, unlike 'full income' fuel poverty. Gordon & Fahmy made a similar observation about the distribution of fuel poverty (see maps in Annex 4) in their report of the fuel poverty indicator methodology (Gordon & Fahmy, 2007).

Figure 7: Relationship between fuel poverty and deprivation



3.4.5 Fuel poverty and other forms of deprivation – summary

The above analysis suggests that the urban/rural contrast between fuel poverty and other forms of deprivation observed in the interim report may to some extent arise from definitional issues. When fuel poverty is measured in a similar way to other forms of deprivation (for example, incomes are equivalised

and income excludes most housing costs), fuel poverty displays similar trends to other forms of deprivation.

Nevertheless, important differences remain between fuel poverty and other forms of deprivation whichever definition is used. Fuel poverty is more pronounced in private housing than other forms of deprivation because, in general, energy efficiency standards in social housing have improved markedly over recent years. Fuel poverty is even more pronounced among older people than other forms of deprivation because older people have higher heating needs due to their physiology and greater amounts of time spent in the home.

Rurality represents a higher risk factor for fuel poverty, compared to other forms of deprivation because of the nature of housing stock in rural areas (i.e. 'hard to treat' is much more extensive). 'Remote rurality' (villages and hamlets) is a particularly significant risk factor for low income households due to the higher fuel costs they face.

These observations have important implications for understanding the equity of the distribution of Warm Front funding between urban and rural areas. The following section investigates this.

3.5 Take-up of Warm Front Grants

3.5.1 Introduction

The interim report showed that Warm Front take-up rates (for grants delivered between 2000 and 2003) were significantly lower in rural areas than urban (Baker & Preston, 2006). Furthermore, take-up rates generally declined with increasing dispersal of settlement type; this difference was significant for each pair of settlement types, with the exception of the difference between 'villages' and 'hamlets'. Thus, the more rural an area was, the less likely households living within that area were to receive Warm Front grants. This trend, with a few exceptions, was found in each of the five regions investigated (London was not included in the analysis because it is almost entirely 'urban').

The interim report went on to observe that the analysis was not able to take into account any differences in levels of need between urban and rural areas. Thus, the differences reported may have been due to differences in levels of need between urban and rural areas. CSE therefore re-ran the analysis for this report and in doing so took the opportunity to:

- Update the analysis by considering Warm Front grants delivered between April 2000 and April 2008.
- Incorporate a 'relative need' factor to the analysis by exploring the relationship between Warm Front take-up and 'basic equivalised' fuel poverty, as defined by the University of Bristol/CSE fuel poverty indicator (see Section 3.3.1 for explanation of why this definition was used).
- Investigate whether Warm Front take-up in rural areas improved between 2000-2005 and 2005-2008. Such improvement may have come about as a result of scheme innovations introduced in 2005, e.g. improvements to measures offered and the establishment of targets for 'hard to treat' and 'hard to reach' households (see Section 2.2.5).
- Exclude grants awarded for 'CFLs only' on the grounds that CFLs only have a minor impact on fuel poverty levels.
- Investigate urban/rural difference in Warm Front take-up for all of the English regions (rather than the five regions considered in the interim report) for the 2005-2008 period. Again we excluded London because it is almost entirely urban.

3.5.2 Analysing the distribution of Warm Front grant: issues

The research aims to show whether Warm Front grants are equitably distributed between urban and rural areas, taking need into account. Geographic equity in the context of fuel poverty is defined as “a distribution of fuel poverty resources to individual areas that reflects the level of fuel poverty need in those areas” (Baker et al, 2007). Central to ‘geographic equity’ is the notion of ‘territorial justice’ in which policy aims to ensure that the area allocation of resources reflects area need.

Baker’s study of geographic equity found that stakeholders interviewed for the research disagreed as to whether territorial justice was relevant to fuel poverty services (mainly delivery of Warm Front grants). Some argued that it is a case of ‘when’, rather than ‘where’. That is, all fuel poor households should eventually receive help, regardless of where they live; the issue is more about when they receive help. Others considered the issue was taking on increasing significance, particularly with the recent policy drive towards ‘area-based’ approaches to fuel poverty reduction (Defra, 2007).

This study starts with an assumption that geographic equity between urban and rural areas in delivering Warm Front grants is an important concern. However, commentators have raised a number of issues about analysing the allocation of Warm Front take-up by area. The table below summarises the key issues and our response to these.

Issue	Response
Eligibility for Warm Front is based on benefit status, not fuel poverty status. Thus, area differences in take-up reflect variations in benefit levels not variations in fuel poverty.	Warm Front is explicitly intended to reduce fuel poverty. If eligibility criteria are preventing it from effectively meeting this goal, it is important to know this. Low rates of benefit take-up are an acknowledged problem in rural areas (Naji & Griffiths, 1999). The research used the ‘basic equivalised’ definition precisely because it represents a closer approximation to means-tested benefit eligibility criteria than other definitions.
Warm Front is only intended for private sector households, whereas the Fuel Poverty Indicator (FPI) measures fuel poverty in all tenures.	There is no straightforward solution to this issue. However, the construction of the FPI is weighted towards private sector housing since it reflects the preponderance of fuel poverty in this sector.
Local activity, e.g. by individual local authorities, has an important influence on take-up levels within an area; however, such activity is not necessarily related to need.	It is reasonable to hypothesise that ‘rurality’ represents a barrier to focussed local activity, e.g. it is easier to increase awareness in an inner city area where there are large concentrations of deprivation than in a remote rural area where deprivation is more dispersed.
Warm Front is not designed to provide measures for hard to treat properties.	Hard to treat is a major issue in rural areas. Warm Front should therefore provide measures suitable for hard to treat properties, if it is to effectively tackle rural fuel poverty.
Some areas may have low take-up because local authorities or other agencies have already installed a wide range of measures through other programmes, e.g. EEC.	This may be the case in certain specific areas but is unlikely to apply ‘across the board’. The analysis examines trends across all areas. If statistically significant differences are found at the aggregated level, this would suggest the problem is ‘real’.

3.5.3 Summary statistics on Warm Front take-up

Table 7 below shows the urban and rural rates of Warm Front take-up (2000-2008) by region. The table also gives fuel poverty data for the regions according to the 'basic equivalised' definition.

Table 7: Urban/rural differences in Warm Front take-up by region

Region	Rural/ urban	Total households	No. fuel poor h/hds (basic equivalised)	% fuel poor	Total WF grants 2000- 2008 ¹	Average annual number of grants ²	Annual take-up rel. to fuel poverty ³	% of WF grants (no. of grants in area/ total no. in region)	% of FP h/hds (no. of FP in area/ total no. in region)
East Midlands ¹	Urban	1,229,085	81,401	6.6%	33,833	11,278	13.9%	74%	74%
	Rural	503,489	28,439	5.6%	11,695	3,898	13.7%	26%	26%
East of England ¹	Urban	1,522,894	84,506	5.5%	29,429	9,810	11.6%	69%	70%
	Rural	681,142	35,771	5.3%	13,185	4,395	12.3%	31%	30%
London	All	3,016,393	209,388	6.9%	119,064	14,883	7.1%	-	-
North East	Urban	863,300	62,254	7.2%	158,664	19,833	31.9%	83%	82%
	Rural	202,825	13,921	6.9%	32,327	4,041	29.0%	17%	18%
North West	Urban	2,480,670	173,359	7.0%	480,385	60,048	34.6%	94%	90%
	Rural	333,126	18,316	5.5%	30,390	3,799	20.7%	6%	10%
South East	Urban	2,567,003	133,142	5.2%	152,803	19,100	14.3%	85%	80%
	Rural	720,628	33,562	4.7%	26,897	3,362	10.0%	15%	20%
South West	Urban	1,389,306	81,969	5.9%	101,325	12,666	15.5%	72%	67%
	Rural	697,033	40,113	5.8%	39,914	4,989	12.4%	28%	33%
West Midlands	Urban	1,818,325	121,649	6.7%	286,507	35,813	29.4%	93%	87%
	Rural	335,128	18,197	5.4%	20,612	2,577	14.2%	7%	13%
Yorkshire & Humber ¹	Urban	1,657,579	120,849	7.3%	50,881	16,960	14.0%	82%	83%
	Rural	407,078	23,939	5.9%	10,808	3,603	15.0%	18%	17%
All regions	Urban	16,539,023	1,068,238	6.5%	468,867	156,289	18.8%	84%	83%
	Rural	3,885,981	212,538	5.5%	88,148	29,383	14.4%	16%	17%
All regions - London	Urban	13,528,162	859,128	6.4%	349,948	141,424	21.4%	80%	80%
	Rural	3,880,449	212,259	5.5%	88,003	29,365	14.4%	20%	20%

¹ Data for East Midlands, East of England and Yorkshire & Humber was only available for the 2005-2008 period. The number of grants delivered in these regions is therefore lower.

² Total number of grants/number of years grant delivered: 3 years for East Midlands, East of England and Yorkshire & Humber (2005-08); 8 years for all other regions (2000-08)

³ Of course many Warm Front grants go to non-fuel poor households. The actual proportion of Warm Front grants received by fuel poor households is therefore much lower than that shown. The results are therefore only indicative.

Table 7 shows that the annual take-up of Warm Front grants relative to fuel poverty was higher in urban areas than rural in 'all England' and in each individual region, with the exception of East England and Yorkshire & Humber. However, data for these two regions only applies to the 2005-8 period.

The last two columns of table 7 show that 13% of fuel poor households in the West Midlands live in rural areas, whereas only 7% of the region's Warm Front grants were distributed here. Similar imbalances, although not as marked, exist in the South East, South West and North West. In the four remaining regions, the distribution of grants broadly reflects the difference between urban and rural areas with respect to proportions of households in fuel poverty.

3.5.4 The influence of rurality on Warm Front take-up

Figure 8 below shows the take-up of Warm Front grants relative to fuel poverty by settlement type for all of England.

Figure 8: Take-up of Warm Front grants relative to fuel poverty (basic equivalised)

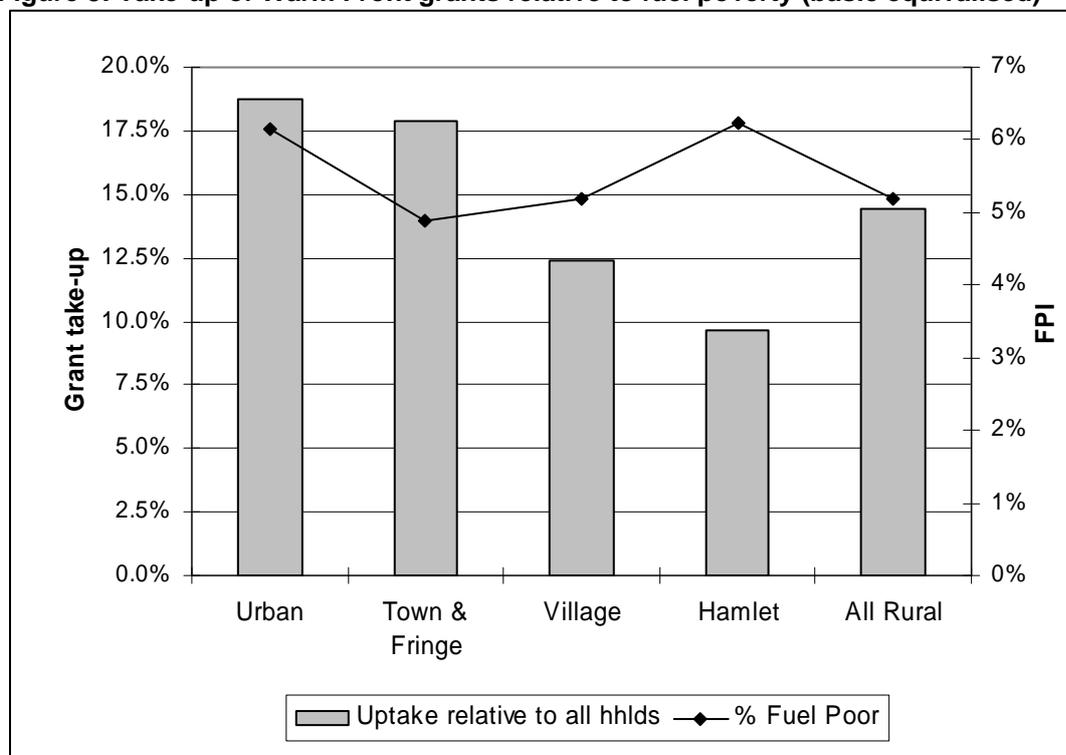
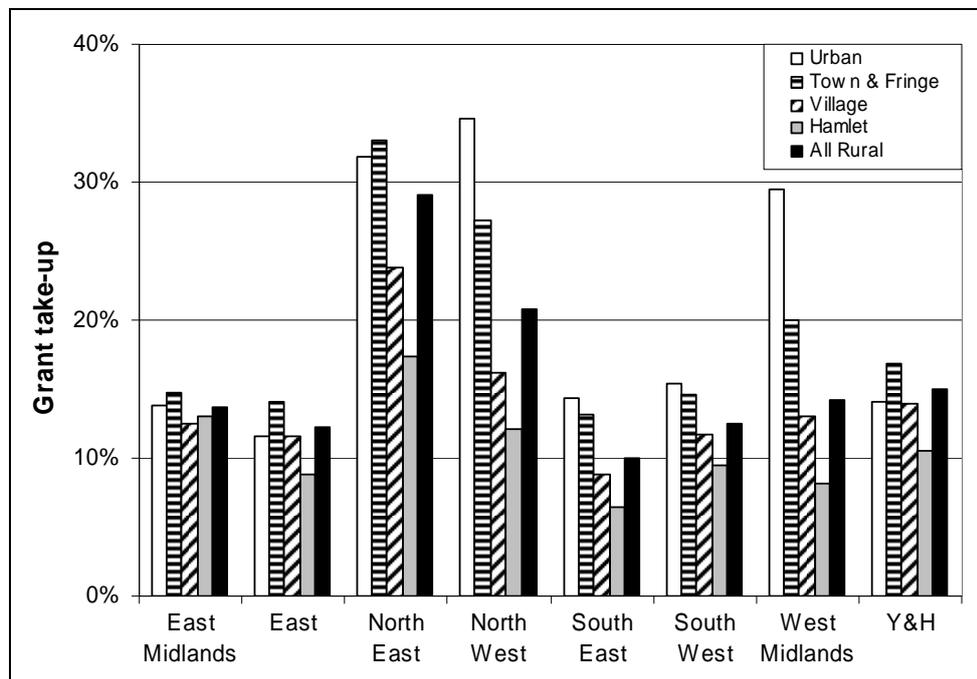


Figure 8 suggests that the take-up of Warm Front grants relative to fuel poverty declines with increasing rurality. Take-up rates are particularly low in hamlets, despite their relatively high levels of fuel poverty. By contrast, urban areas have relatively high fuel poverty levels but take-up rates are also relatively high. The difference in take-up rates between each pair of settlement types was found to be statistically significant (using the post-hoc Tukey test).

Figure 9 below shows the take-up of Warm Front grants relative to fuel poverty by settlement type and region. The graph shows that the take-up is highest in the North East and North West and lowest in the South East. The high rates for the North East and North West would suggest, on first sight, that Warm Front is going a long way towards reaching its target audience (the graph suggests that around a third of fuel poor households have received Warm Front grants in urban areas). However, it is important to note that fuel poverty has risen considerably since 2003 (the date of the FPI) and many

Warm Front grants are distributed to non-fuel poor households. The true figure for target efficiency is therefore likely to be much lower.

Figure 9: Take-up of Warm Front grants relative to fuel poverty (basic equivalised): all regions



In the North East, North West, South East, South West and West Midlands take-up of grants relative to fuel poverty is substantially higher in urban areas than 'all rural' areas. For the remaining regions, the difference is minor (and slightly higher in rural areas in Yorkshire & Humber and East England). In all regions take-up is lowest in hamlets, with the exception of the East Midlands where it is slightly lower in villages.

Figure 9 suggests there are significant differences in take-up rates, relative to fuel poverty levels, between settlement types in all regions. Table 8 below shows whether these differences are statistically significant for each pair of settlement types (using ANOVA and the post hoc Tukey test). Non-significant results are highlighted.

Table 8: ANOVA results for WF take up relative to fuel poverty by settlement type and region

		East Mids	East	North East	North West	South East	South West	West Mids	Y&H
	F statistic	15.38	27.43	54.61	325.03	182.83	142.65	419.18	29.60
Urban	Town	0.98	0.00	0.99	0.00	0.00	0.00	0.00	0.00
	Village	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03
	Hamlet	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Town	Urban	0.98	0.00	0.99	0.00	0.00	0.00	0.00	0.00
	Village	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Village	Urban	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03
	Town	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.96	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Hamlet	Urban	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Village	0.96	0.00	0.03	0.00	0.00	0.00	0.00	0.00

Table 8 shows that the differences are significant in almost all cases. The exceptions are the differences between ‘urban’ areas and ‘towns’ in the East Midlands and North East and between ‘villages’ and ‘hamlets’ in the East Midlands.

3.5.5 Distribution of Warm Front grants: comparing 2000-2005 and 2005-2008

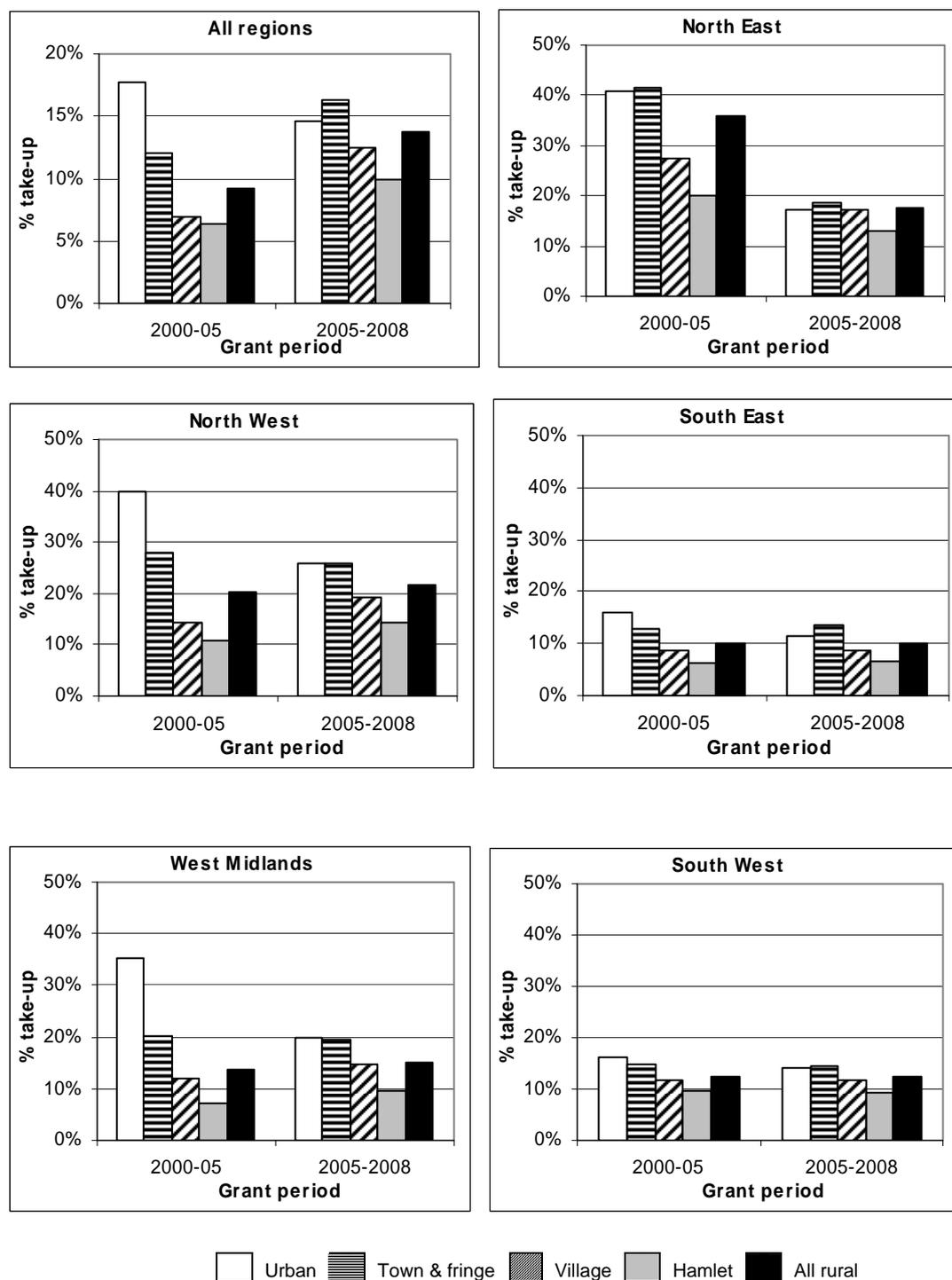
Table 9 below compares Warm Front take-up relative to fuel poverty between the 2000-2005 and 2005-2008 periods. Average annual take-up rates are used, rather than total take-up, to enable comparison between the two periods. 2005 was chosen as the threshold because of the improvements introduced to Warm Front that year, e.g. more measures offered, introduction of targets for ‘hard to treat’ and ‘hard to reach’. These reforms should have helped improve take-up rates in rural areas. Data was not available for 2000-2005 for the three regions in which eaga was not the Warm Front managing agent (highlighted in grey).

Table 9: Warm Front grants and take-up rates: 2000-2005 and 2005-2008

Region	Rural/ urban	Total WF grants		Average annual no. of grants		Take-up relative to fuel poverty	
		2000-2005	2005-2008	2000-2005	2005-2008	2000-05	2005-2008
East Midlands	Urban	2	33,831	0	11,277	0.0%	13.9%
	Rural	3	11,692	1	3,897	0.0%	13.7%
East of England	Urban	2	29,427	0	9,809	0.0%	11.6%
	Rural	2	13,183	0	4,394	0.0%	12.3%
London	All	84,225	34,839	16,845	11,613	8.0%	5.5%
North East	Urban	126,756	31,908	25,351	10,636	40.7%	17.1%
	Rural	24,980	7,347	4,996	2,449	35.9%	17.6%
North West	Urban	346,657	133,728	69,331	44,576	40.0%	25.7%
	Rural	18,572	11,818	3,714	3,939	20.3%	21.5%
South East	Urban	106,615	46,188	21,323	15,396	16.0%	11.6%
	Rural	16,686	10,211	3,337	3,404	9.9%	10.1%
South West	Urban	66,179	35,146	13,236	11,715	16.1%	14.3%
	Rural	25,101	14,813	5,020	4,938	12.5%	12.3%
West Midlands	Urban	213,516	72,991	42,703	24,330	35.1%	20.0%
	Rural	12,405	8,207	2,481	2,736	13.6%	15.0%
Yorkshire & Humber	Urban	1	50,880	0	16,960	0.0%	14.0%
	Rural	2	10,806	0	3,602	0.0%	15.0%
All regions	Urban	1,412,746	943,879	200,373	188,776	17.7%	14.6%
	Rural	185,973	97,825	30,682	19,565	9.2%	13.8%
All regions - London	Urban	1,328,595	909,111	183,543	177,186	20.6%	16.5%
	Rural	185,899	97,754	30,667	19,541	9.2%	13.8%

Table 9 shows that the difference in take-up rates relative to fuel poverty between urban and rural areas was much less pronounced in the 2005-2008 period, compared with 2000-2005. In the East, North East and Yorkshire & Humber, take-up was actually higher in rural areas than urban. Figure 10 overleaf shows a much ‘flatter’ relationship in take-up rates between settlement types in the second period for each of the five regions in which it was possible to make a comparison. Similarly, take-up in the three ‘new’ eaga regions was very evenly spread between urban and rural areas for the 2005-08 period, although it was not possible to compare this with previous years.

Figure 10: Take-up of Warm Front relative to fuel poverty, by region and settlement type



Note: Graphs compare take up between 2000-05 and 2005-08 for the original five eaga regions only. London is not included.

Figure 10 above suggests that the Warm Front ‘reach’ to fuel poverty in rural areas improved considerably after 2005, although there are still some differences between settlement types. For example, take-up is still lowest in hamlets in each of the five regions over the second period. Table 10 below shows the significance results (using the post-hoc Tukey test) for each pair of settlement types over the two periods. Non-significant results are highlighted.

Table 10: Significance results for WF take-up by settlement type, region and grant period

		North East		North West		South East		South West		West Mid		Five regions combined	
		2000-2005	2005-2008	2000-2005	2005-2008	2000-2005	2005-2008	2000-2005	2005-2008	2000-2005	2005-2008	2000-2005	2005-2008
F statistic		55	10	360	79	180	78	119	74	434	100	1419	482
Urban	Town	0.89	0.78	0.00	0.83	0.00	0.00	0.00	0.03	0.00	0.17	0.00	0.00
	Village	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Town	Urban	0.89	0.78	0.00	0.83	0.00	0.00	0.00	0.03	0.00	0.17	0.00	0.00
	Village	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Village	Urban	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hamlet	0.17	0.01	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Hamlet	Urban	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Town	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Village	0.17	0.01	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00

Table 10 shows that the difference in take-up rates relative to fuel poverty for each pair of settlement types remains significant in most cases for the second grant period¹⁵. The main exception is in the North East, where the only significant difference is between hamlets and all other settlements. Table 10 suggests that take-up rates in rural areas relative to urban areas improved considerably in the second period, as reflected in the lower F statistic. However, much of this improvement is likely to be due to the increased take-up rates in 'towns'. Take-up is still low in hamlets despite the relatively high fuel poverty rates in this settlement type.

¹⁵ However, note that the difference between 'urban' and 'town' is either not statistically significant or where it is, take-up is actually higher in 'towns'. This will tend to increase the rates in 'all rural' areas in general.

4 CONCLUSIONS & RECOMMENDATIONS

The analyses of 'off-gas' and 'solid wall' properties found that both issues (collectively referred to as 'hard to treat') were more extensive in rural areas than urban. This was particularly the case for 'off-gas' properties. Further, the extent of hard to treat problems increased with increased settlement dispersal (the urban exception being London, which also has a high proportion of solid wall properties).

The British Household Panel Survey found that rural households spent more than urban households on fuel in 2002 for every single fuel type (oil, electricity, gas and 'other') (Commission for Rural Communities, 2005). This compounds the fact that rural households are generally reliant on more expensive fuels, due to the lack of access to gas.

The problems of 'hard to treat' properties and high fuel costs may help explain why fuel poverty appears to be at a similar level, if not higher, in rural areas compared to urban, while income deprivation is generally lower. However, it is important to note that the trend is reversed if the 'basic income' or 'basic equivalised income' definitions of fuel poverty are used. Nevertheless, the research found that fuel poverty is high under all definitions in more dispersed rural settlement types, particularly hamlets. Thus, fuel poverty can be characterised as a phenomenon of urban and remote rural areas.

The research found that Warm Front take-up relative to fuel poverty over the 2000-08 period was higher in urban areas than rural. Take-up was particularly low in 'villages' and 'hamlets & isolated dwellings'. However, the research also found that take-up improved considerably in rural areas in the 2005-08 period compared to the 2000-05 period, although much of this improvement took place in 'town & fringe' areas. It therefore appears that Warm Front is now successfully reaching eligible households in 'towns' but that take-up is still a problem in more remote rural areas, particularly 'hamlets'. This is despite the fact that fuel poverty is relatively high in this settlement type.

A number of reports have commented on the 'mis-match' between benefit status and fuel poverty status (e.g. NAO, 2003; CSE/NEA, 2005). These reports estimate that between 25% and 33% of fuel poor households are not claiming the Warm Front grants. Similarly, the 2005 English House Condition Survey (EHCS) found that 42% of fuel poor households (full income definition) did not claim means-tested benefits (BERR, 2008).

The 'mismatch' problem may in part arise from fuel poverty definitions. Under the 'basic income' definition, the 2005 EHCS found that 25% of fuel poor households did not claim benefits. This figure may be lower still if a 'basic equivalised' definition is used (the EHCS does not provide equivalised data), since it represents a closer approximation to means-tested benefit eligibility criteria than other definitions. However, other possible explanations may include fuel poor households are not claiming the Warm Front passport benefits to which they are entitled or that some households with modest incomes just above benefit levels are vulnerable to fuel poverty because of the very low energy efficiency standards of their homes.

The research found that fuel poverty is more closely related to general deprivation and 'income poverty' under the 'basic' and 'basic equivalised' definitions. There is little relationship under the 'full income' definition. The interim report speculated that the 'mis-match' between benefit status and fuel poverty status may be particularly pronounced in rural areas due to the extensive problem of 'hard to treat' properties. Thus, Warm Front take-up is low in rural areas because many fuel poor households

are just above benefit levels (i.e. their fuel poverty is more a function of high fuel costs than low income). However, this research suggests that mis-match may be less of an issue if different fuel poverty definitions are used.

The research also found that take-up has improved in towns, suggesting that Warm Front is reaching some rural areas. However, Warm Front 'reach' to more remote rural areas has not improved to the same extent. This is despite the relatively high fuel poverty levels in these areas. Possible explanations for this problem may include:

- Lower take up of Warm Front passport benefits among eligible households in remote rural areas, due to lack of information services and possibly 'cultural factors' associated with rural populations (Baker, 2002; Citizens Advice, 1999).
- High fuel costs for properties in remote rural areas due to the high levels of 'hard to treat' problems may mean that some fuel poor households above benefit levels are not eligible for Warm Front.
- Few appropriate measures for rural properties are available in Warm Front packages. Loft insulation is the only major measure available, given the low proportion of properties built with cavity walls and the lack of access to gas in rural areas, coupled with high oil prices¹⁶. Thus, households see little value in applying for Warm Front grants.

It would be relatively straightforward to investigate this latter factor by exploring the type of Warm Front measures delivered according to settlement type. This could be carried out through analysis of the Warm Front database supplied by eaga to CSE for this research. However, this would require further research that is beyond the scope of this project.

Recommendations

1. While Warm Front take-up has improved in market towns, Warm Front is still not adequately reaching fuel poor households in remote rural areas despite their relatively high levels of fuel poverty. Defra should recognise the additional costs of delivering Warm Front in remote rural areas due to longer travelling times and dispersed populations etc. It should set targets for delivery of Warm Front in 'villages' and 'hamlets' proportionate to fuel poverty levels in these settlement types.
2. There is considerable under-claiming of benefits and tax credits among rural households which further exacerbates the poor take-up of Warm Front among rural fuel poor households. Community development and other outreach activities are particularly effective in encouraging take-up among rural households. DWP and Defra should therefore jointly fund outreach activities in rural areas to encourage improved take-up. The Welsh Assembly Government's funding of welfare rights advice sessions in rural GP surgeries has helped improve benefits take-up among rural households. Similar advice and information initiatives should be carried out in rural areas of England, including advice on Warm Front. Increased benefit take-up will both improve incomes and increase access to Warm Front, both of which will contribute to the reduction of fuel poverty.
3. Even with improved take-up of passport benefits, it is likely that many fuel poor households in more remote rural areas will not be eligible for Warm Front. Defra should consider introducing

¹⁶ Oil central heating was introduced to the Warm Front package in summer 2005 as a low running cost heating option for rural households. However, it is possible that many fuel poor households will now be reluctant to take up this option, given the large increase in domestic oil prices that has taken place over the past couple of years (considerably larger than the corresponding rises in gas and electricity prices).

more flexible eligibility criteria for Warm Front in cases where there is a clear demonstration of need. For example, certain front-line staff, such as health workers, could refer clients for help following a simple assessment of need.

4. Many fuel poor households in rural areas require expensive measures to take them out of fuel poverty due to the high levels of hard to treat housing in rural areas. Measure options include solid wall insulation, ground and air source heat pumps, biomass boilers, solar thermal and, for larger rural settlements, communal biomass CHP/district heating. These solutions are considerably more expensive than the maximum Warm Front grant (£4,500 in the case of oil condensing boilers). However, these costs should come down with escalated installation rates due to improved economies of scale. Defra should include suitable measures for hard to treat properties within the Warm Front scheme and raise grant maxima for cases where such measures are suitable.
5. CLG should recognise the additional costs of achieving affordable warmth in hard to treat social housing, and ensure sufficient funds are available for social housing providers to install the more expensive measure options required. Setting a SAP81 target¹⁷ within the successor to the Decent Homes programme would ensure occupants of such properties should not live in fuel poverty. This could require the installation of low/zero carbon technologies in a large number of properties, particularly hard to treat, with consequent environmental benefits.
6. The Design and Demonstration Unit within BERR has carried out a number of innovative initiatives to extend the gas network and install renewable technologies in areas currently off the gas network. However, only 4,000 households to date have benefited from these initiatives. The Treasury should re-consider its rejection of the former DTI's 2006 £95m spending proposal to extend the gas network to 200,000 households. This would have a major impact on reducing fuel poverty among rural households.
7. While gas network extension, solid wall insulation and renewable technologies provide long-term physical solutions to tackling rural fuel poverty (and for households living in hard to treat properties in urban areas), more immediate policies are required in the interim. Given the reliance of many rural households on oil and LPG, there is a strong case for regulation of these sectors, including improved consumer protection, transparent pricing and the establishment of easy pay schemes to enable bulk purchase of oil.
8. The research found that fuel poverty was more closely related to general deprivation under the 'basic' and 'basic equivalised' definitions of fuel poverty. It is likely that this correlation would be stronger still with an 'After Housing Costs' (AHC) income definition of fuel poverty. The research found that it was difficult to evaluate the effectiveness of Warm Front in reaching fuel poor households under the Government's preferred 'full income' fuel poverty definition, particularly with respect to equity between urban and rural areas. This is because non-equivalised incomes are very different to the measurement of income used for establishing eligibility for benefits.

The Government should therefore develop both AHC and equivalised definitions of fuel poverty. This would enable more meaningful comparison of fuel poverty in different geographic areas (since variations in housing costs will not affect fuel poverty rates); better evaluation of the targeting effectiveness of fuel poverty programmes (since equivalised incomes more closely approximate to benefit eligibility criteria); and improved comparison of fuel poverty with other forms of deprivation (which tend to use both equivalised and AHC definitions of income).

¹⁷ With the rapid rise in fuel prices over recent years, many now consider that SAP 81 is the minimum standard required to ensure a property is 'fuel poverty proofed', assuming optimal occupancy and households claim all benefits to which they are entitled (e.g. Boardman, 2007). This standard equates to the standard of a new home built today and to Energy Performance Certificate level B.

ANNEX 1: CONSTRUCTION OF CENSUS OUTPUT AREAS

Arguably the most significant innovation in the 2001 Census is that the output geography used for the production of Census tables is different from the data collection areas. All previous Census since 1841 used Enumeration Districts to both collect Census data and also as a basis for producing Census tables, i.e. the geography of data collection and table output were the same.

Unfortunately, Enumeration Districts have limited social meaning as they are designed primarily to equalise as far as possible the workloads of enumerators (Clark and Thomas, 1990) i.e. in 'difficult' to collect areas they are often smaller or contain fewer people/households than in 'easier' to collect areas. In the 2001 Census, the Output Areas for which detailed tables are published differ from the Enumeration Districts. The Output Areas were constructed by amalgamating the 1.7 million unit postcodes into larger areas containing a minimum 40 households and 100 residents for *Census Area Statistics* and a minimum of 400 households and 1,000 people for *Standard Tables*.

These Output Areas were conducted using the Census data by an automated zone design methodology based on the automated zoning procedure (AZP) originally developed by Openshaw (1977). AZP operates by the iterative recombination of a series of building block zones into Output Areas, in such a way as to maximize the value of some objective functions and thus produce socially homogeneous areas (Martin et al, 2001; Martin, 2002). The homogeneity measure used in the 2001 Census consisted of four tenure categories and seven dwelling types:

Tenure

1. Owner-occupied
2. Rented privately
3. LA/HA
4. Other

Dwelling Type

1. Detached
2. Semi-detached
3. Terraced
4. Flat
5. Part-house
6. Commercial
7. Non permanent

Thus, the Output Areas in the 2001 Census are amalgamations of 1.7 million unit postcode areas which contain similar dwellings and occupational tenures, e.g. semi-detached houses in owner occupation, local authority flats, etc. The Output Areas are the smallest areas for which detailed Census tables are available (although four Census statistics are available for all 1.7 million unit postcode areas).

ANNEX 2: THE FUEL POVERTY INDICATOR METHODOLOGY

The methodology for the updated CSE/Bristol University fuel poverty indicator (FPI), in brief, is based on a predictive model in which the vulnerability of different groups of households to fuel poverty is estimated using 2003 English House Condition Survey (EHCS) data. The model uses binary logistic regression to predict the odds of fuel poverty for households of different types, and then applies the results of the model to 2001 Census data. The research has produced four models of fuel poverty, according to different definitions of fuel poverty:

- The 'full income' definition (Housing Benefit and Council Tax Benefit are included as income), using a 'non-equivalised' definition of income (the Government's preferred definition).
- The 'basic income' definition (Housing Benefit and Council Tax Benefit are not included as income), using an 'non-equivalised' definition of income (the Government also presents fuel poverty statistics on this definition).
- The full income definition, using an 'equivalised' definition of income.
- The basic income definition, using an 'equivalised' definition of income.

Equivalisation describes the process by which incomes are adjusted to take account of differences in household size and composition. It is standard practice in both international and UK surveys that include income measurement (with the exception of the English House Condition Survey). For example, the United Nations Expert Group on Household Income Measurement (Canberra Group) recommended "*that income should be adjusted to take account of household size, using equivalence scales.*" The Department for Work and Pensions (DWP) and the European Union both now use the Modified OECD Scale to equivalise incomes in low income and poverty statistics.

The incomes used to calculate fuel poverty in the 'equivalised' definitions were therefore adjusted according to the Modified OECD Scale. Equivalisation has very little impact on the overall rate of fuel poverty between the different definitions. However, it has a substantial impact on the composition of the fuel poor, which in turn influences the geography of fuel poverty.

The following research tasks were undertaken to produce the FPI models:

- **Data harmonisation.** Harmonisation of data from the 2003 English EHCS to the 2001 Census
- **Re-weighting.** Post-stratification weighting of 2003 EHCS data to the 2001 Census
- **RESIDATA matching.** Matching of RESIDATA post-coded data on dwelling type, age and property value to 2001 Census OA geography
- **Selecting optimal splits.** The selection of an optimal subset of variables to predict fuel poverty (e.g. using Exhaustive CHAID)

The fuel poverty models were then calibrated to the 2001 Census data to ensure that the weightings achieved 100% coverage. The final weights used to derive the small area estimates, for the non-equivalised fuel poverty definitions are shown below:

<p>The number of Basic Income FPI hhlds. =</p> <ul style="list-style-type: none"> 1.3% of hhlds. in properties valued less than £80k + 1.1% of routine/semi-routine hhlds. (HRP) + 1.4% of single pensioner households + 4.7% of single non-pensioner households + 3.7% of lone parent households + 1.9% of private rental households + 1.1% of council tenant households + 5.0% of hhlds. in which the HRP is not in work + 1.3% of households living in pre-WW1 dwellings + 1.0% of households lacking central heating + 1.1% of hhlds. without educational qualifications + 1.0% of under-occupied dwellings + 1.7% of one-person households with 7+ rooms + 2.8% of hhlds. in detached pre-WW1 dwellings 	<p>The number of Full Income FPI poor hhlds. =</p> <ul style="list-style-type: none"> 0.8% of hhlds. in properties valued less than £80k + 0.6% of routine/semi-routine hhlds. (HRP) + 1.3% of single pensioner households + 3.0% of single non-pensioner households + 1.6% of lone parent households + 0.9% of private rental households + 3.3% of hhlds. in which the HRP is not in work + 1.2% of households living in pre-WW1 dwellings + 1.0% of households lacking central heating + 1.2% of hhlds. without educational qualifications + 1.5% of under-occupied dwellings + 1.3% of one-person households with 7+ rooms + 2.2% of hhlds. in detached pre-WW1 dwellings
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A full report of the FPI methodology is available on CSE's website: www.cse.org.uk

ANNEX 3: RESULTS

Annex Table 1: Solid wall statistics

GOR	Settlement Type	No. solid wall	% solid wall	Total h/hds
London	Urban >10K	1,195,956	39%	3,049,073
	Town and Fringe	674	25%	2,748
	Village	457	26%	1,744
	Hamlet & Isolated Dwellings	428	32%	1,357
	All rural	1,559	27%	5,849
North East	Urban >10K	188,713	21%	917,542
	Town and Fringe	38,301	26%	144,661
	Village	20,386	41%	49,281
	Hamlet & Isolated Dwellings	14,743	60%	24,490
	All rural	73,430	34%	218,432
North West	Urban >10K	716,733	27%	2,644,326
	Town and Fringe	48,445	27%	179,130
	Village	45,181	41%	109,110
	Hamlet & Isolated Dwellings	37,140	58%	63,734
	All rural	130,766	37%	351,974
South East	Urban >10K	578,937	21%	2,710,462
	Town and Fringe	66,125	20%	334,392
	Village	95,879	34%	283,689
	Hamlet & Isolated Dwellings	64,459	50%	129,100
	All rural	226,463	30%	747,181
South West	Urban >10K	342,014	23%	1,458,336
	Town and Fringe	88,753	28%	320,599
	Village	102,277	35%	291,851
	Hamlet & Isolated Dwellings	64,514	53%	121,488
	All rural	255,544	35%	733,938
West Midlands	Urban >10K	403,063	21%	1,917,452
	Town and Fringe	33,339	24%	139,400
	Village	41,742	32%	132,317
	Hamlet & Isolated Dwellings	42,877	57%	74,943
	All rural	117,958	34%	346,660
All regions, not including London	Urban >10K	2,229,460	23%	9,648,118
	Town and Fringe	274,963	25%	1,118,182
	Village	305,465	35%	866,248
	Hamlet & Isolated Dwellings	223,733	54%	413,755
	All rural	804,161	34%	2,398,185

Annex Table 2: Off-gas statistics

GOR	Settlement Type	Estimated no. h/hds off gas	% h/hds off gas	Total h/hds
London	Urban >10K	134,432	4%	3,049,073
	Town and Fringe	69	3%	2,748
	Village	379	22%	,744
	Hamlet & Isolated Dwellings	399	29%	1,357
	All rural	847	14%	5,849
North East	Urban >10K	36,857	4%	917,542
	Town and Fringe	11,149	8%	144,661
	Village	23,523	48%	49,281
	Hamlet & Isolated Dwellings	16,139	66%	24,490
	All rural	50,811	23%	218,432
North West	Urban >10K	89,042	3%	2,644,326
	Town and Fringe	12,169	7%	179,130
	Village	40,686	37%	109,110
	Hamlet & Isolated Dwellings	37,119	58%	63,734
	All rural	89,974	26%	351,974
South East	Urban >10K	158,658	6%	2,710,462
	Town and Fringe	33,825	10%	334,392
	Village	133,397	47%	283,689
	Hamlet & Isolated Dwellings	69,612	54%	129,100
	All rural	236,834	32%	747,181
South West	Urban >10K	84,709	6%	1,458,336
	Town and Fringe	62,702	20%	320,599
	Village	192,128	66%	291,851
	Hamlet & Isolated Dwellings	92,065	76%	121,488
	All rural	346,895	47%	733,938
West Mids	Urban >10K	86,040	4%	1,917,452
	Town and Fringe	17,774	13%	139,400
	Village	69,578	53%	132,317
	Hamlet & Isolated Dwellings	55,415	74%	74,943
	All rural	142,767	41%	346,660
All regions, not inc. London	Urban >10K	455,306	5%	9,648,118
	Town and Fringe	137,619	12%	1,118,182
	Village	459,312	53%	866,248
	Hamlet & Isolated Dwellings	270,350	65%	413,755
	All rural	867,281	36%	2,398,185

Annex Table 3: Warm Front grant take-up (2000-2003)

GOR	Settlement Type	Total WF Grants	WF take-up rate	Total h/hds
London	Urban	49,736	1.6%	3,049,073
	Town and Fringe	11	0.4%	2,748
	Village	10	0.6%	1,744
	Hamlet	10	0.7%	1,357
	All rural	31	0.5%	5,849
North East	Urban	69,936	7.6%	917,542
	Town and Fringe	10,685	7.4%	144,661
	Village	2,228	4.5%	49,281
	Hamlet	811	3.3%	24,490
	All rural	13,724	6.3%	218,432
North West	Urban	171,992	6.5%	2,644,326
	Town and Fringe	6,673	3.7%	179,130
	Village	2,113	1.9%	109,110
	Hamlet	991	1.6%	63,734
	All rural	9,777	2.8%	351,974
South East	Urban	52,769	1.9%	2,710,462
	Town and Fringe	4,149	1.2%	334,392
	Village	2,648	0.9%	283,689
	Hamlet	973	0.8%	129,100
	All rural	7,770	1.0%	747,181
South West	Urban	29,567	2.0%	1,458,336
	Town and Fringe	4,853	1.5%	320,599
	Village	3,970	1.4%	291,851
	Hamlet	1,732	1.4%	121,488
	All rural	10,555	1.4%	733,938
W Mids	Urban	99,796	5.2%	1,917,452
	Town and Fringe	2,676	1.9%	139,400
	Village	1,758	1.3%	132,317
	Hamlet	901	1.2%	74,943
	All rural	5,335	1.5%	346,660
All regions, not inc. London	Urban	424,060	4.4%	9,648,118
	Town and Fringe	29,036	2.6%	1,118,182
	Village	12,717	1.5%	866,248
	Hamlet	5,408	1.3%	413,755
	All rural	47,161	2.0%	2,398,185

ANNEX 4: THE DISTRIBUTION OF FUEL POVERTY

The maps below illustrate how the definition of fuel poverty effects the distribution of fuel poverty across England (maps taken from Gordon & Fahmy, 2007). The first map shows the distribution of fuel poverty according to the 'full income' definition whereas the second shows the distribution according to the 'basic equivalised income' definition.

Figure 1: Full Income FPI at 2001 Middle Super Output Area Level (%)

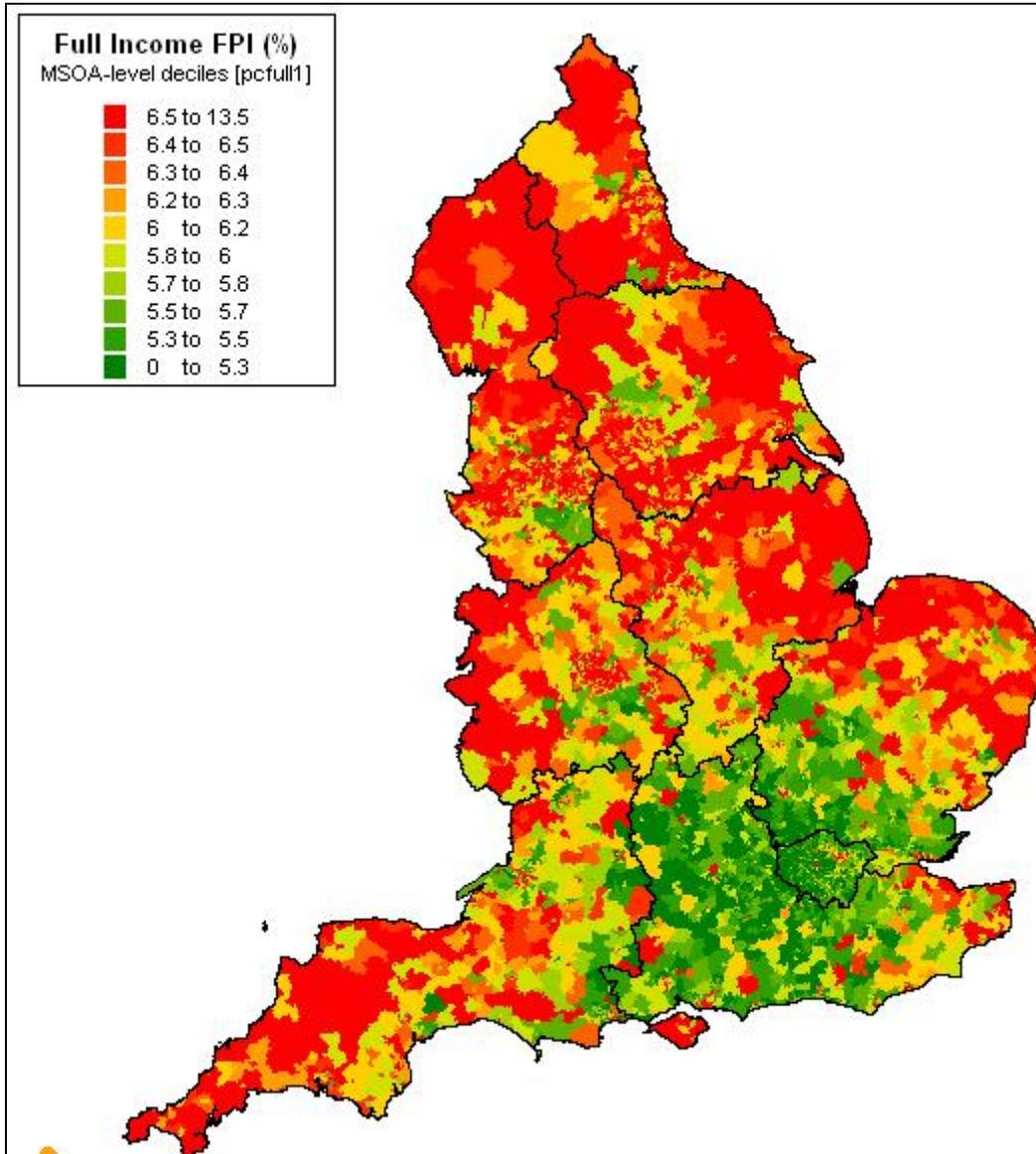
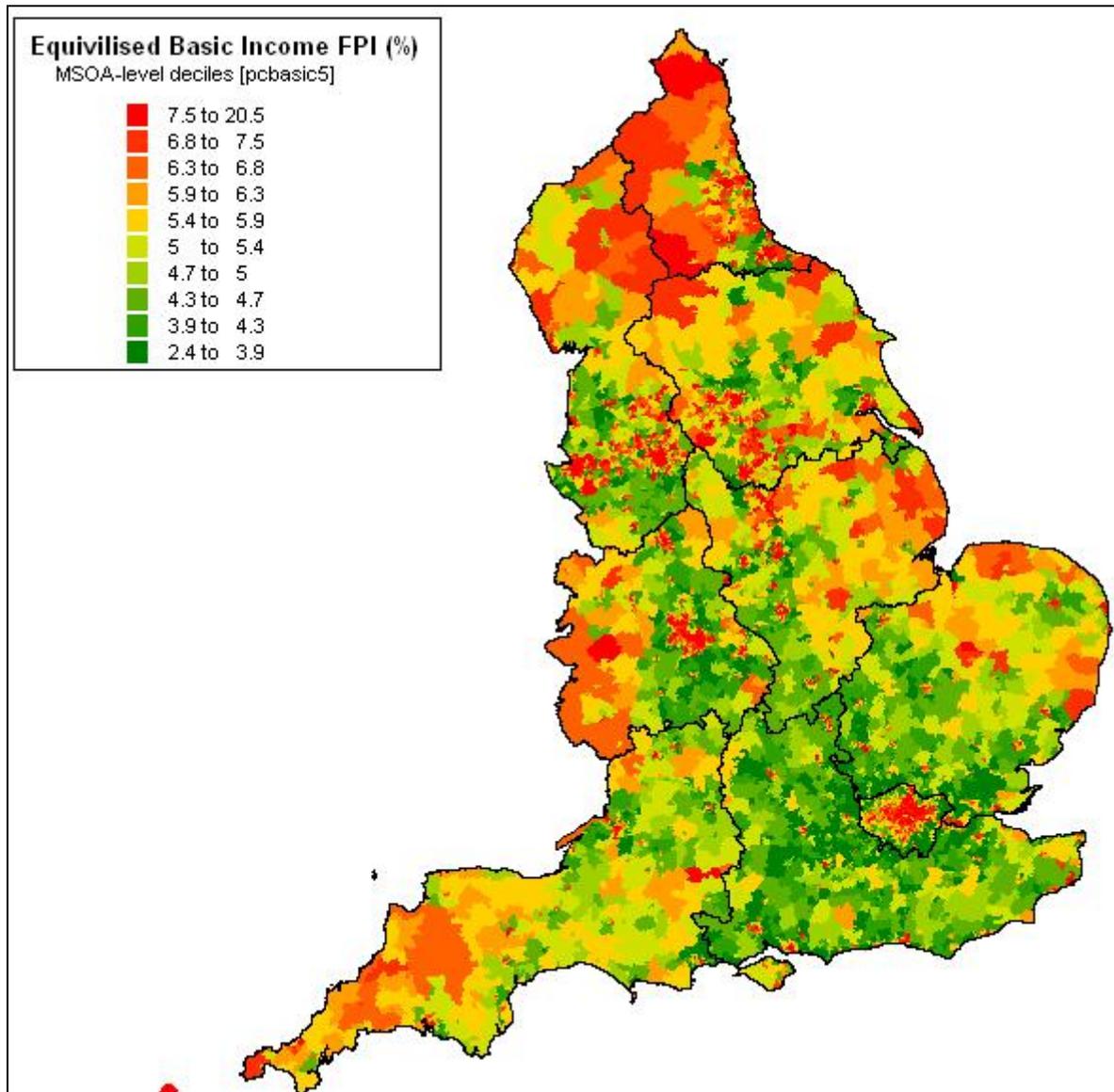


Figure 2: Equivalised Basic Income FPI at 2001 Middle Super Output Area Level (%)



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