Warm Homes Fund Programme Evaluation

Spatial Mapping Report

Dr Caitlin Robinson
School of Geographical Sciences, University of Bristol
caitlin.robinson@bristol.ac.uk

Mapping presented in this report is underpinned by extensive data collection and analysis by the wider Warm Homes Fund evaluation team.

1. Introduction

The Warm Homes Fund is one of the largest fuel poverty programmes ever to be delivered in Great Britain, representing an investment of £150 million in the private sector. The following briefing presents the results of the spatial mapping of the results of the Warm Homes Fund evaluation. In particular, the analysis contributes to the evaluation's aim of determining the extent to which the support has reached the households most in need, and any regional differences, specifically between England, Scotland, and Wales.

2. Analytical approach

Typically, data is aggregated to the Local Authority District (LAD) scale in the analysis. Aggregation ensures that individual households that received an improvement cannot be identified in parts of the Great Britain (GB) where a small number of households were part of the programme. This is especially important given that potentially sensitive characteristics such as income are modelled as part of the evaluation. When calculating averages, we use median values to mitigate the impact of outlier (very high) values on the results. For each variable, the median and total value for properties in a LAD are mapped.

The LAD boundaries for GB have been downloaded from the Open Geography Portal and were correct as of May 2021[1]. The boundaries, downloaded at full resolution, are clipped to the coastline. Of a total of 363 LADs in GB, 62 do not contain any properties that received an improvement, considered as part of our evaluation of the Warm Homes Fund programme. These LADs are represented in white shading on the maps throughout this report. Due to some LADs lacking data, we opt for absolute rather than relative classifications when mapping.

In some instances, we also use Degree Day Regions to disaggregate properties. There are 18 Degree Day Regions in the UK, which reflect the role of the external temperature in shaping energy use, particularly in buildings, or for heating energy use.

The analysis was carried out in RStudio using a range of packages including *tmap, sf, ggsankey, ggpubr, tidyverse, dplyr,* and *ggplot2*.

3. Results

3.1. Properties receiving improvements

A total of 15,677 properties are included in the evaluation. Based on counts of properties (Figure 1), improvements are spatially concentrated in several LADs. The LADs with the highest number of properties receiving improvements as part of the scheme are Leeds (970), Cornwall (621), Liverpool (455), Wakefield (407), Argyll and Bute (395), Flintshire (277), Dorset (260), East Riding of Yorkshire (244), Perth and Kinross (244), Hambleton (236), and Leicester (229). These areas have a wide range of geographic characteristics, from large urban conurbations such as Leeds and Liverpool, to relatively rural areas such as Argyll and Bute, and Dorset.

The WHF programme design reflects how fuel poverty can manifest in diverse settings in GB, especially urban areas and rural areas, where there are a higher proportion of older homes with solid walls. This makes them less efficient than properties in suburban and residential areas, which tend to be newer[2]. Improvements range from Category 1 measures of installing new gas boilers in urban communities, to Category 2 measures focused on rural communities via 'non-gas' solutions such as LPG or heat pumps. This aligns with wider evidence of the diverse geographical distribution of fuel poverty across the devolved nations, that spans urban-rural areas[3].

1. Office for National Statistics (ONS) (2021). Local Authority Districts (May 2021) UK BFC. [online] <https://geoportal.statistics.gov.uk/datasets/ons::local-authority-districts-may-2021-uk-bfc/about>

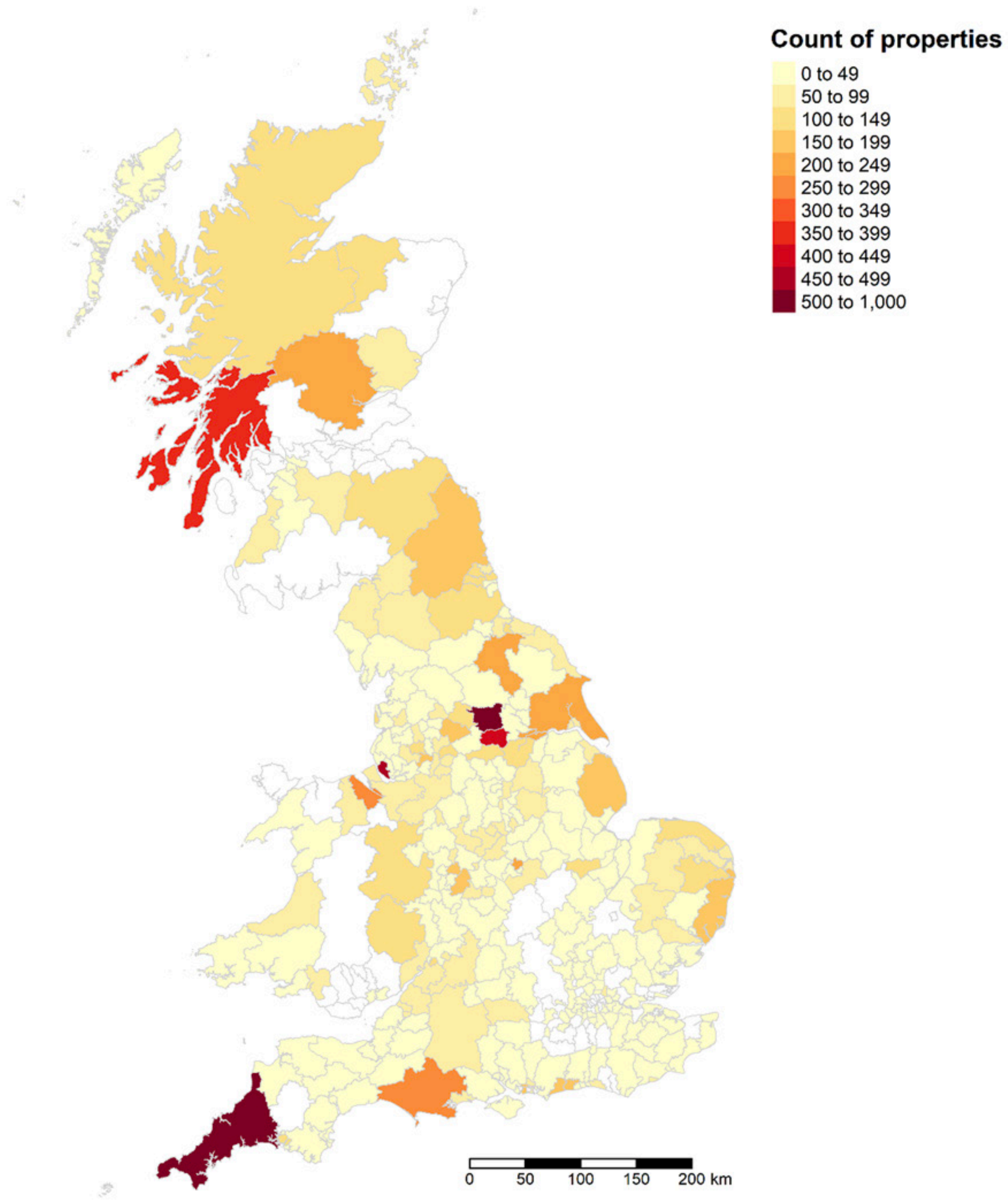

Figure 1. Count of properties that received an improvement in each LAD.

2. Gov.uk (2012) Hard-to-treat properties. [online] <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/335152/Chapter_2_Hard_to_treat_properties.pdf >

3. Morrison, C. and Shortt, N. (2008). Fuel poverty in Scotland: Refining spatial resolution in the Scottish Fuel Poverty Indicator using a GIS-based multiple risk index. Health & Place, 14(4), 702–717; Gordon, D. and Fahmy, E. (2008). A Small Area Fuel Poverty Indicator for Wales. Bristol: University of Bristol; Robinson, C., Bouzarovski, S. and Lindley, S. (2018). 'Getting the measure of fuel poverty': the geography of fuel poverty indicators in England. Energy Research & Social Science, 36, 79–93.

3.2. Net cost savings (£ per year)

Net cost savings reflect the estimated total amount saved per year because of the improvement to a property. Almost all properties that received an improvement and are part of the evaluation have recorded a cost saving of some kind. The median net saving for properties included is £781.80.

Comparing the results for all properties included in the evaluation, disaggregated by Degree Day Regions, Wales has the largest range of cost savings, and the highest median net cost savings per year (Figure 2). Median values are also comparatively high for Orkney and North East Scotland.

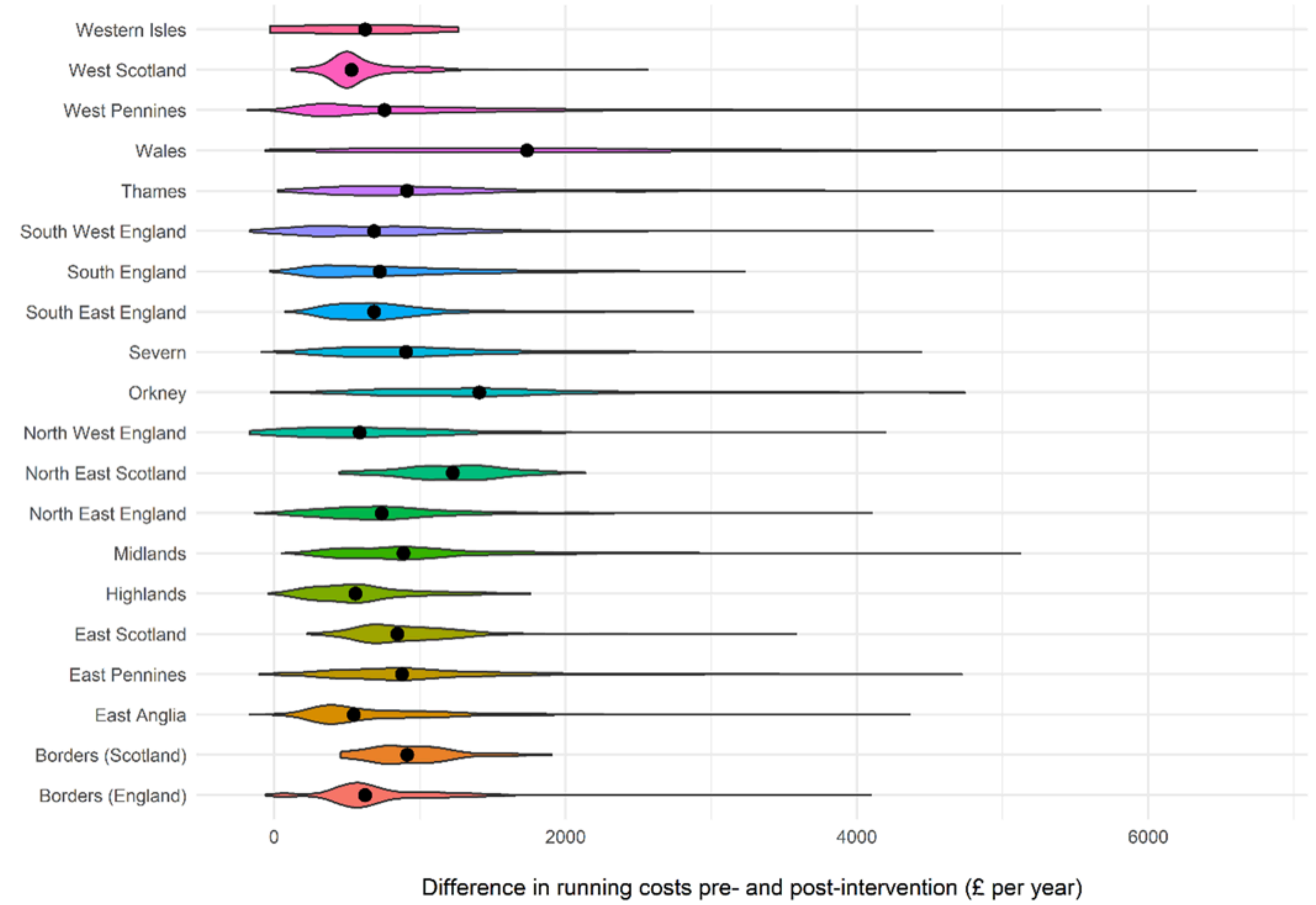

Figure 2. Distribution of properties for each Degree Days Region according to the difference in running costs (£ per year) pre-improvement and post-improvement. The violin plots show the distribution of the data and should be read in a similar way to a box plot. The median value is indicated using a black point.

Aggregating the cost savings to provide LAD totals, the highest total change in cost savings is in Leeds, with a saving of £1,135,556.11 per year after improvements were made (Figure 3). Leeds is an outlier in the dataset, with a comparatively large number of properties receiving improvements. Various types of LAD have a high total net cost saving above £200,000. These include LADs in major urban conurbations, specifically Liverpool (£519,965.74), Wakefield (£359,519.14), and Birmingham (£209,579.47), as well as in relatively remote rural areas including Cornwall (£439,812.52), Flintshire (£242,365.98), Dorset (£237,140.63), Argyll and Bute (£219,548.55), and Perth and Kinross (£210,077.63).

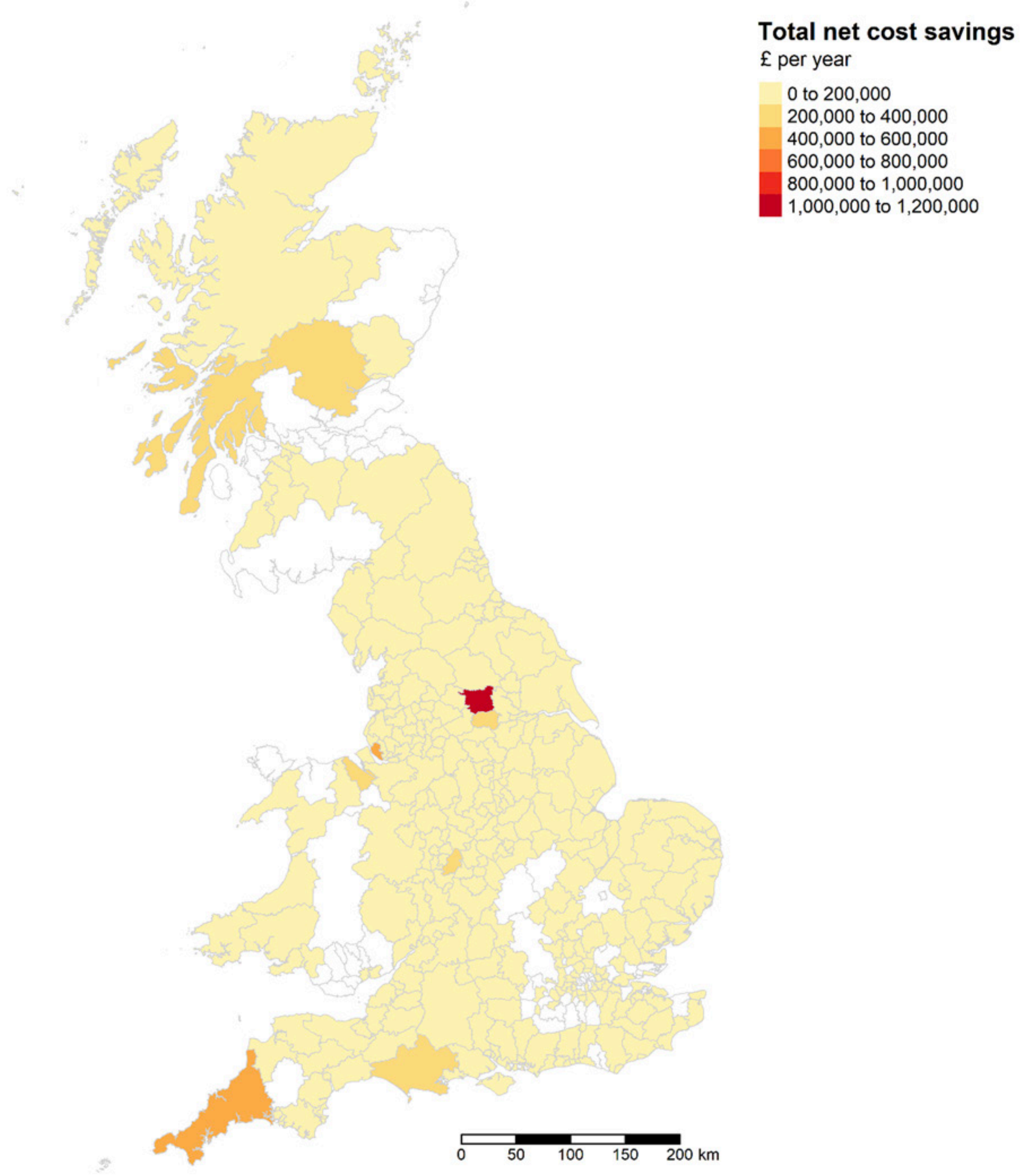

Figure 3. Total difference between pre- and post-improvement net cost savings (£ per year) Boundary data source: ONS 2021. Office for National Statistics licensed under the Open Government Licence v.3.0. Contains OS data © Crown copyright and database right 2022.

Comparatively, the median difference in cost savings in Leeds is more typical of values for other LADs in the evaluation, at £1,166.87 (Figure 4). The most common median cost saving for LAD is around £1,000; however, this value can be as high as £4,408.94 (for Merton LAD) and as low as £54.36 (for South Lakeland LAD). It is worth noting that there is likely to be a smoothing effect of results in those LADs where a high number of properties have received improvements.

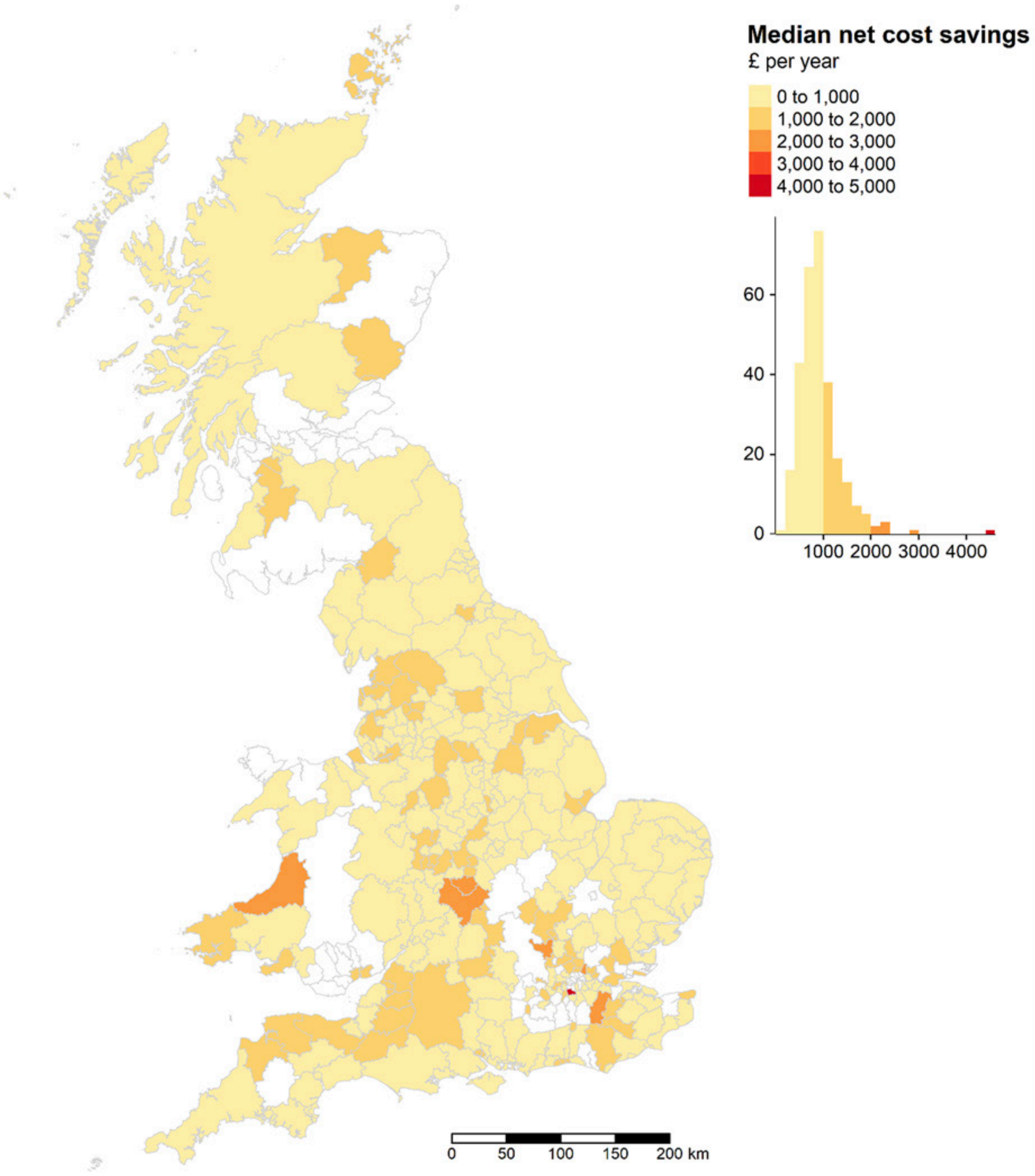

Figure 4. Median difference between pre- and post-improvement cost savings (£ per year).

3.3. Carbon dioxide (CO2) emissions

The difference in carbon dioxide (CO2) released post-improvement compared to pre-improvement is estimated in kilograms (kg) per year. The median CO2 emissions difference across all properties in the dataset is +731.71 kg per year.

For some LADs, total CO2 emissions have reduced considerably (Figure 5); presumably these are where the improvements have encouraged households to transition towards generating energy using a less carbon-intensive fuel, or where significant energy efficiency improvements have been made (e.g. Category 2 improvements through 'non-gas' solutions such as heat pumps). LADs with the largest total reduction in CO2 emissions are typically relatively rural. For example, nine LADs have an estimated total reduction in CO2 emissions (Kg) per year of more than -250,000: East Riding of Yorkshire (-522,451.49), Northumberland (-467,101.77), Argyll and Bute (-453,130.71), County Durham (-388,633.06), Barnsley (-376,200.63), Flintshire (-281,095.72), Cornwall (-266,830.39), Highland (-262,508.47), and Allerdale (-257,307.77).

However, for the majority of LADs (223 of the 301 LADs containing properties that received an improvement), CO2 emissions have increased post-improvement. As the LAD with the most properties receiving improvements, Leeds also tops the list of the largest total increase in CO2 emissions (Kg) per year (+714,538.52). In total, 10 LADs record a total CO2 emissions increase of over +100,000 post-improvement (Leeds, Liverpool, Leicester, Perth and Kinross, Birmingham, Walsall, Arun, Moray, Newcastle-upon-Tyne, Dorset). In major urban conurbations (which form the majority of LADs with comparatively large increases in yearly CO2 emissions) this is likely to be explained by Category 1 improvements in urban homes and communities, where gas central heating systems are installed for the first time, this being a fossil-fuel based improvement.

Median differences in CO2 emissions per year are more geographically varied (Figure 6). Median yearly CO2 emissions decline post-improvement in only 57 LADs. Neath Port Talbot in South West Wales has the highest median reduction of -5,982.12Kg. For 166 of the 301 LADs that contain properties included in the evaluation, the improvements lead to an increase in CO2 emissions on average. Median values are most commonly between +500 and +1,000, with 153 LADs falling within this bracket. The median is highest in Rushmoor LAD in South East England (+2,886.56).

Changes in CO2 emissions post-improvement illustrate tensions between reducing fuel poverty and decarbonising the building stock[4]. Although efforts to decarbonise housing and energy supply can be conducive to reducing fuel poverty, this is not always the case.

4. Sherriff, G., Butler, D. and Brown, P. (2022) 'The reduction of fuel poverty may be lost in the rush to decarbonise': Six research risks at the intersection of fuel poverty, climate change and decarbonisation. People, Place and Policy Online, 1–20.

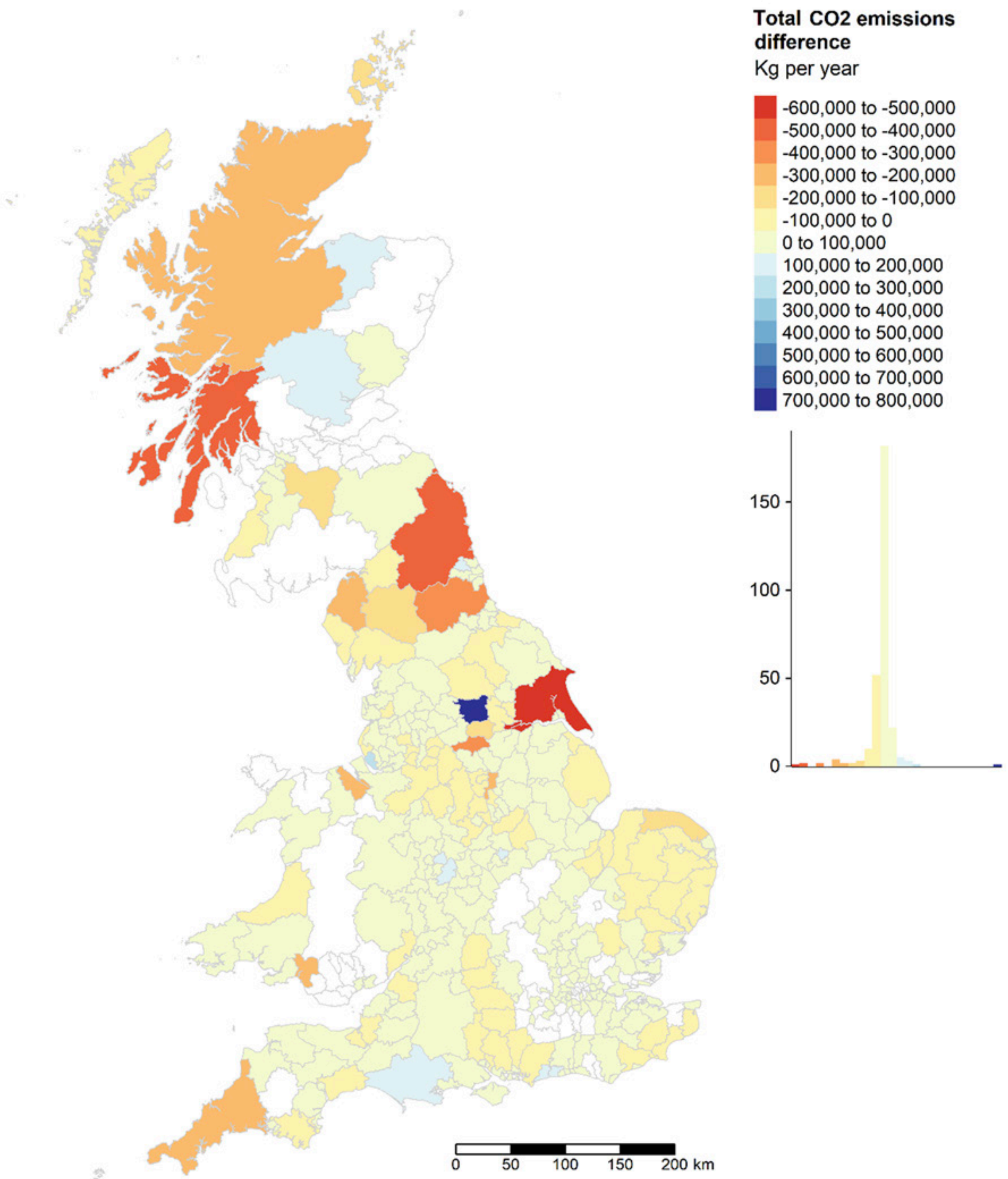

Figure 5. Total difference between pre- and post-improvement CO2 emissions (kg per year).

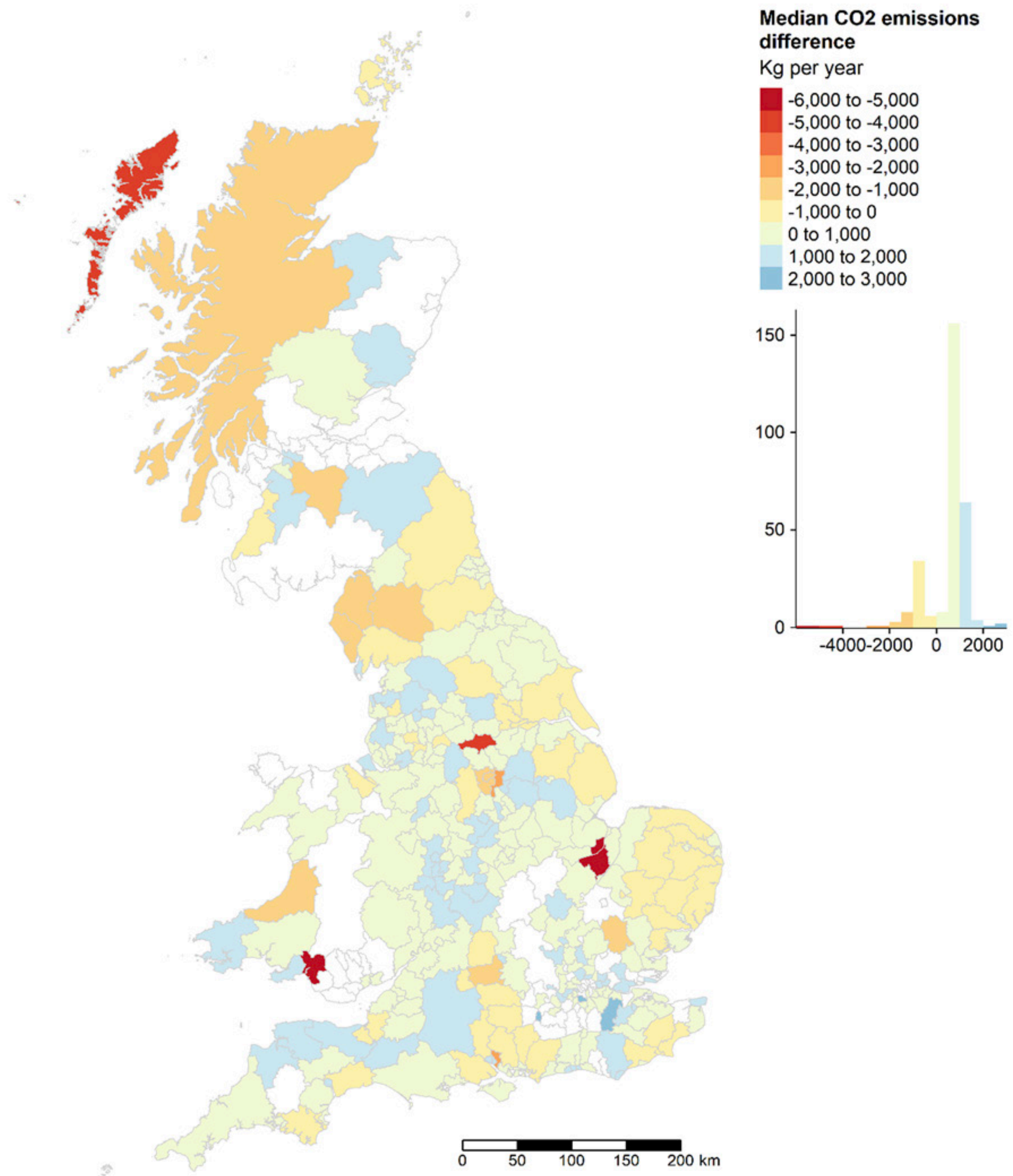

Figure 6. Median difference between pre- and post-improvement CO2 emissions (kg per year).

3.4. Fuel Poverty Gap

The Fuel Poverty Gap (FPG) is the reduction in fuel costs, or the additional income, needed for a household not to be in fuel poverty. Thus, it is a measure of the depth of fuel poverty. The median FPG difference, comparing properties pre- and post-improvement, is -£250.30. Only four properties in the dataset record a wider FPG post-improvement.

The total difference in the FPG for LADs is mapped in Figure 7. As noted previously, Leeds is notably higher than other LADs, with a total FPG difference of -£354,868.59. Eight LADs have a FPG reduction of over -£100,000: Liverpool (-£240,405.60), Flintshire (-£174,596.10), Cornwall (-£172,555.38), Argyll and Bute (-£143,132.82), East Lindsey (-£120,229.66), East Riding of Yorkshire (-£118,022.52), and Birmingham (-£111,811.40). As previously noted, reductions in the FPG are highly spatially concentrated in a handful of LADs, whilst a large proportion of LADs have relatively low totals. For example, 24.2% of the LADs with properties that are part of the evaluation (73 of 301 LADs) have a total FPG difference of between £0 and -£10,000.

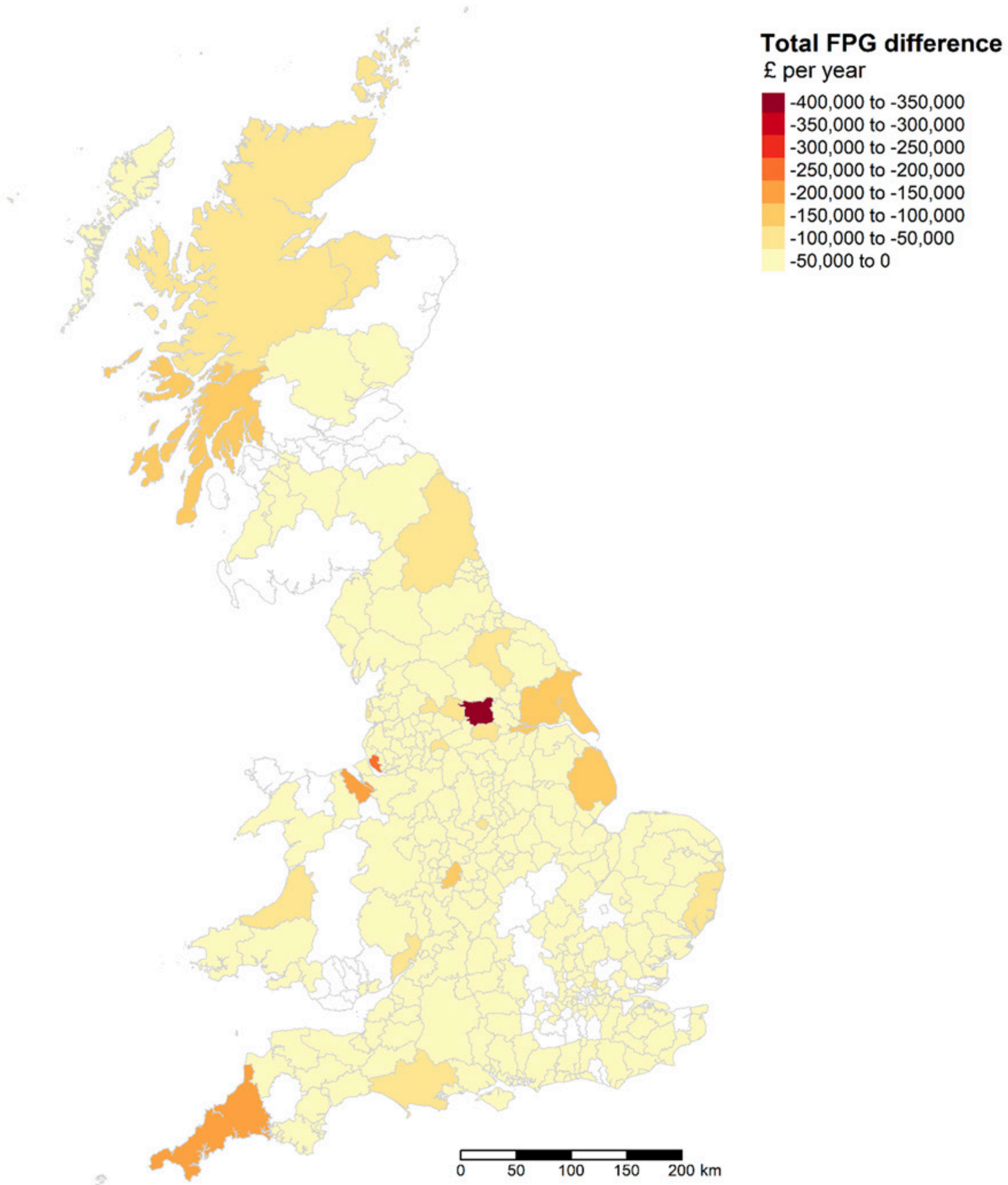

Figure 7. Total difference in FPG between pre- and post-improvement (£ per year).

Based on the median change in the FPG from pre- to post-improvement, the average gap decreased in all LADs (Figure 8). In the majority of LADs in GB, the median change was -£1,000 or below. However, some LADs had more substantial reductions in the gap: for example, Merton in South West London, with -£3,975.58.

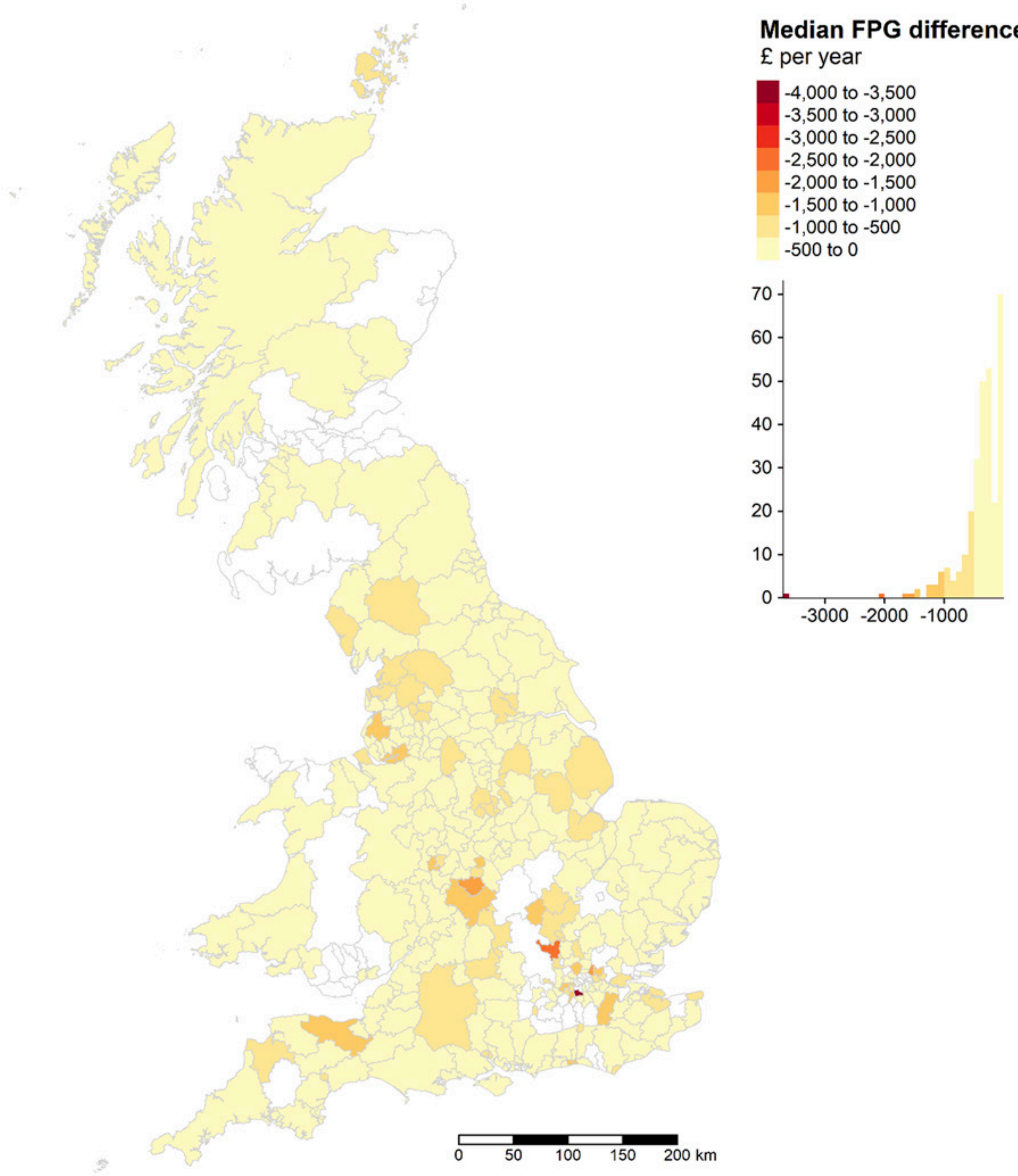

Figure 8. Median difference in FPG between pre- and post-improvement (£ per year).

3.5. Standard Assessment Procedure (SAP) ratings

The Standard Assessment Procedure (SAP) rating assesses the energy performance of a home, providing a figure between 0 and 100+. Here, 100 represents zero energy costs, and a higher score means that the property is a net exporter of energy. Across all properties in the evaluation, the median difference in SAP rating is +13.6.

When properties are aggregated to LADs, the median difference in the SAP rating pre- and post-improvement ranges from +3.96 in Gateshead to +53.93 in Merton (Figure 9). High median SAP increases are concentrated spatially in particular regions, especially the North West of England, parts of Greater London, the West Midlands conurbation, and South West Wales.

The total difference in SAP rating between pre- and post-improvement is greatest in the LAD of Leeds (+18,159.24) (Figure 10). Only 84 LADs have a total SAP rating improvement of over +1,000.

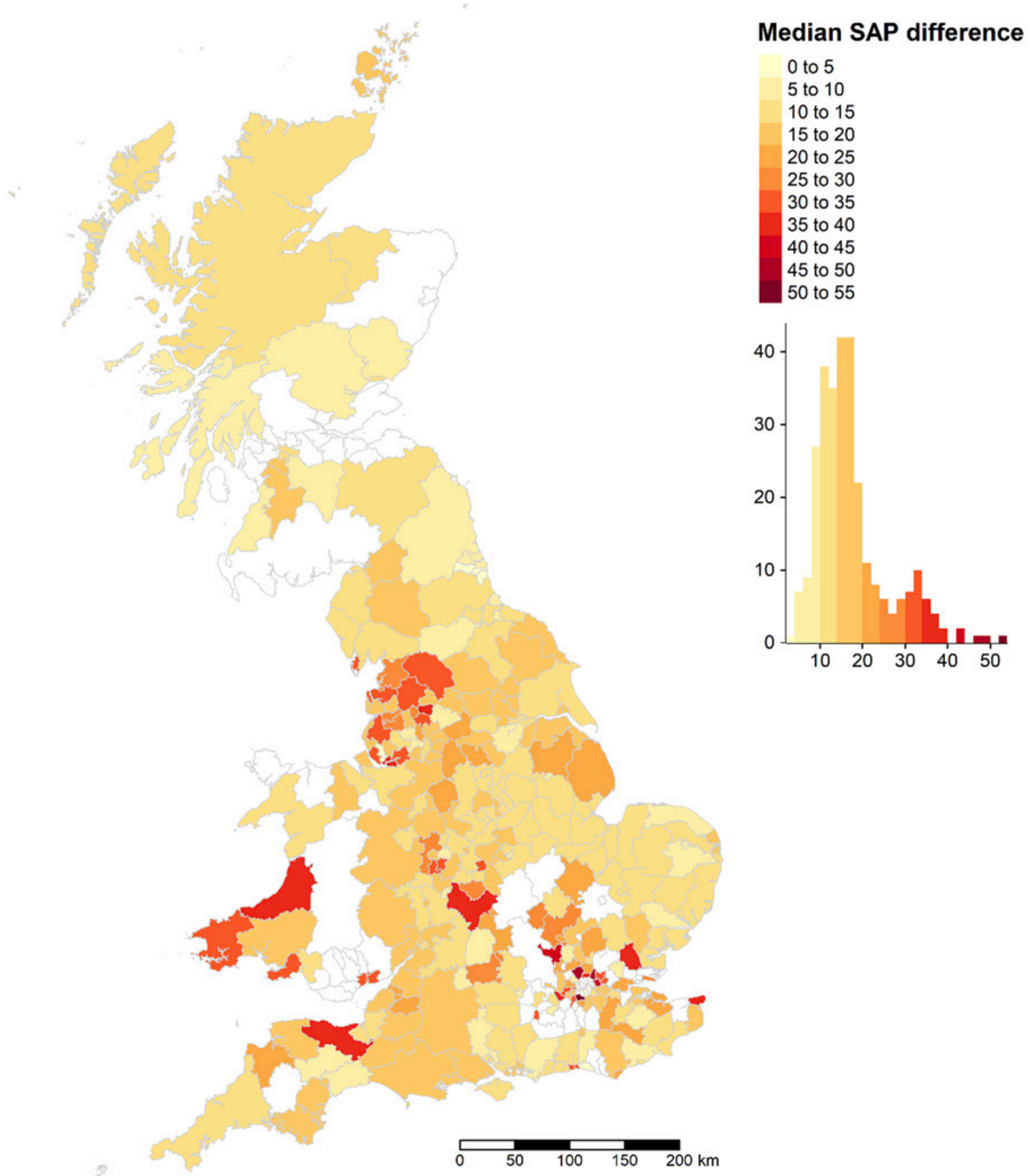

Figure 9. Median difference in SAP rating for LADs pre- and post-improvement.

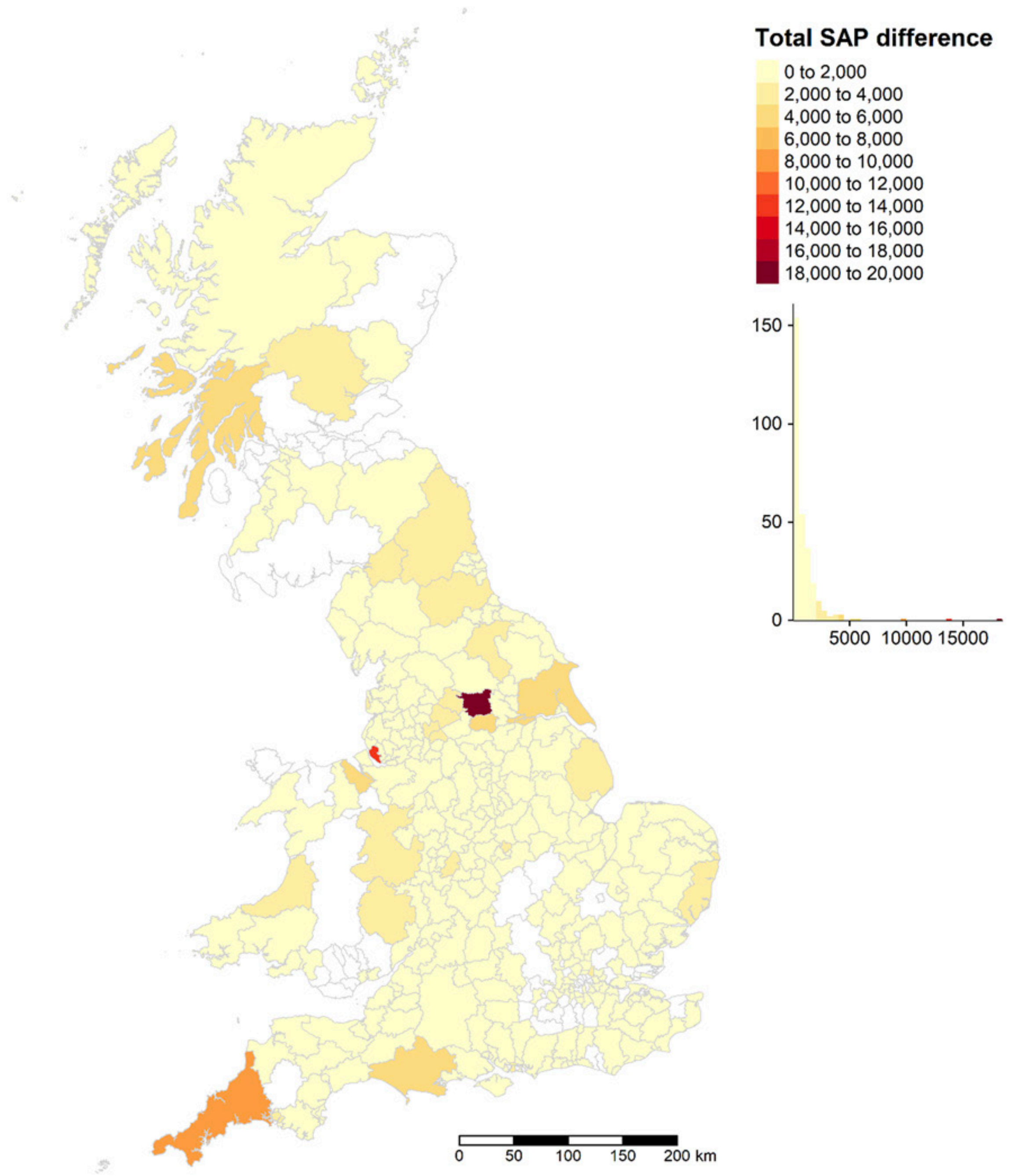

Figure 10. Total difference in SAP rating for LADs pre- and post-improvement.

3.6. Low Income Low Energy Efficiency (LILEE) fuel poverty indicator

The evaluation also considers whether a household is in fuel poverty pre- and post-improvement, based on the Low Income Low Energy Efficiency (LILEE) indicator adopted in England by BEIS in 2021.[5] Using the LILEE metric, a household is considered fuel poor if it has a fuel poverty energy efficiency rating (FPEER) of band D or below, and if householders pay their modelled energy costs, they will be left with an income below the poverty line. Although the indicator has only been formally adopted in England, as part of this evaluation the LILEE metric is also calculated for properties in Wales and Scotland.

Sixty-three per cent of properties (n=990) that received an intervention as part of the scheme are classified as LILEE pre-improvement. Of these properties, 57% are still classified as LILEE post-intervention (n=5,663). This illustrates that the improvements made as part of the programme are effective at reducing fuel poverty, when measured based on incomes and energy efficiency. However, for some households, the improvements are not sufficient to lift them out of fuel poverty. Nevertheless, it is worth noting that the LILEE indicator is less sensitive to high energy prices that are currently driving high levels of fuel poverty in the UK context (Middlemiss 2017).[6]

Figure 11. Fuel poverty classification of properties using LILEE pre- and post-improvement. The abbreviations in the diagram refer to: LILEE (Low Income Low Energy Efficiency), HILEE (High Income High Energy Efficiency), LIHEE (Low Income High Energy Efficiency), and HIHEE (High Income High Energy Efficiency).

5. Department for Business, Energy and Industrial Strategy (BEIS) (2021) Fuel Poverty Methodology Handbook (Low Income Low Energy Efficiency). [online] <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1056802/fuel-poverty-methodology-handbook-2022-lilee-with-projection.pdf>

6. Middlemiss, L. (2017) A critical analysis of the new politics of fuel poverty in England. Critical Social Policy, 37(3), 425–443.

Properties' eligibility for improvements as part of the Warm Homes Fund programme is based on four criteria: Affordable Warmth Benefits (n=5,193); ECO Flex (n=3,514); Fuel Poverty (n=2,930); and the Index of Multiple Deprivation (IMD) (n=4,040). The following analysis compares the fuel poverty indicator status of properties pre- and post-intervention, broken down by eligibility criteria.

Based on receipt of Affordable Warmth Benefits (Figure 12), 96.5% of properties eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=5,014). Post-improvement, 57.7% of the eligible properties remain in the LILEE classification (n=2,995).

The ECO Flex Grants Scheme helps those householders who are not in receipt of a qualifying benefit, but who are living on a low income and are vulnerable to the effects of living in a cold home, to qualify for the programme. Based on ECO Flex (Figure 13), 31.6% of properties considered eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=1,109). Post-improvement, 20% of the eligible properties remain in the LILEE classification (n=704). Compared to other eligibility criteria, a higher proportion of properties are classified as HILEE (n=2,283) or HIHEE (n=137) pre-improvement.

Using Fuel Poverty status as the criteria (Figure 14), 86.8% of properties considered eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=2,542). Post-improvement, 52.4% of the eligible properties remain in the LILEE classification (n=1,534).

Based on the Index of Multiple Deprivation (IMD) (Figure 15), 30.6% of properties considered eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=1,235). Post-improvement, 10.6% of the eligible properties remain in the LILEE classification (n=430).

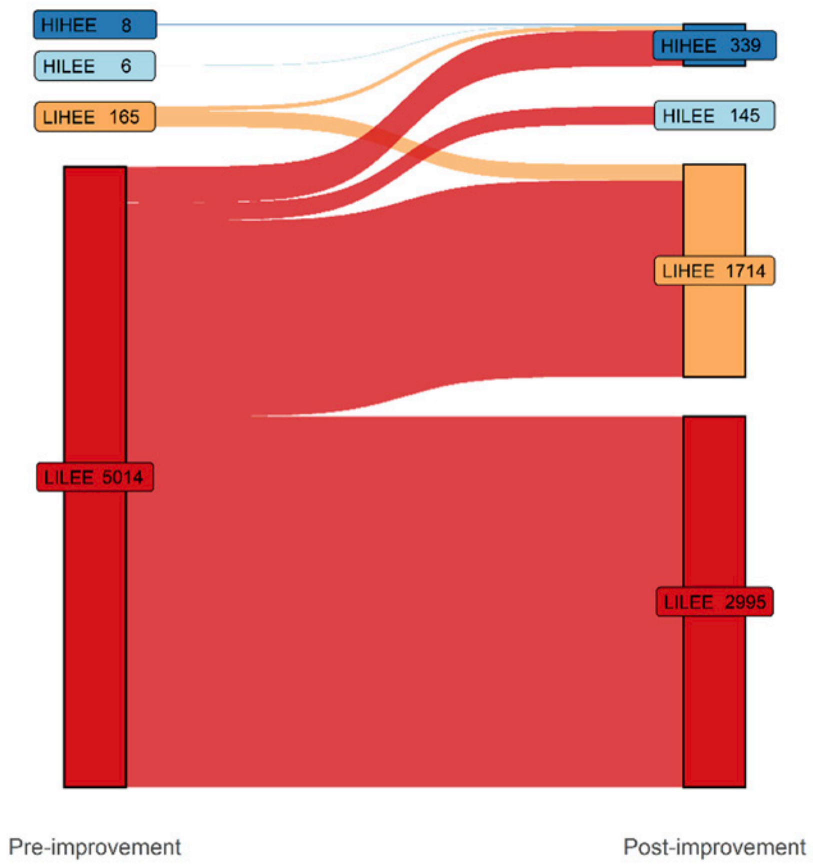

Figure 12. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on Affordable Warmth Benefits.

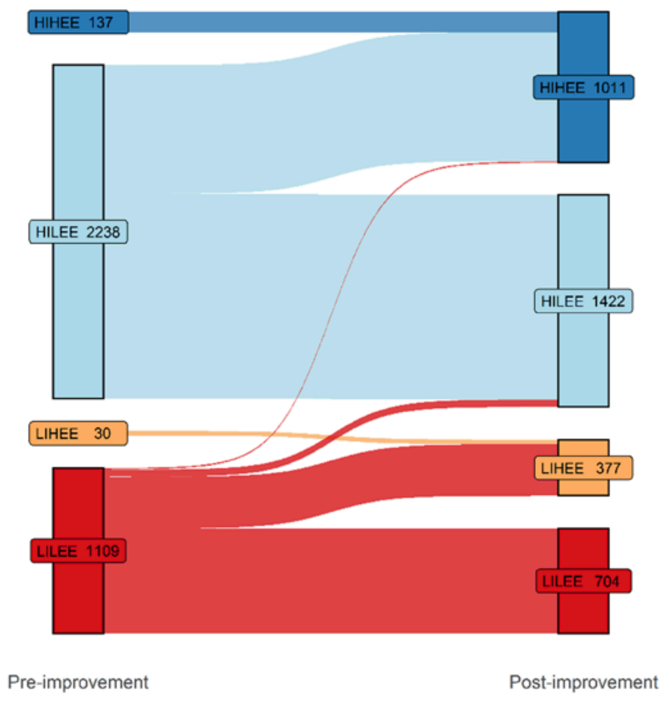

Figure 13. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on ECO Flex.

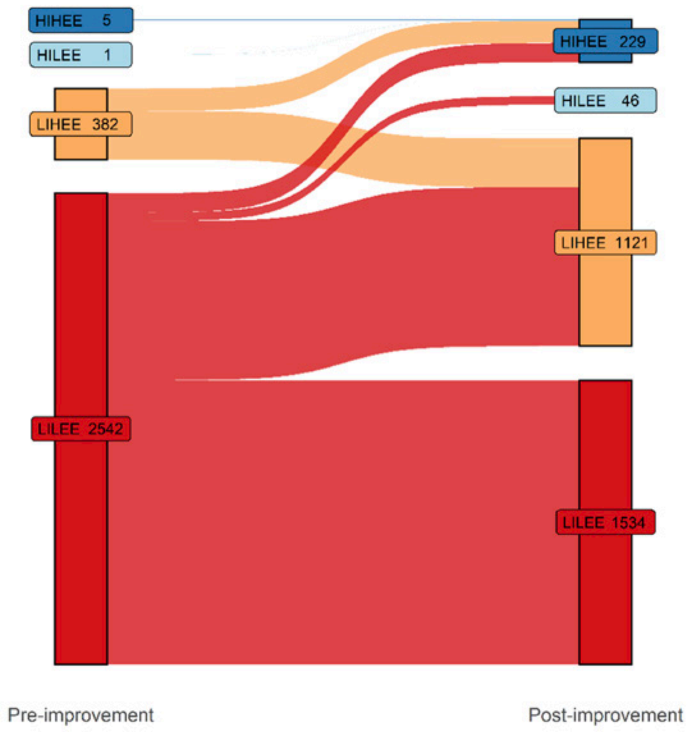

Figure 14. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on Fuel Poverty criteria.

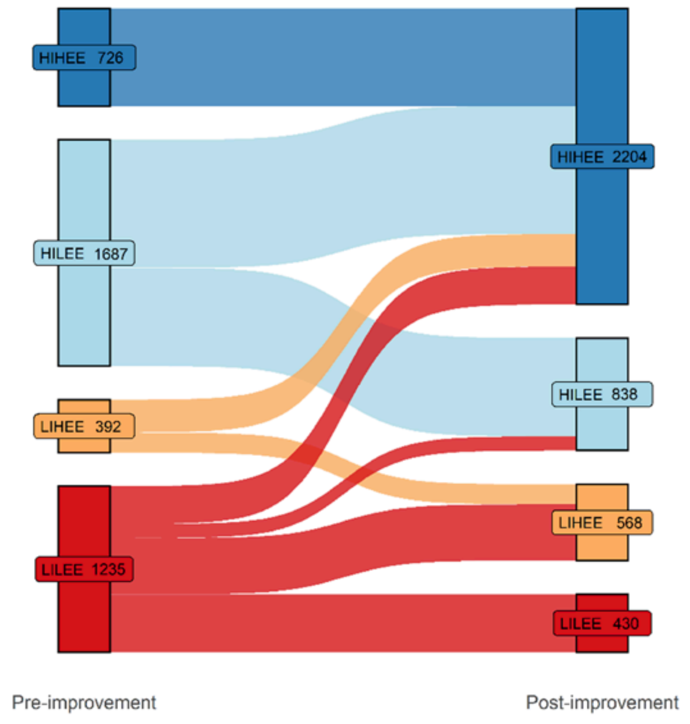

Figure 15. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on IMD criteria.

4. Code availability

The code for replicating the analysis and outputs presented here can be openly accessed via the GitHub repo: https://github.com/CaitHRobinson/warm-homes-fund/ (currently private until the report is published). This repository does not contain any of the raw data underpinning the analysis, which is not publicly available.