



Fuel Poverty Risk in Fife: Composite Index

Methodology Report

18th December 2024

Topics: Poverty and Deprivation, Population, Equalities

1.0 Fuel Poverty

Fuel poverty is a growing issue across Fife and the UK. In Scotland, fuel poverty is described as when a household needs to spend 10% or more of their income to keep their home at a reasonable temperature. Extreme fuel poverty is where a household is spending 20% or more of their income on fuel.

There are a varied set of social factors that are both influences and outcomes of fuel poverty. Figure 1 provides an overview of these interconnected factors.

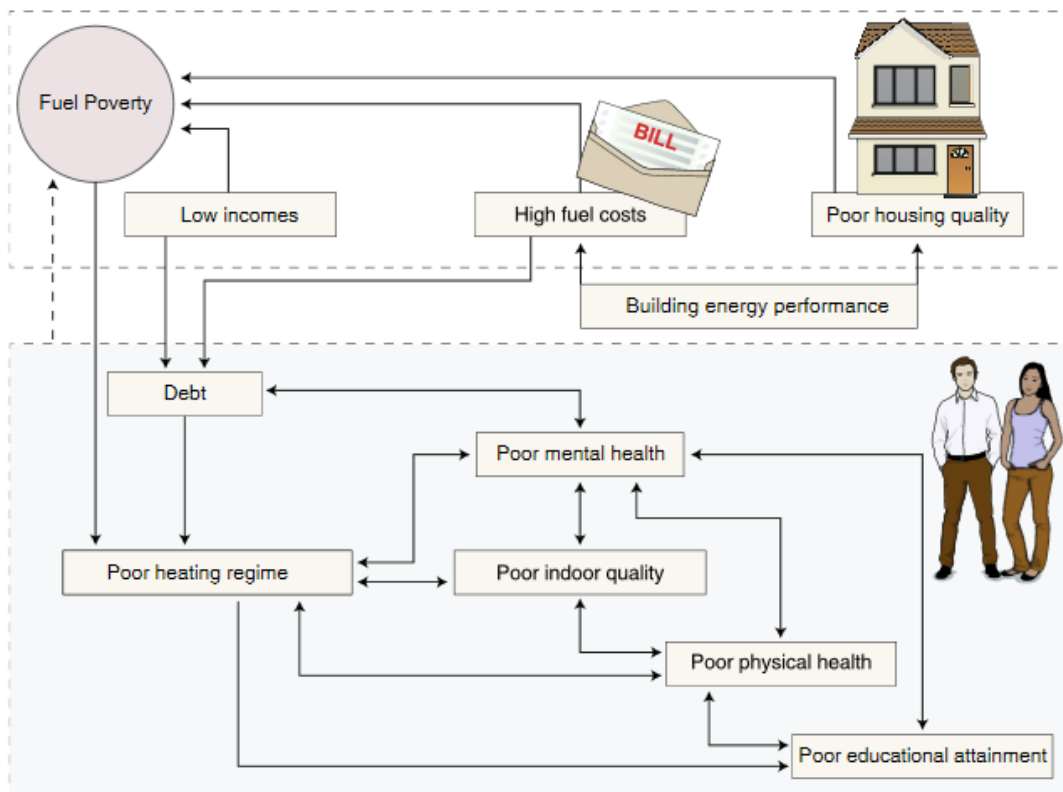


Fig. 1 | Reconceptualization of fuel poverty. The factors included in the Boardman definition of fuel poverty (top box) and a set of wider social factors (grey box) that are known to be both influences on and outcomes of the fuel-poverty condition. These social factors are directly measurable risks, for which data is already collected and reported.

Figure 1 – Social Factors of Fuel Poverty¹

The fall in disposable income linked to the ‘cost of living crisis’ means that households that spend a higher proportion of their income on fuel and food are also less able to adapt, when compared to ‘better off’ households. As fuel prices rise this pushes households into, (or further into) fuel poverty, having to make choices over prioritising essentials, for example paying for fuel or food. The reduced capacity to pay for fuel is also evidenced with an increase in fuel debt and people seeking money and debt advice.²

¹ Baker, K.J, Mould, R. and Restrict, S. (2018) Rethink fuel poverty as a complex problem. *Nature Energy*, 3, 610-612.

² Fife Council Fuel Poverty Needs and Demand Assessment. Accessed on the 5th August 2023.

Government fuel poverty targets outline that as far as reasonably possible no household in Scotland is in fuel poverty, with specific objectives set out for year 2030, 2035 and 2040³. By 2040:

- No more than 5% of households in Scotland are in fuel poverty,
- No more than 1% of households in Scotland are in extreme fuel poverty,
- The median fuel poverty gap of households in Scotland in fuel poverty is no more than £250 adjusted in accordance with section 5(5) to take account of changes in the value of money.

Local Heat and Energy Efficiency Strategies (LHEES) have been developed through coordination between Scottish Government and local authorities and are driven by driven by Scotland's statutory targets for greenhouse gas emissions reduction and fuel poverty. The LHEES should:

- Set out how each segment of the building stock needs to change to meet national and local objectives, including achieving zero greenhouse gas emissions in the building sector, and the removal of poor energy efficiency as a driver of fuel poverty.
- Identify strategic heat decarbonisation zones and set out the principal opportunities and measures for reducing buildings emissions within each zone.
- Prioritise areas for delivery, against national and local priorities.

Fife Council Housing Services provides help to support tenants to reduce their fuel bills and help them avoid debt and crisis with their utility costs. Fife Council also partners and financially supports Cosy Kingdom which is a free and impartial energy advice service available to all tenants and home owners in Fife. It is a partnership between Greener Kirkcaldy, St Andrews Environmental Network and Citizen's Advice & Rights Fife. The energy advice workers work with people to find practical and affordable ways to save energy, understand their utility bills and tariffs, switch supplier, and advice on gas and electricity debt. They also provide benefit checks, refer to free and impartial debt advice and offer a free handy service.

Tackling fuel poverty requires a coordinated approach that addresses both the immediate needs of households and the underlying causes of the problem.

Previous fuel poverty interventions generally targeted specific groups, those in receipt of certain benefits (e.g. pension credit) or vulnerable occupants (e.g. disability, 65+ years) however these approaches may miss people who do not fall into these specific groups, for example those that are not eligible for support but are still in fuel poverty e.g. pension credit threshold, and those that are within the vulnerable occupants category, but are not experiencing fuel poverty. They do not take home energy efficiency into consideration. Current indicators and definitions of fuel poverty are not at small geographic areas to provide local insights and/or include out of date indicators.

³ Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019, Available at: [Fuel Poverty \(Targets, Definition and Strategy\) \(Scotland\) Act 2019 \(legislation.gov.uk\)](#). Accessed on the 17th October 2024

2.1 Design

Composite indices (CI) should not be created in isolation and should be informed by academic research, expertise in the subject area and the community.

Workshops/presentations were delivered to services through the Healthy Heating and Poverty Partnership and Fuel Poverty Task Group to provide background and updates, and to support the different workflow stages. Figures 3 and 4 provide an overview of a presentation delivered to the Healthy Heating and Poverty Partnership.

The level of spend on supporting households in fuel poverty crisis is not sustainable. Resources need to be targeted to the areas of greatest need, with directed preventative measures reducing the likelihood that households will experience fuel poverty. This links to the purpose of creating the CI.

Step one in the workflow details defining the index question. The question was defined by partners as:

‘Where are neighbourhoods in Fife with increased risk of experiencing fuel poverty?’

Figure 5 provides an overview of the CI question, sub-indices, variables and variable weighting. Further information on the selected 13 variables is provided in Appendix A. The Home Analytics 3.9 dataset, provided by Energy Savings Trust (EST), was used to add variables including percentage of properties below EPC C, average fuel bill estimate, percentage of private rented properties and percentage social housing properties. Median gross income was provided by CACI Paycheck⁵. Household type was provided by CACI ACORN.⁶

Variables must be considered including the quality, relevance, and availability of data sources. Variable weights represent the relative importance of each variable as it contributes to the index. Evidence of why the variables were selected is shown in Appendix B.

The CI is divided into two domains demand for fuel and ability to pay for fuel. With demand further divided into property and people sub-indices representing the heating requirements of the building and increased heating requirements from specific demographics.

Variables have been attributed to sub-indices to reduce the impact of correlation, as correlation among selected variables may lead to unintentional weighting. The ability to pay sub-index includes household characteristics that have been associated with increased risk of fuel poverty. The results from the domains were combined to create an overall index, which is the average of the sub-indices, after preprocessing and analysis.

⁵ ©CACI Limited 1996 – 2024. Source: Office for National Statistics licensed under the Open Government Licence v.3.0.

⁶ ACORN ©CACI Limited 1979 – 2024. Contains public sector information licensed under the Open Government Licence v3.0. Contains data compiled by Registers of Scotland. This report shall be used solely for academic, personal, and/or non-commercial purposes.

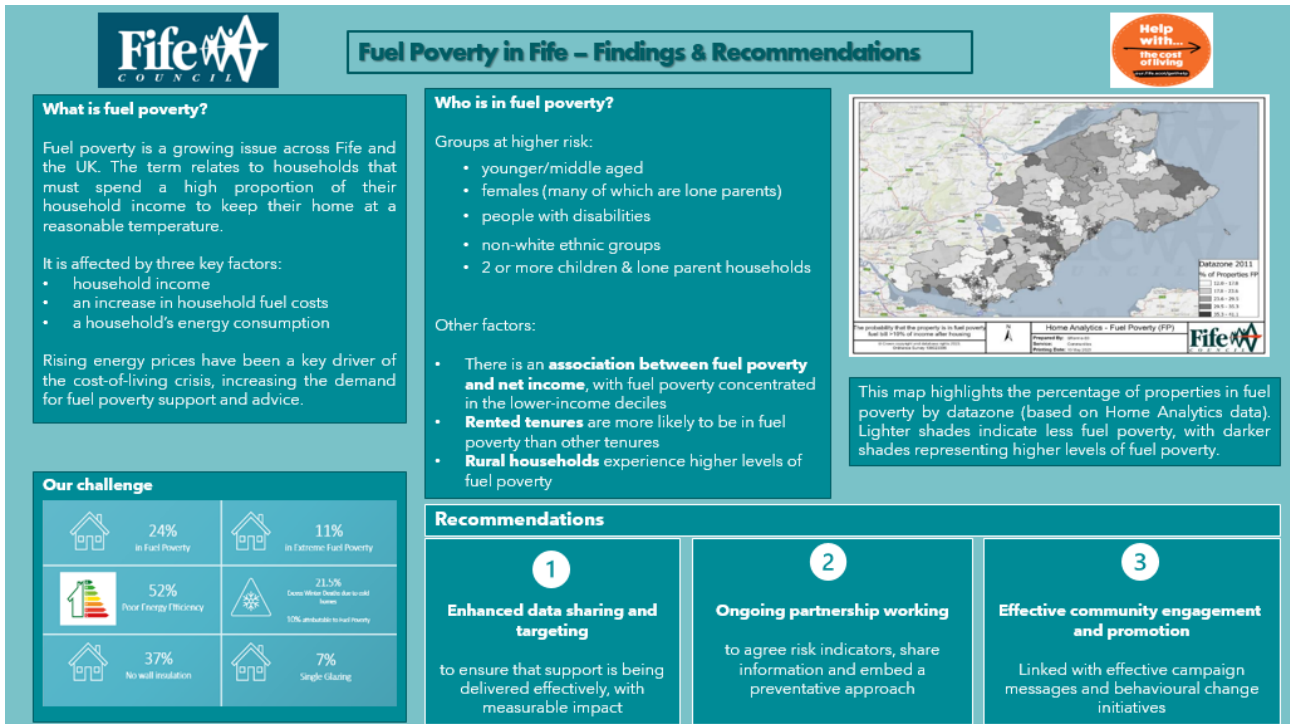


Figure 3 – Fuel Poverty Background

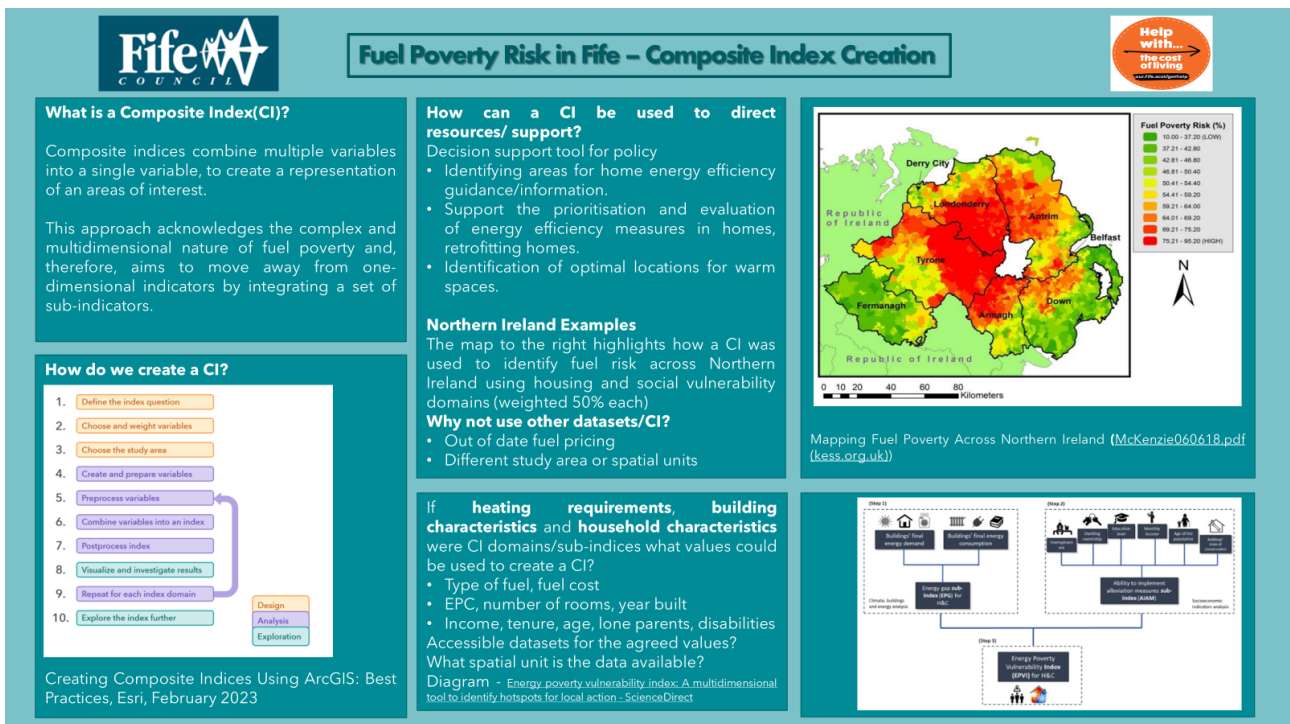


Figure 4 – Composite Index Briefing

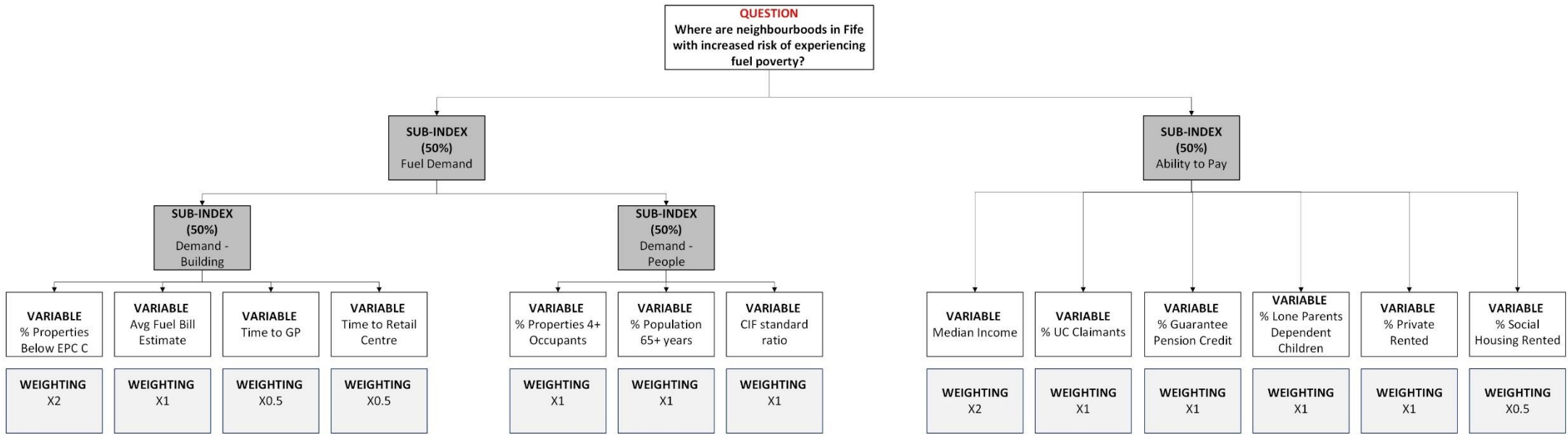


Figure 5 – Composite Index Variables and Weighting

The study area is the area covered by all the spatial units and has a significant impact on the CI results. The Scottish fuel poverty index created by Edina@ University of Edinburgh⁷ used local authority as spatial units, with Scotland being the study area. The study area for the CI is the Fife local authority area, as risk was to be identified across the entire local authority.

The spatial unit selected was data zone (DZ) 2011⁸ as DZ's represent natural neighbourhoods and are designed to have roughly standard populations of 500 to 1,000 household residents, nest within local authorities, have compact shapes that respect physical boundaries where possible, and contain households with similar social characteristics. This smaller scale also reduces the impact of the modifiable areal unit problem (MAUP).⁹ The availability of datasets also influenced spatial unit selection. Analysis at Fife study area level, using DZ spatial units will highlight different results compared to a different spatial unit, for example intermediate zones, or if the study was area committees.

Although the CI is based on the DZ spatial unit, this will be linked to the Local Heat and Energy Efficiency Strategy (LHEES)¹⁰ optioneering exercise to inform a fuel poverty indicator to determine building level energy efficiency and heat decarbonisation actions. All Scottish Local Authorities have a statutory duty to prepare, publish, and update a Local Heat and Energy Efficiency Strategy and delivery plan. Fife Council published their strategy and a high-level delivery plan in November 2023. LHEES must set out how each segment of building stock needs to change to meet national and local objectives. This includes the removal of poor energy efficiency as a driver of fuel poverty. Fife Council expanded this to include heat decarbonisation and has placed tackling fuel poverty as one of its 8 key LHEES priorities.

⁷ Fuel Poverty Index – Scotland, Edina@ University of Edinburgh. Available at: [Fuel Poverty Index - Scotland - Dataset - Spatial Hub Scotland](#) accessed 10th September 2024.

⁸ SpatialData.gov.uk. Available at: [Data Zone Boundaries 2011 \(spatialdata.gov.scot\)](#) accessed 2nd October 2024.

⁹ Modifiable Areal Unit Problem, Science Direct. Available at: [Modifiable Areal Unit Problem - an overview | ScienceDirect Topics](#) accessed 1st September 2024.

¹⁰ Fife Local Heat and Energy Strategy and delivery plan. Available at: [Local heat & energy efficiency strategy \(LHEES\) and delivery plan | Fife Council](#) accessed 14th September 2024.

2.2 Analysis

The analysis stage included preprocessing, analysis and postprocessing actions. Preprocessing refers to the various data preparation steps that ensure variables are compatible and can be properly combined into an index including reversing, scaling and combining variables.

Appendix C provides an overview of variable direction, if reversed and units/range. As the CI is to be used as a resource allocation tool it was more important to understand which DZ's present the highest risk, are better or worse (rank), than how much better or worse they are (magnitude). Due to the presence of skewness and outliers the percentile scaling method was used to convert each variable to a uniform distribution from 0 to 1.

A compensatory method was used to combine variables and sub-indices (mean) as households do not have to experience high levels of all selected variables to be at increased risk of fuel poverty, with some variables compensating for others. For example, increased demand for fuel can be compensated by increased income.

Postprocessing included the index being reversed to show low values/rank indicating high fuel poverty risk and high values indicating low fuel poverty risk. This was chosen due to familiarity with the SIMD, with low ranks being increased deprivation and high ranks reduced deprivation. An index mean scale of between 0 and 100 was selected to support the interpretation of results across sub-indices and the CI.

Figure 6 provides an overview of the process for creation of the sub-indices and CI. This process was completed multiple times to create an index with 4 sub-indices. The demand building, demand people, and ability to pay mean outputs were reversed. The demand sub-index was created from the mean outputs from the demand building and demand people sub-indices. The demand and ability to pay sub-index mean outputs were used to calculate the final CI mean and rank outputs, using the same preprocessing, analysis and postprocessing actions.

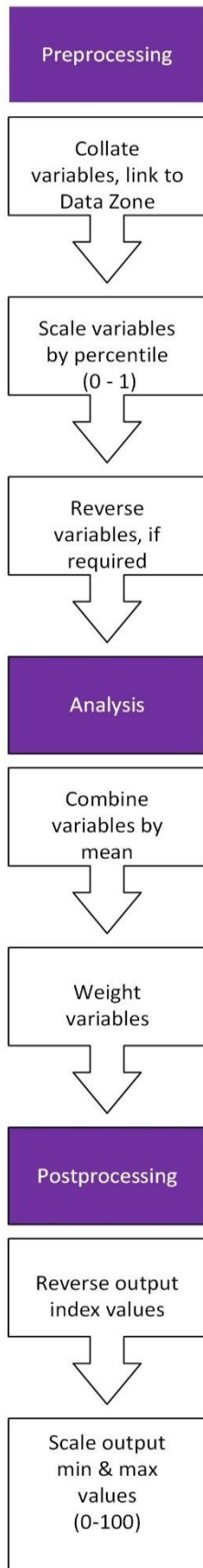


Figure 6 - Overview of Sub-Indices and CI Creation Process

2.3 Exploration

The development of a CI is subjective with decisions required for the selection and weighting of variables, and the choice of processing and classification methods. Weights have a significant impact on the resulting index. Charts and maps were used to understand the spatial patterns, distribution, composition and importance of each variable to the index.

Spatial patterns and composition were completed by classifying the sub-indices and CI using different methods, including quantile classes, standard deviation classes and exploring spatial clustering and outliers. The standard deviation method classifies the index to show the number of standard deviations each value lies from the average (mean). This highlights where the extreme values are located, areas of very high risk with the lowest values and areas very low risk with the highest values.

Figures 7, 8 and 9 detail the areas of high risk in dark purple to the areas of very low risk in dark green for the sub-indices and CI.

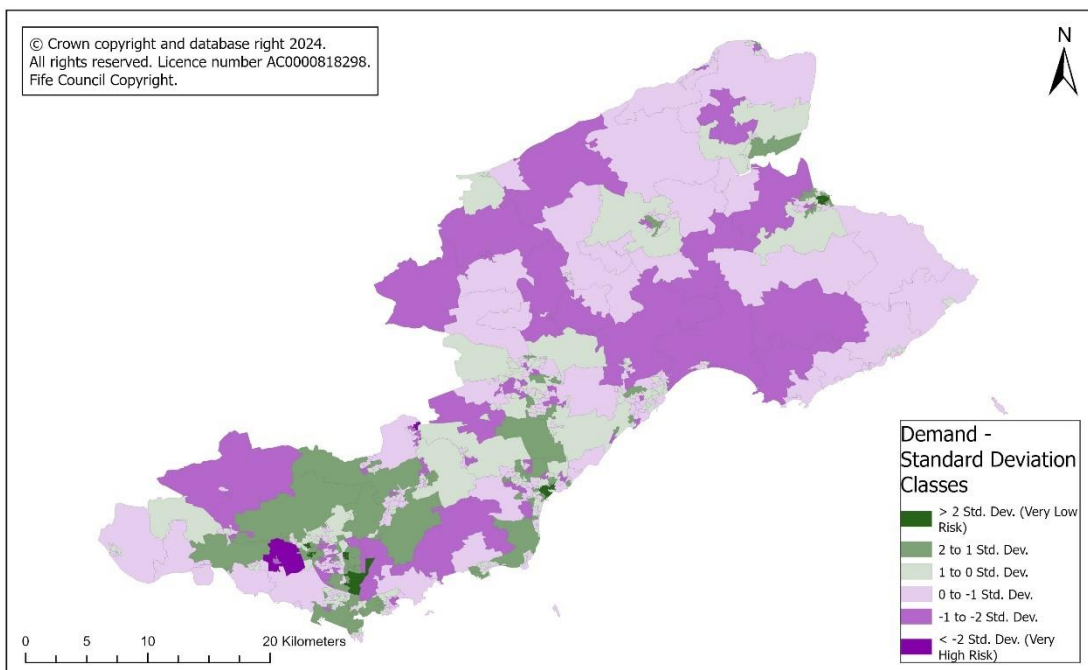


Figure 7 – Demand Standard Deviation Mapping

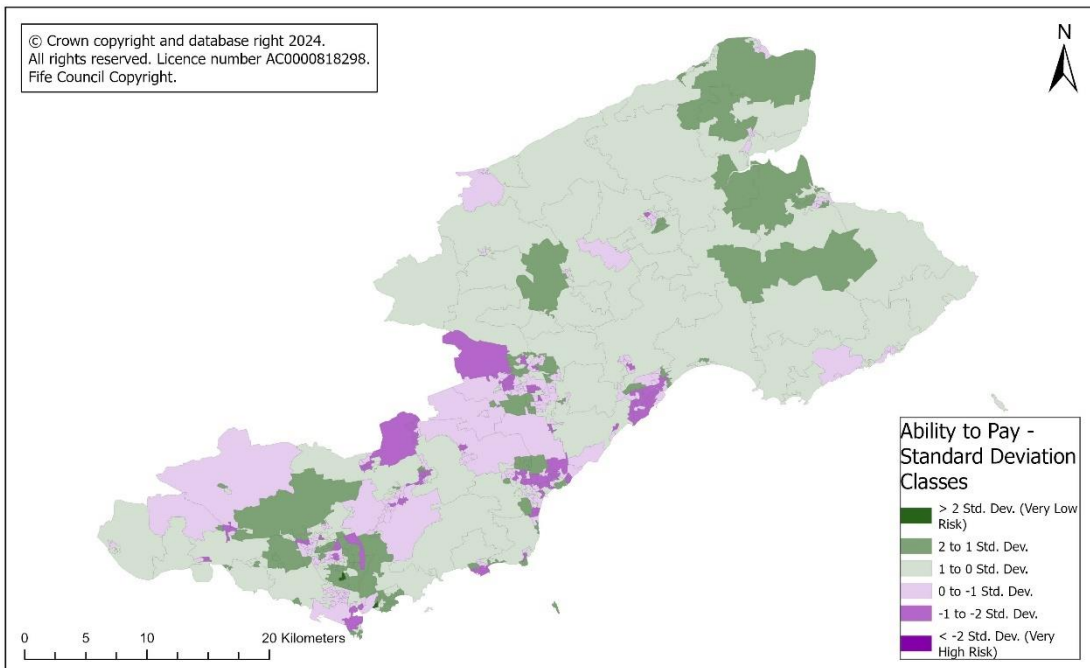


Figure 8 - Ability to Pay Standard Deviation Mapping

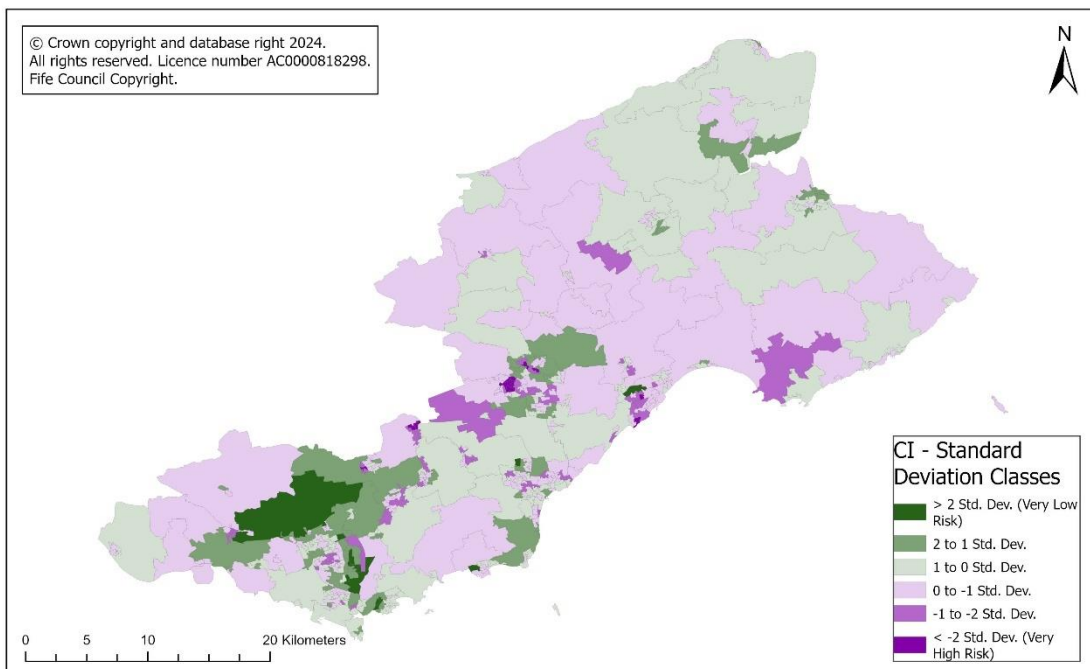


Figure 9 - Composite Index Standard Deviation Mapping

Anselin's Local Moran's I (LMI) statistic was used to identify statistically significant spatial clusters and spatial outliers for each of the two sub-indices (demand, ability to pay) and the overall CI. The Cluster and Outlier Analysis tool available in ArcGIS was used to calculate a local Moran's I value, a z-score, a p-value, and a code representing the cluster type for each feature.

Table 1 details the LMI results for the two sub-indices and the CI.

The LMI analysis indicates that 17.0% of all DZ's form statistically significant high-risk clusters for the CI, with 8.5% for demand and 23.3% for ability to pay. Spatial outliers are the actual locations of interest and can provide further insight, particular variables that have driven these outliers. 2.8% of DZ's are CI high risk outliers close to low risk areas.

Local Moran's I mapping is shown in figures 10 and 11 for the sub-indices and 12 for the CI.

Pink and red symbology reflects low risk clusters and outliers, and light blue and dark blue reflect high risk clusters and outliers.

Table 1 – Local Moran's I

Data Zones	Demand	Ability to Pay	Overall CI
Not Statistically Significant (White)	71.9% (355)	57.1% (282)	62.8% (310)
High-High Clustering (Hot spot) <i>Low Risk (Pink)</i>	12.6% (62)	13.2% (65)	13.6% (67)
Low-Low Clustering (Cold Spot) <i>High Risk (Light Blue)</i>	8.5% (42)	23.3% (115)	17.0% (84)
High- Low (Spatial Outlier) <i>Low Risk Close to High Risk (Red)</i>	2.6% (13)	5.9% (29)	3.8% (19)
Low-High (Spatial Outlier) <i>High Risk Close to Low Risk (Dark Blue)</i>	4.5% (22)	0.6% (3)	2.8% (14)

High risk clusters: Demand high risk clusters (light blue) are primarily in non-urban areas and the outskirts of urban areas. These clusters are distributed across Mid-Fife and North East Fife areas.

High risk Outliers: High risk areas that are located near to low risk areas (dark blue) are highlighted in North East Fife, Kirkcaldy, City of Dunfermline, South West Fife and Cowdenbeath committee areas.

North East Fife: Areas of high risk outliers (dark blue) in North East Fife include Tayport Central, Cupar Westfield, Cupar Tarvit and Cannongate, Kilrymont and Langlands in St Andrews.

Kirkcaldy: In Kirkcaldy high risk outliers (dark blue) include Kinghorn South, Linktown South and Seafield North, Raith Estate and Southerton, Kirkcaldy Central North, Hayfield South, Smeaton North and Newliston.

City of Dunfermline: In the City of Dunfermline high risk outliers (dark blue) include Headwell North, Abbeyview East, Halbeath, Pitreavie Castle East and Heathery.

South West Fife: High risk outliers (dark blue) include Rosyth Pease Hill South, Admiralty South, Rosyth Wilderness East, Inverkeithing West and Dalgety Longhill Park.

Cowdenbeath: One high risk outlier (dark blue) in Cowdenbeath area committee, Crossgates, South Knowe and Annfield.

High risk clusters: High risk clusters (light blue) for ability to pay are primarily highlighted in Mid Fife and Cowdenbeath.

High risk outliers: High risk outliers (dark blue) within Halbeath, Wellwood and Inverkeithing Spencerfield South.

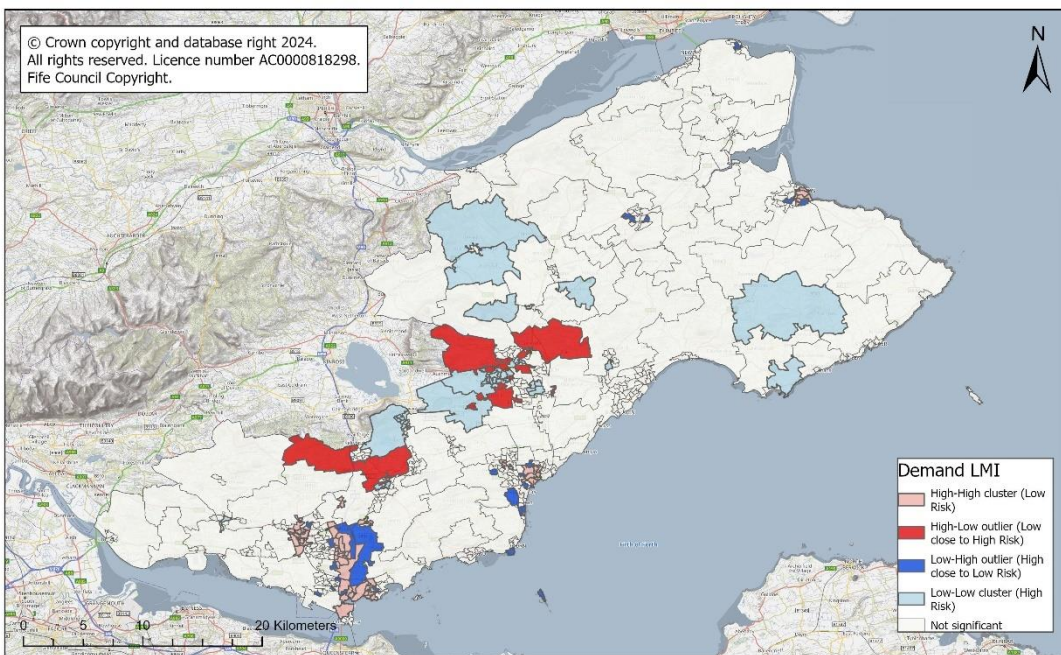


Figure 10 – Demand Local Moran's I Mapping

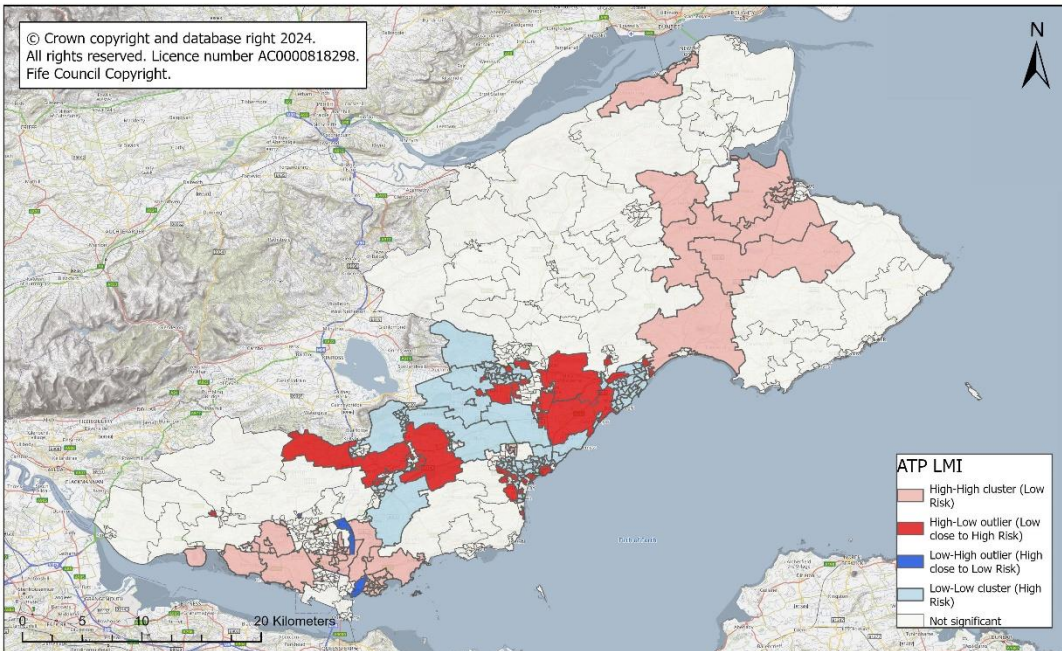


Figure 11 - Ability to Pay Local Moran's I Mapping

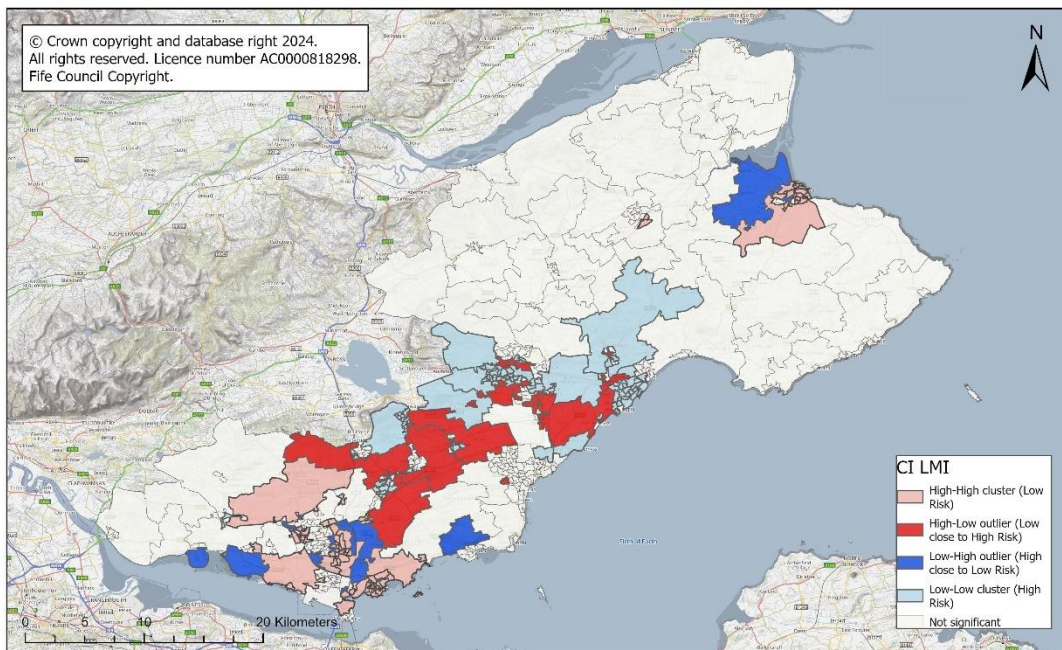


Figure 12 Composite Index Local Moran's I Mapping

Statistically similar low values (light blue), high risk areas are highlighted in the CI within Levenmouth, Glenrothes and Cowdenbeath area committees however increased variation detailed within Kirkcaldy, with one high risk DZ (Mitchelson and Randolph).

High risk outliers (dark blue) in North East Fife detailed in St Andrews and surrounding area (Cannongate, Strathkinness and Craigton).

Increased high risk outliers (dark blue) are highlighted in South Fife with Crombie, Inverkeithing West, Dalgety Donibristle South within South and West Fife, and Milesmark East, Balbridgeburn North, Wellwood, West Dunfermline and Abbeyview East, Abbeyview Linburn and Duloch to the East. Pitreavie is also highlighted as a high-risk outlier.

There are high clusters, low risk areas (pink) within St Andrews, South West Cupar, outskirts of Dunfermline and Inverkeithing, Dalgety Bay and Aberdour in South West Fife.

Sensitivity Analysis

Sensitivity analysis of the sub-indices and CI scores were conducted to assess the sensitivity of the mapped index outputs to the assumptions made on the index weighting. Specifically, the influence of the demand sub-indices (building and people). A comparison of changes to the weighting of the sub-indices on the CI was not carried out due to demand and ability to pay being equal drivers of fuel poverty.

Spatial cluster and outlier analysis was also completed using the K nearest neighbours conceptualisation of spatial relationship, with an 8 nearest neighbour threshold. This enables a consistency of number of neighbours for analysis, however, there is increased variation in scale between urban and rural DZ's.

3.0 Results

Figure 17 shows the final fuel poverty Composite Index (CI) mean, alongside the two composite sub-indices in figures 13 and 15. A lower average score means areas are at a higher risk of fuel poverty and these are visualised as darker colours. The variation in risk between the sub-indices is highlighted with increased demand risk within urban and rural areas, compared to ability to pay, which although shows rural pockets, is concentrated within the Mid Fife area, mirroring areas of increased deprivation.

High risk areas in rural North East Fife (Largoward/Colinsburgh, Giffordtown, Lower Largo) and the outskirts of urban areas in Kirkcaldy and Dunfermline are primarily linked to increased building demand variables, with high fuel bills, fuel inefficient homes and increased over 65 population.

Urban areas and accessible small towns with the highest demand risk (up to rank 14), relative to the rest of Fife, include Ballingry East and Ballingry Central (poor fuel efficiency, increased fuel bill and occupants and chronic disability risk), Raith Estate and Southerton (poor fuel efficiency, increased fuel bill and 65+ population), Macedonia North (poor fuel efficiency, increased fuel bill, chronic disability risk), Kelty West (poor fuel efficiency, increased occupants, chronic disability risk), Collydean South (poor fuel efficiency and chronic disability risk) and Cowdenbeath Foulford (increased fuel bill, chronic disability risk).

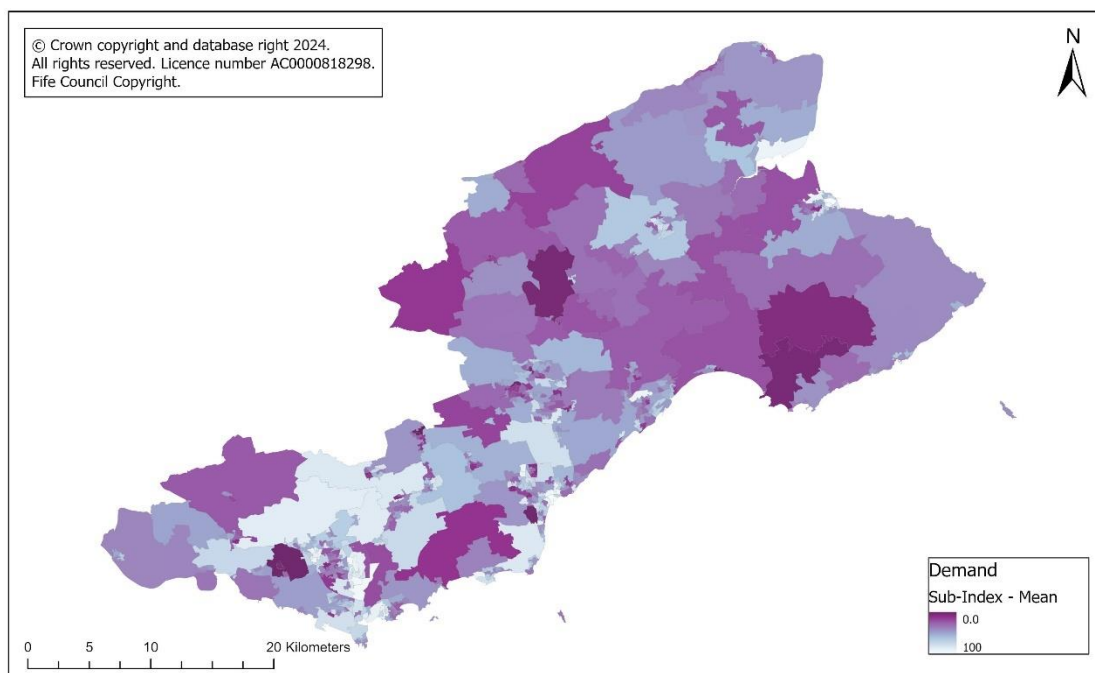


Figure 13 – Demand Mean

Figure 14 highlights the demand decile map, splitting the total DZ's into 10 groups, from 1 to 10, high to low risk. The DZ rank and corresponding decile is detailed within table 2. Varying frequency of DZ's per decile are detailed within the sub-indices and CI, due to duplication of DZ risk ranks.

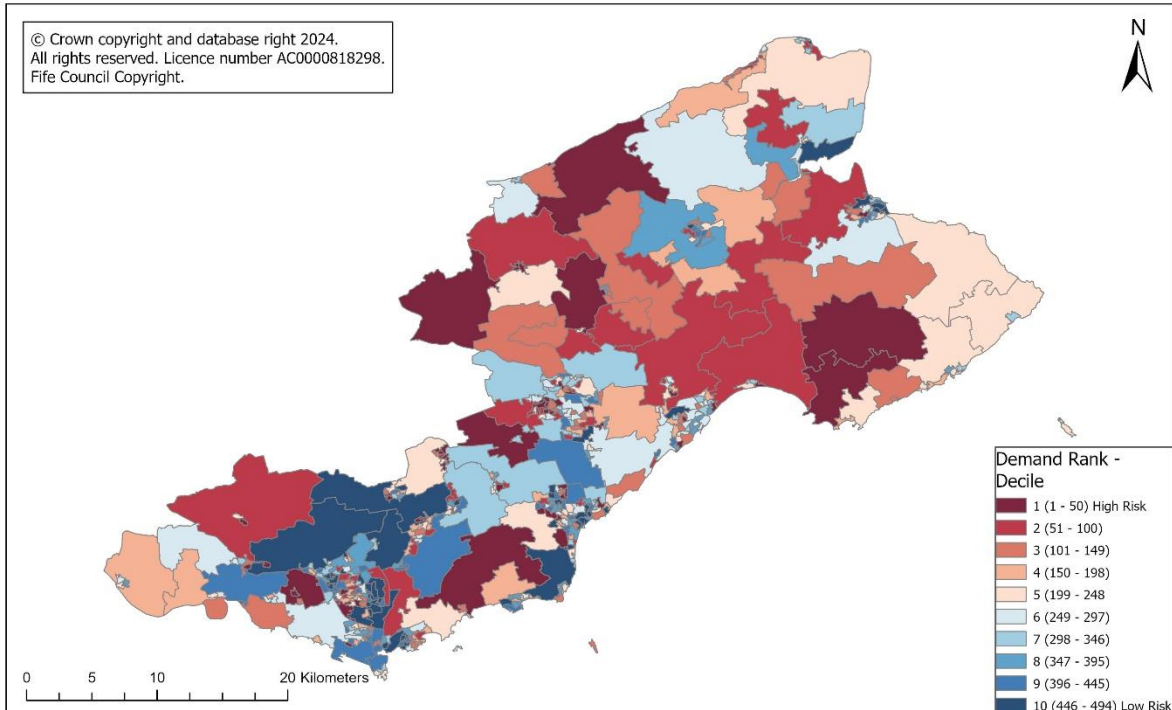


Figure 14 – Demand Decile

Table 2 – Datazone rank and Decile

Decile	Data Zone Rank	Decile	Data Zone Rank
1	1 - 50	6	249 - 297
2	51 - 100	7	298 - 346
3	101 - 149	8	347 - 395
4	150 - 198	9	396 - 445
5	199 - 248	10	446 - 494

Table 3 provides a breakdown of the top 10% of high-risk demand DZ's by area committee.

Table 3 – High Risk Demand Data Zones (Decile 1)

Area Committee	DZ Name
Cowdenbeath	Ballingry East, Ballingry Central, Kelty West, Cowdenbeath Foulford, Cardenden West, Crosshill and Lochore South, Lochore North, Kelty South West
City of Dunfermline	Crossford East and Berrylaw, Crossford West, Brucefield North, Pitreavie, Pitcorrhie Central
Glenrothes	Macedonia North, Collydean South, Coaltown of Balgonie West, Woodside North, Rimpleton West, South Parks North, Macedonia East, Cadham South, Macedonia West, Tanshall East, Kinglassie West
Kirkcaldy	Raith Estate and Southerton, Dunnikier East, Dunnikier North, Newliston, Bennochly West, Auchtertool, Dunnikier South, Sinclairtown East, Kirkcaldy Long Braes
Levenmouth	Lower Largo, Methil Trees East, Kennoway South East, Buckhaven Central, Leven Links
North East Fife	Giffordtown to Lathrisk, Colinsburgh Kilconquhar and Balcarmo, Largoward Landward, Cannongate, Auchtermuchty West, Gateside Landward, Flisk Lindores and Luthrie, Auchtermuchty East
South and West Fife	Oakley East, Rosyth Pease Hill South, Carnock, Saline South

The ability to pay maps below demonstrates pockets of ability to pay increased risk in both urban and rural areas, including coastal areas, throughout Fife.

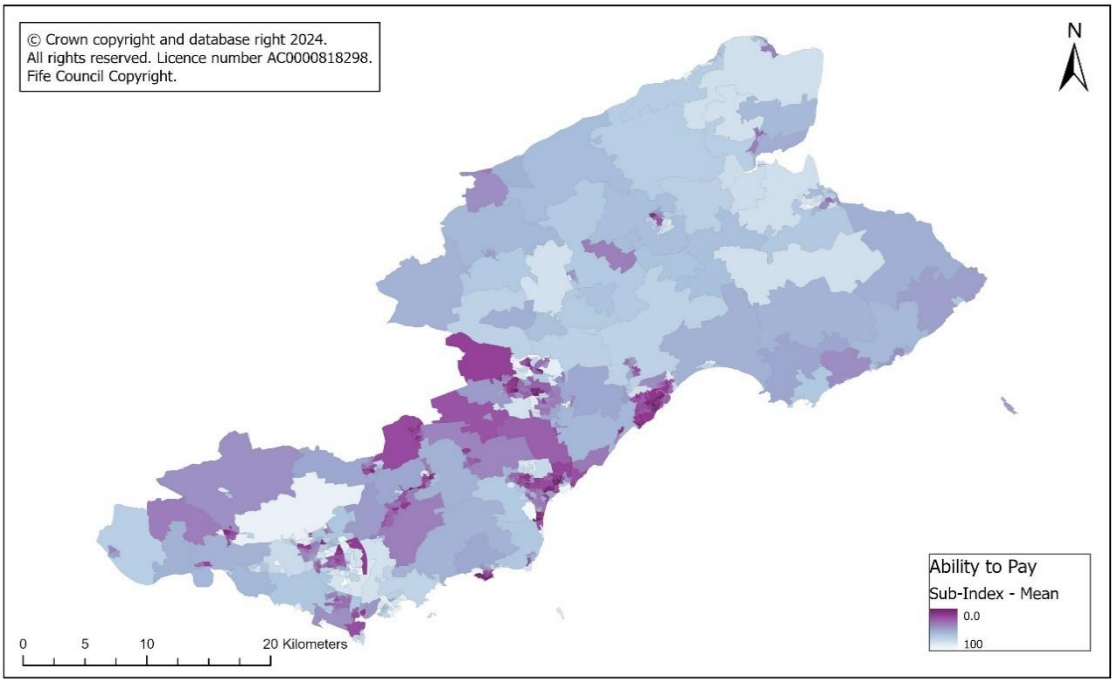


Figure 15 - Ability to Pay Mean

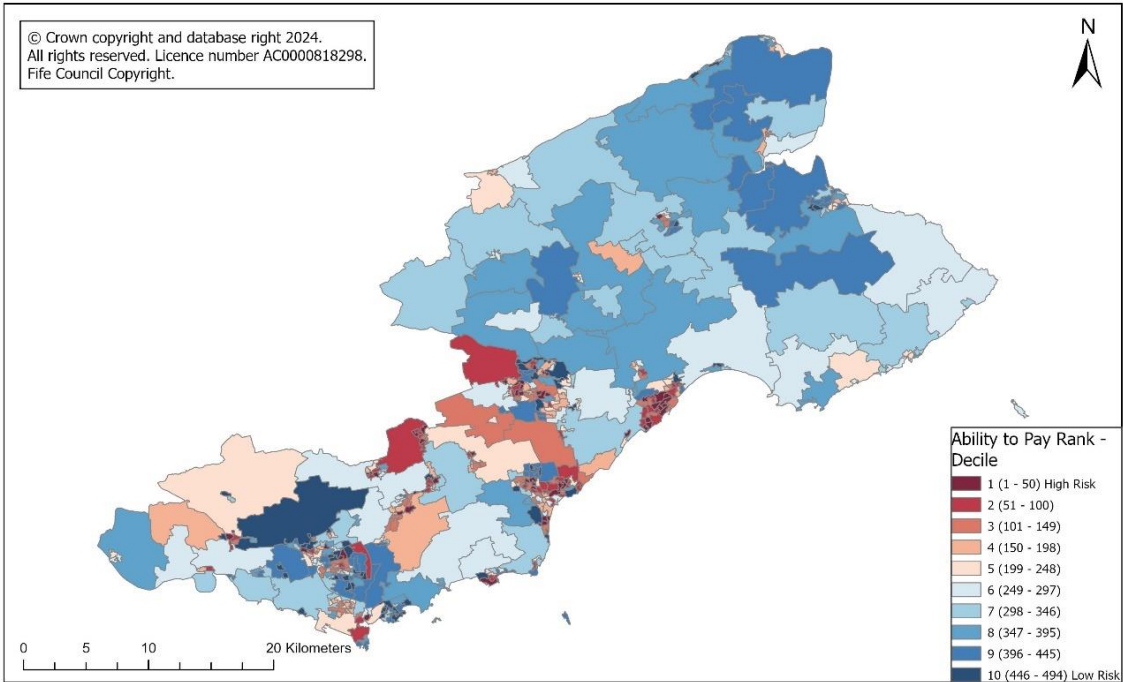


Figure 16 Ability to Pay Decile

Table 4 – High Risk Ability to Pay Data Zones (Decile 1)

Area Committee	DZ Name
Cowdenbeath	Lumphinnans, Kelty Central, Lochgelly East, Lochore Central, Ballingry West, Bowhill East, Cowdenbeath South, Ballingry East, Kelty West, Cowdenbeath South East
City of Dunfermline	Touch, Headwell East, Woodmill North, Balbridgeburn North
Glenrothes	Tanshall East, Cadham, Auchmuty West, Auchmuty North West, Macedonia East, Macedonia North, Auchmuty East, Tanshall Central, Collydean South, Leslie West
Kirkcaldy	Sinclairtown Central, Linktown Central, Burntisland Docks, Sinclairtown West, Pathhead North West, Gallatown West, Linktown North, Templehall North, Templehall, Templehall North Eastern, Linktown East, Fair Isle
Levenmouth	Methil Memorial Park, Aberhill, Buckhaven South, Lower Methil, Methil Savoy, Buckhaven Central, East Wemyss McDuff, Buckhaven North, Methil Old Bayview, Methil Kirkland, Methilhill North
North East Fife	Cupar North West
South and West Fife	Comrie East, Inverkeithing Spittalfield

The Composite Index map details the spatial distribution of the composite Fuel Poverty Index scores at DZ level across Fife. The CI is a compensatory Index, with areas of increased demand risk balanced by areas of low ability to pay risk, and areas of high ability to pay risk balanced by areas of low demand risk.

Households in mid-Fife have the highest potential for fuel poverty based on the aggregate metric. This is because households in that area tend to have below average incomes and are more likely to be in receipt of Universal Credit or pension credit. The majority of the ability to pay variables, for the highest risk DZ's, are high/above average excluding private rented, with half of these DZ's above the Fife average.

These high risk DZ's also score highly for demand risk, with the Macedonia area highest risk due to percentage of properties below EPC C, followed by Ballingry (East and Central) and Kelty West. All DZ's present higher CIF scores, with the majority above average for the percent of 4+ occupants. Interestingly, the majority of the highest risk DZ's have below average 65+ population excluding Buckhaven Central. The influence of this variable was reduced by splitting demand into building and people to enable CIF and properties 4+ to have increased influence. The vulnerable over 65 years category is reflected by the Pension Credit variable, with all highlighted DZ's above the Fife average, excluding Tanshall Central.

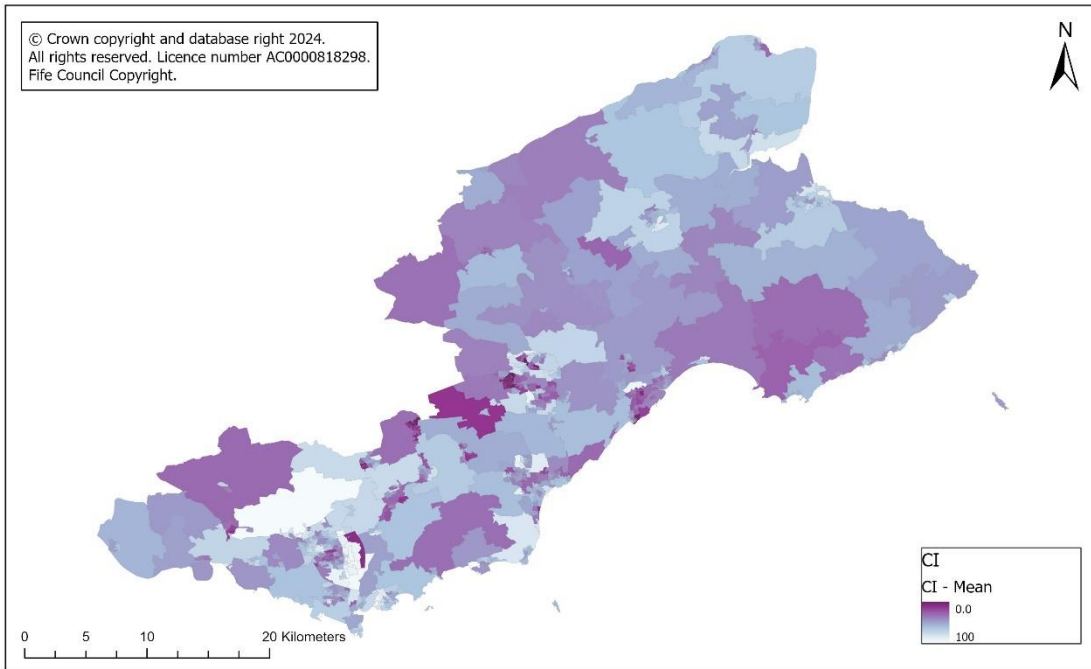


Figure 17 - Composite Index Mean

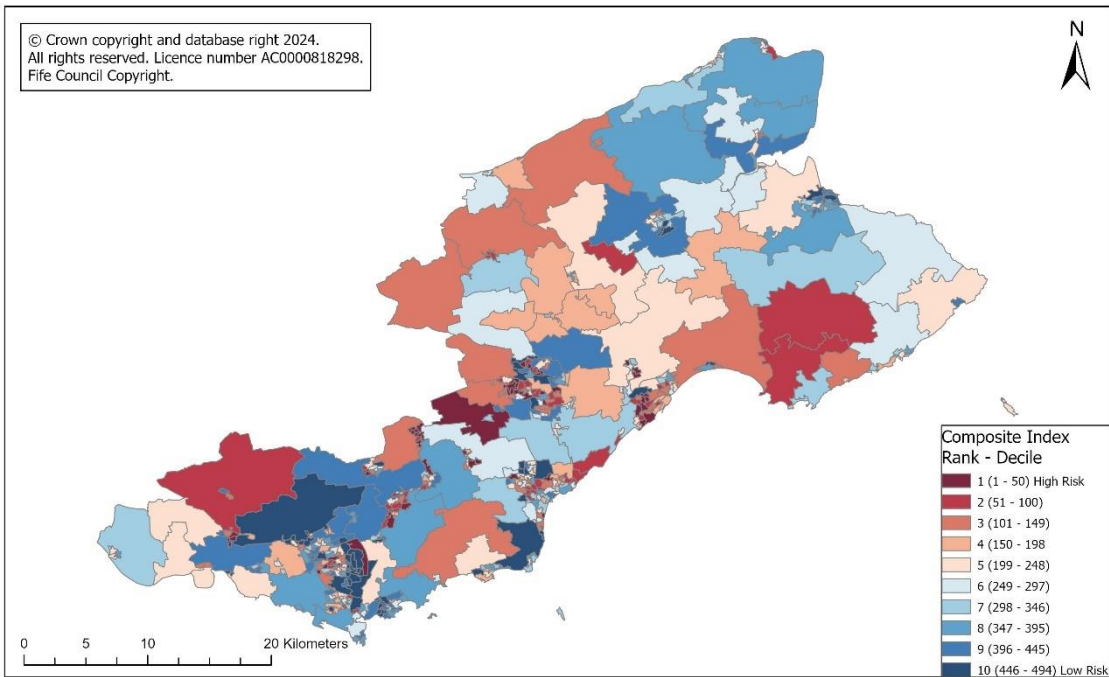


Figure 18 – Composite Index Decile

DZ's showing the highest risk of fuel poverty (decile 1) by area committee highlighted in table 5.

Table 5 – High Risk Composite Index Data Zones (Decile 1)

Area Committee	DZ Name
Cowdenbeath	Ballingry East, Kelty West, Ballingry Central, Crosshill and Lochore South, Kelty South West, Cowdenbeath South East, Ballingry West, Ballingry South, Cardenden West, Lochore North, Cardenden East, Bowhill West, Hill of Beath, Lochgelly North
City of Dunfermline	Halbeath, Woodmill West, Pitbauchlie West, Abbeyview West, Brucefield North
Glenrothes	Macedonia North, Collydean South, Tanshall East, Macedonia East, Cadham, Tanshall Central, Macedonia West, Kinglassie West, Auchmuty East, Rimbleton West, Cadham South, Pitteuchar Central, Viewfield North and Rimbleton South, Collydean West, Woodside North
Kirkcaldy	Linktown East, Smeaton North, Chapelhill and Torbain
Levenmouth	Buckhaven Central, Methil Trees East, Kennoway South East, Denbeath South, Methilhill Toll Bar, Kennoway North West, Methil Trees West, Methil Methilhill, Kennoway East, Buckhaven Birds
North East Fife	None in Decile 1. Highest NEF DZ is Colinsburgh Kilconquhar and Balcormo rank 63. Followed by Auchtermuchty West at rank 66. Both are in Decile 2.
South and West Fife	Oakley East, Oakley North

Table 6 provides an overview of the highest CI risk areas, with 3 standard deviations below the mean, with the sub-index scores also detailed. The DZ's highlighted as the highest risk of fuel poverty are within the stretched society and low income living CACI Acorn categories¹¹. This includes hard-up households, cash strapped families, constrained pensioners, challenging circumstances and limited budget groups.

¹¹ Acorn, CACI. Available at: [Acorn | Geodemographic Segmentation | Acorn Data | CACI](#), accessed 14th October 2024.

Table 6 – High Risk Data Zones - Composite Index and Sub-Indices Rank

Data Zone	CI Rank	CI Mean	Demand Rank	Ability to Pay Rank	ACORN Household Type
Macedonia North	1	0.00	5	19	Single-parent families in terraced housing Older, single-person households on the outskirts of town Families in low-value terraced housing
Collydean South	2	1.60	12	27	Single-parent families in terraced housing Socially renting families in terraces Families in low-value terraced housing
Ballingry East	3	2.45	1	46	Older, single-person households on the outskirts of town Families in low-value terraced housing
Tanshall East	4	3.09	49	4	Older, single-person households on the outskirts of town Families in low-value terraced housing
Macedonia East	5	3.19	38	16	Single-parent families in terraced housing Older, single-person households on the outskirts of town
Cadham	6	3.51	52	5	Single-parent families in terraced housing Poorer pensioners in semis
Kelty West	6	3.51	10	47	Older, single-person households on the outskirts of town Young families in socially rented semis
Ballingry Central	8	3.73	3	56	Older, single-person households on the outskirts of town Families in low-value terraced housing
Buckhaven Central	9	4.90	37	33	Older renters in flats and tenements Older, single-person households on the outskirts of town Socially rented flats, singles and pensioners
Tanshall Central	10	6.18	58	24	Families in low-value terraced housing Single-parent families in terraced housing Older, single-person households on the outskirts of town
Methil Trees East	11	6.60	33	53	Routine occupations, socially renting families in semis Young families in socially rented semis
Macedonia West	12	7.24	41	51	Older, single-person households on the outskirts of town Single-parent families in terraced housing

4.0 Limitations

The composite approach can address the multi-dimensional nature of fuel poverty, and alongside supporting or contextual datasets, can drive improved fuel poverty alleviation outcomes. Although the variables and datasets have been selected to provide relevant and robust analysis the methodology can be refined further to include up to date data, including Comparative Illness Factor representing increased demand from chronic illness within the updated SIMD. Variables were also based on modelled data from Home Analytics and CACI Paycheck and Acorn and may not be region specific.

Generally, increased risk in demand is seen in both accessible urban and rural areas in Fife, with high risk ability to pay concentrated in urban areas, however, fuel poor in rural areas may require a larger reduction in fuel costs to escape fuel poverty (compared to fuel poor urban households).

Automation of the process is required to ensure updated datasets and changes to weighting can be actioned. Examples of this include the updated EPC methodology¹², changes to small area boundaries¹³ and modelled data updates including Home Analytics and CACI's Paycheck and Acorn.

A further risk variable, that was not available at the relevant geography, that could be incorporated into the CI is the percentage of homes with a pre-payment meter (PPM). A higher proportion of households with a PPM (PPM; electricity, gas or both) were in fuel poverty in Scotland compared to those without a PPM; 47% compared to 28% respectively.¹⁴

A key driver of how energy is used in the home is missing within the CI. This is partially included within the median fuel bill estimate variable as this is calculated from fuel demand, fuel type and fuel pricing.

Transparency is required throughout the CI creation process. The demand sub-index was created from two sub-indices (building and people) due to the properties with 4+ occupants and CIF having little influence over the demand CI due to the correlation between EPC below C and fuel bill estimate variables. The LMI analysis for sub-indices and CI were with a default distance threshold of 5.6km/3.5 miles to ensure every DZ had at least one neighbour. This means that smaller urban DZ's will be compared with significantly more DZ's to identify clusters/outliers than rural DZ's. 11 DZ's were compared against under 5 DZ's and 84 against 100+. As stated, composite indices are subjective with required assumptions and simplifications, decisions made on relevant variables, datasets and weightings, all of which significantly influence the results and insights derived from this. Fizaine & Kahouli (2019)¹⁵ provide that CI can be seriously misleading when identifying fuel poor and driving public policy if not handled correctly.

¹² Scottish Government, EPC Reform Consultation. Available at: [2. Current EPC System in Scotland - Energy Performance Certificate \(EPC\) reform: consultation - gov.scot \(www.gov.scot\)](https://www.gov.scot/resources/consultations-petitions/html/2024/2-Current-EPC-System-in-Scotland-Energy-Performance-Certificate-EPC-reform-consultation-gov.scot) accessed 15th October 2024.

¹³ Scottish Government, Revising Small Area Statistics Geographies: data zones and intermediate zones. Available at: [Revising small area statistics geographies: data zones and intermediate zones - Scottish Government consultations - Citizen Space](https://www.gov.scot/resources/consultations-petitions/html/2024/Revising-small-area-statistics-geographies-data-zones-and-intermediate-zones-Scottish-Government-consultations-Citizen-Space), accessed 15th October 2024.

¹⁴ Scottish Government, Scottish House Condition Survey 2022. Available at: [Scottish House Condition Survey: 2022 Key Findings - gov.scot \(www.gov.scot\)](https://www.gov.scot/resources/consultations-petitions/html/2024/Scottish-House-Condition-Survey-2022-Key-Findings-gov.scot) accessed 15th October 2024.

¹⁵ Fizaine., F. and Kahouli, S (2019). On the power of indicators: how the choice of fuel poverty indicator affects the identification of the target population, *Applied Economics*, 51:11, 1081-1110. <https://doi.org/10.1080/00036846.2018.1524975>

5.0 Next Steps

- Provide a strategic overview of fuel poverty for each area through the 2025 Local Strategic Assessments.
- Communicate priority areas/DZ rank through visualisations and data.
- Compare areas with increased support/service demand with fuel poverty risk to understand the extent to which current support is targeted to support those most in need.
- Further questions can be explored including optimal warm space locations, in/near to areas of increased risk.
- Use of the CI alongside the LHEES optioneering model to help identify areas of intervention in the LHEES Delivery Plan.
- Further explore statistical outliers to understand what risk variables within these areas are different and are influencing the difference in risk score.
- Create an interactive solution that allows user to select geography and overlay sub-indices, CI and supporting information, extending CI use and further sharing insights. An example of this is provided by the Open Data Institute using Tableau.¹⁶
- Create a model utilising ArcGIS Pro model builder to improve reproducibility. This will ensure that as datasets are updated, sub-indices and CI can be updated to reflect priority areas of increased risk.
- Continue to refine CI methodology with services to progress the CI and derived insight.

¹⁶ Fuel Poverty Risk Index 2023, Open Data Institute, Available at: [Fuel poverty risk index 2023 | The ODI](#) Accessed 1st October 2024.

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Appendix

Appendix A – Selected Variables

Variable	Geography	Period	Source
Properties below EPC C	UPRN	June 2024	Home Analytics 3.9, Energy Savings Trust
Median Fuel bill estimate	UPRN	June 2024 July 2024	PEAT, Energy Savings Trust Fuel pricing OFGEM
Properties 4+ Occupants	Data Zone	2022	Census (table UV406)
65+ years population	Data Zone	2022	Census (table UV103)
Time to GP via road network	Data Zone	2020v2	Scottish Index of Multiple Deprivation (SIMD)
Time to Retail Centre via road network	Data Zone	2020v2	Scottish Index of Multiple Deprivation (SIMD)
Comparative Illness Factor	Data Zone	2020v2	Scottish Index of Multiple Deprivation (SIMD)
Median Income	Data Zone	2024	Paycheck, CACI
Universal Credit Claimants	Data Zone	Avg 2022/23 & 2023/24	Stat X-plore, DWP
Lone parents with dependent children	Data Zone	2022	Census (table UV116)
Guarantee pension credit	Data Zone	Avg 2021/22, 2022/23 & 2023/24	Stat X-plore, DWP
Private rented	Data Zone	June 2024	Home Analytics 3.9, Energy Savings Trust
Social housing rented	Data Zone	June 2024	Home Analytics 3.9, Energy Savings Trust

Appendix B – Variable Weighting

Variable	Weight	Evidence	Source
EPC Below C	X2	Key indicator of fuel poverty risk: The lowest rates of fuel poverty are associated with higher energy efficiency standards.	Scottish House Condition Survey 2022, https://www.gov.scot/publications/scottish-house-condition-survey-2022-key-findings/pages/3-fuel-poverty/ Scottish Government, Home energy and fuel poverty - gov.scot (www.gov.scot)
Fuel Bill Estimate	X1	High energy costs. Indicator created from fuel type and energy costs.	Portfolio Energy Assessment Tool (PEAT), EST, Home Analytics housing stock data - Energy Saving Trust OFGEM, Energy price cap Ofgem
Properties 4+ Occupants	X1	Increased energy demand in occupied households (4+).	Open Data Institute, Fuel poverty risk index 2023 The ODI
Properties 65+ Occupants	X1	Increased energy demand due to increased temperature required and time within the home.	SGN, Energy safeguarding for older people SGN Your gas. Our network. Stakeholders
Rurality - Avg drive time to GP	X0.5	Increased demand risk in rural areas linked to both larger and less energy efficient homes.	British Gas Energy Trust, Tackling fuel poverty in rural communities - British Gas Energy Trust Scottish Government, 3. Challenges - Rural Scotland Data Dashboard: Overview - gov.scot (www.gov.scot)

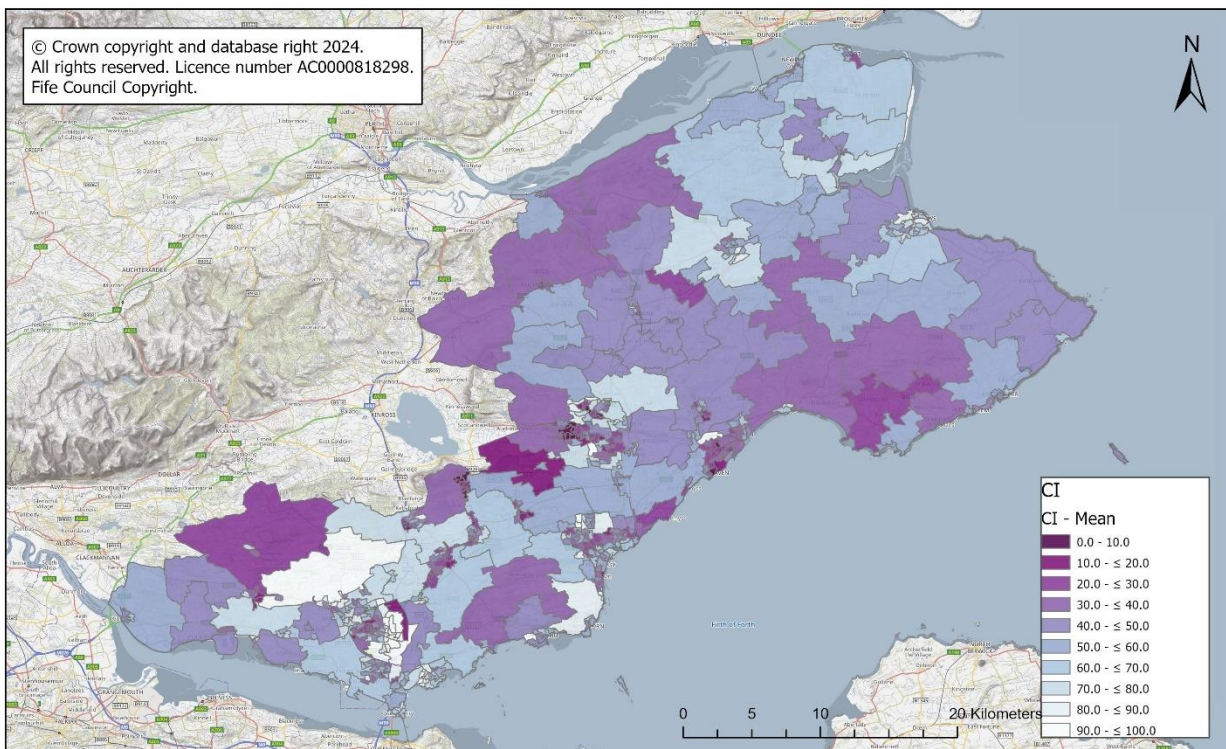
Variable	Weight	Evidence	Source
Rurality - Avg drive time to Retail Centre	X0.5	Increased demand risk in rural areas linked to both larger and less energy efficient homes.	Rural Services Network, Rural Fuel Poverty Gap widens - Rural Services Network (rsnonline.org.uk) , UK Parliament, Cost of living: impact on rural communities in Scotland - Scottish Affairs Committee (parliament.uk)
Comparative Illness Factor	X1	Measures how many individuals receive contributions for chronic disability. People are more vulnerable if have an ongoing health condition which requires higher-than-average amounts of energy	The Scottish Fuel Poverty Advisory Panel, Key Facts - Fuel Poverty Scotland (fuelpovertypanel.scot)
Median Income	X2	Key indicator of fuel poverty risk: Fuel poverty and extreme fuel poverty have a strong association with income, with rates increasing as annual household income decreases.	Scottish House Condition Survey 2022, https://www.gov.scot/publications/scottish-house-condition-survey-2022-key-findings/pages/3-fuel-poverty/ Scottish Government, Fuel poverty - Home energy and fuel poverty - gov.scot (www.gov.scot)
Universal Credit Claimants	X1	Reduced ability to pay. Represents people that are on low incomes, out of work or cannot work.	Open Data Institute, Fuel poverty risk index 2023 The ODI Edina, Fuel Poverty Scotland, scottish fuel poverty index user guide_final.pdf (spatialhub.scot)

Variable	Weight	Evidence	Source
Lone Parents with Dependent Children	X1	Reduced ability to pay.	Energy Policy, Occupant behaviour as a fourth driver of fuel poverty (aka warmth & energy deprivation) - ScienceDirect
Pension Credit (Guarantee)	X1	Guarantee Pension Credit shows the areas that have concentrations of older people on a low income.	Open Data Institute, Fuel poverty risk index 2023 The ODI Edina, Fuel Poverty Scotland, scottish fuel poverty index user guide_final.pdf (spatialhub.scot)
Private Rented	X0.5	The highest rates of fuel poverty by tenure continue to be found in the rental sector where Similarly, 44% of private rented sector households are fuel poor. In comparison, only 14% of those with a mortgage and 28% of those who own outright are assessed to be fuel poor. Increased risk for private rented due to lower energy efficiency, higher rent and less FP support	Scottish House Condition Survey 2022, https://www.gov.scot/publications/scottish-house-condition-survey-2022-key-findings/pages/3-fuel-poverty/
Social Housing	X1	Highest risk in the rented sector over owner. 48% of households renting from a local authority and 47% of households renting from a housing association are fuel poor. Less risk as more likely increased energy efficiency and support measures, and reduced rent compared to private rented.	Scottish House Condition Survey 2022, https://www.gov.scot/publications/scottish-house-condition-survey-2022-key-findings/pages/3-fuel-poverty/

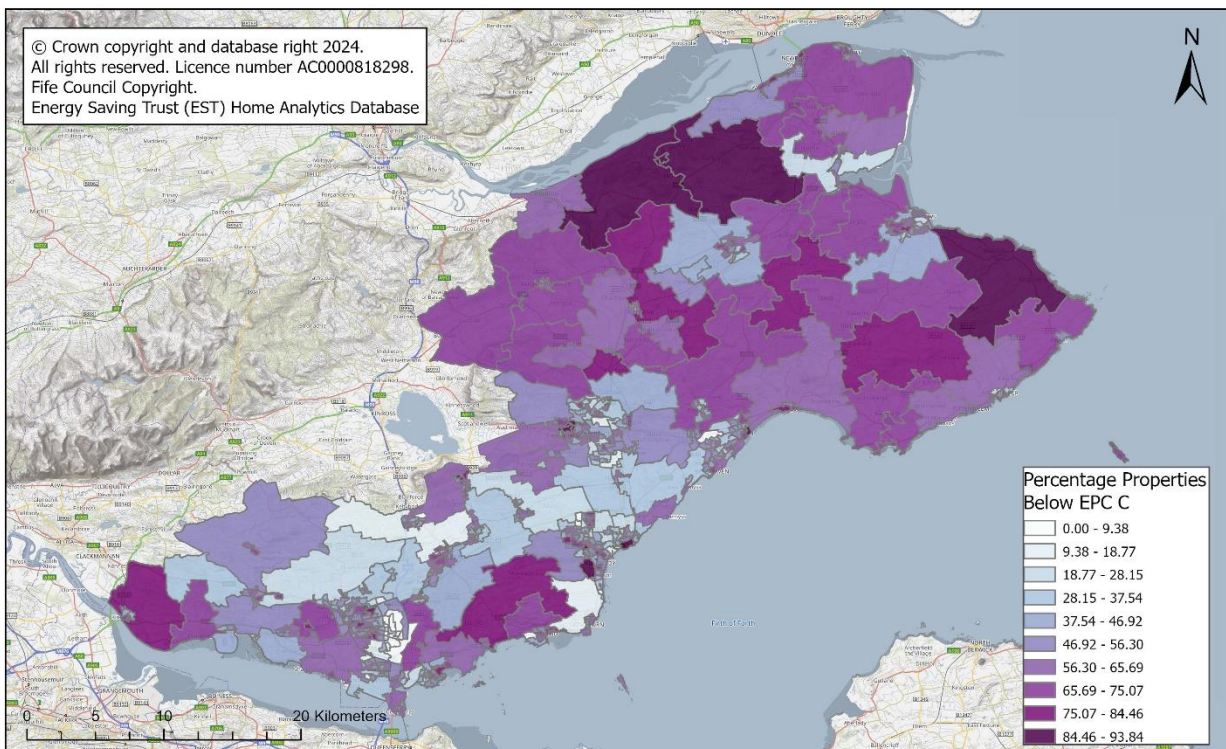
Appendix C – Reversing Variables

Sub-Index	Variable	Direction	Reversible	Unit & Range
Demand - Property	Properties EPC below C	High values are detrimental	N	Percentage 0 – 93.84%
	Median Fuel Bill Estimate	High values are detrimental	N	Pounds 1,951.68 - 5,174.71.
	Avg drive time to GP via road network	High values are detrimental	N	Minutes 0.8 – 11.3
	Avg drive time to Retail Centre via road network	High values are detrimental	N	Minutes 1.2 – 18.7
Demand - People	Properties 4+ Occupants	High values are detrimental	N	Percentage 0 – 46.3
	People 65+ years	High values are detrimental	N	Percentage 1.5 – 47.3
	Comparative Illness Factor (CIF)	High values are detrimental	N	Standard Ratio 5 -250
Ability to Pay	Median Income	High values are beneficial	Y	Pounds 19,146 – 85,611
	Universal Credit	High values are detrimental	N	Percentage 0.2 – 51.0
	Lone Parents with Dependent Children	High values are detrimental	N	Percentage 0.0 – 18.33
	Pension Credit (guarantee)	High values are detrimental	N	Percentage 0.00 – 21.27
	Private Rented	High values are detrimental	N	Percentage 0.78 – 61.33
	Social Housing Rented	High values are detrimental	N	Percentage 0.00 – 79.31

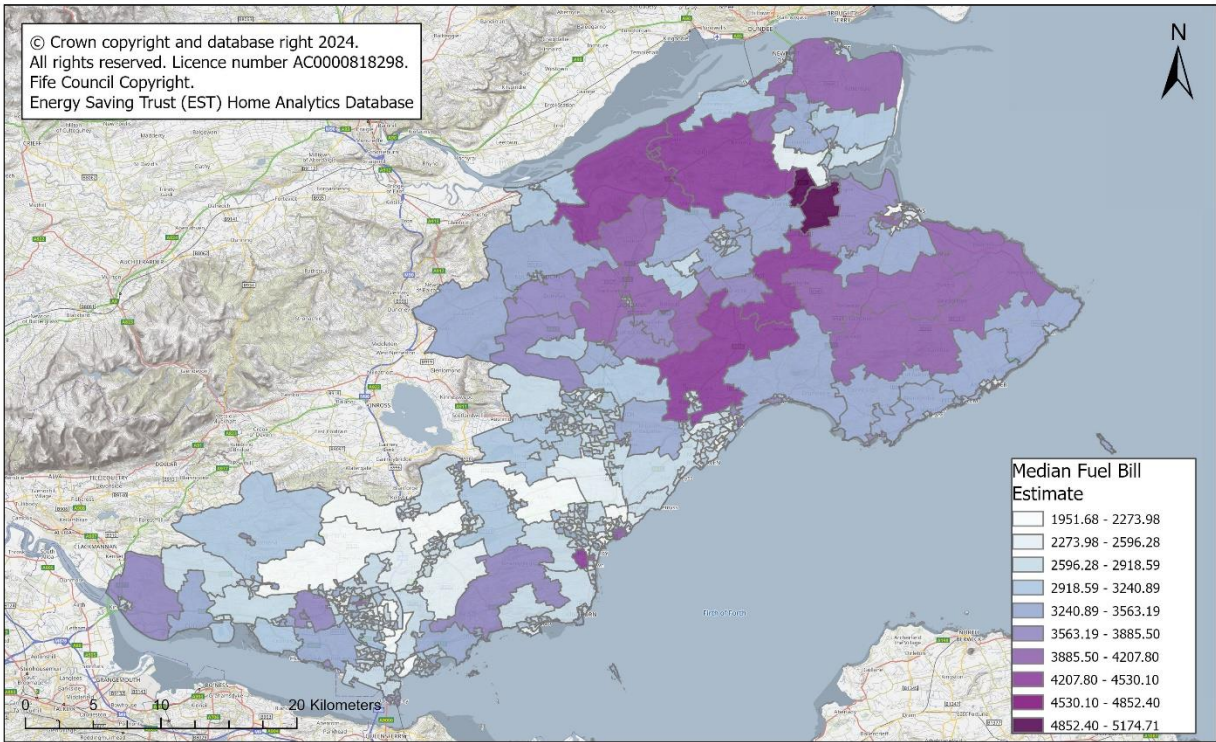
Appendix D – CI and Selected Individual Variables Mapping (Equal Interval)



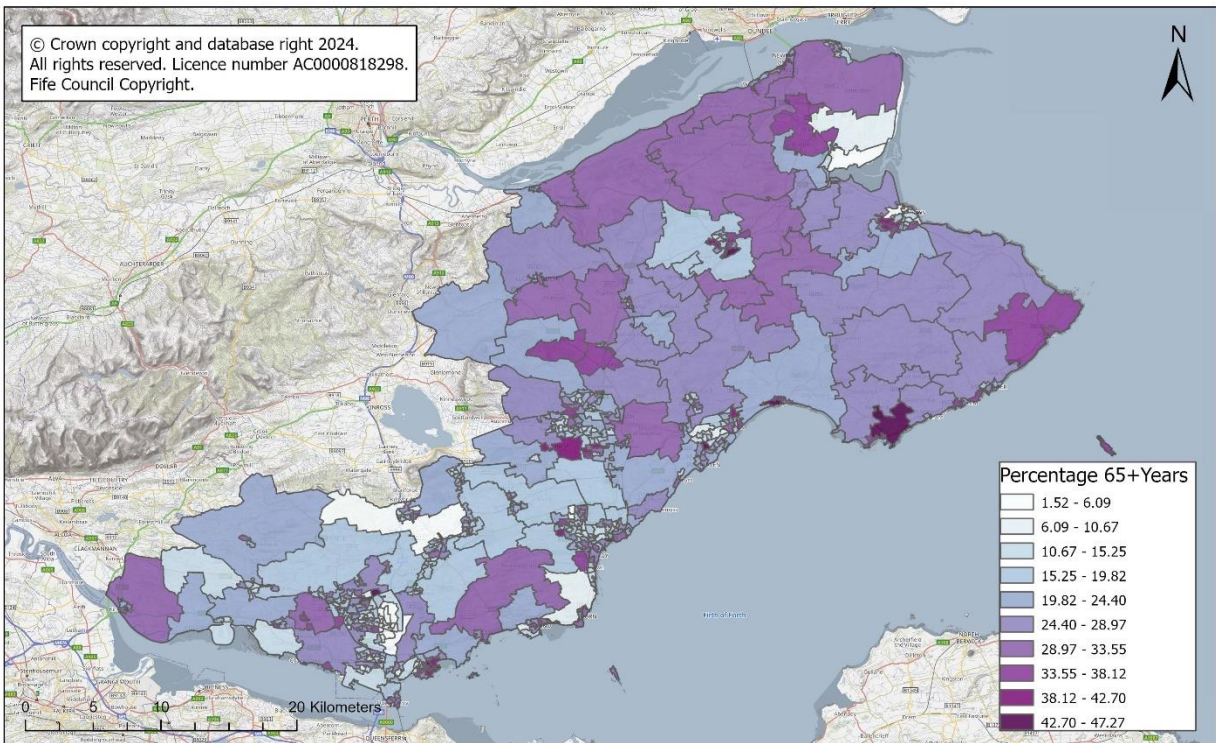
Composite Index



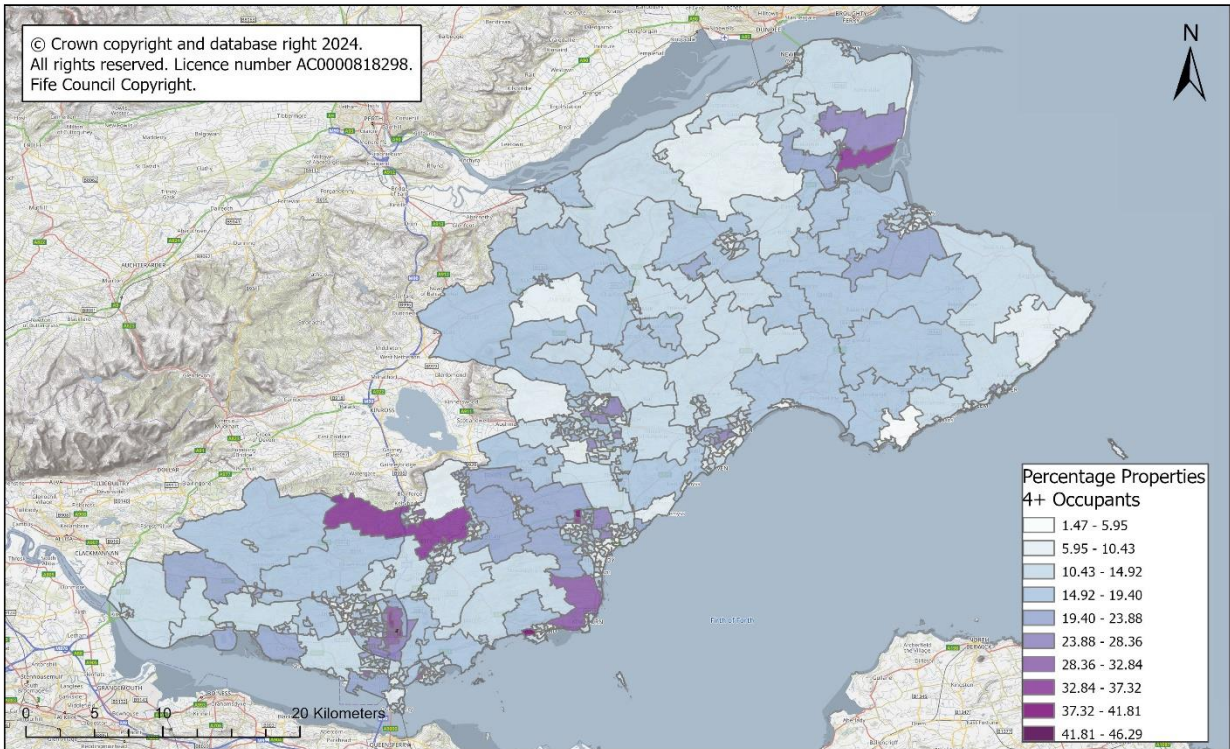
Percentage EPC Below C



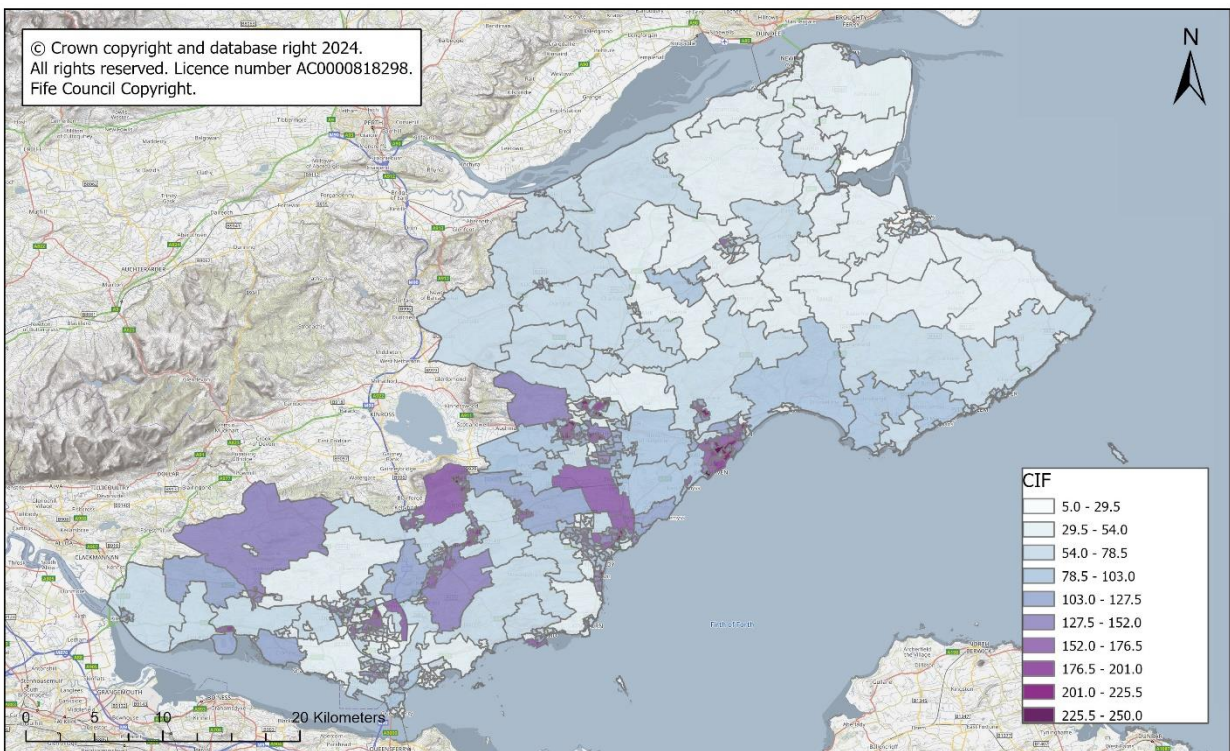
Median Fuel Bill Estimate



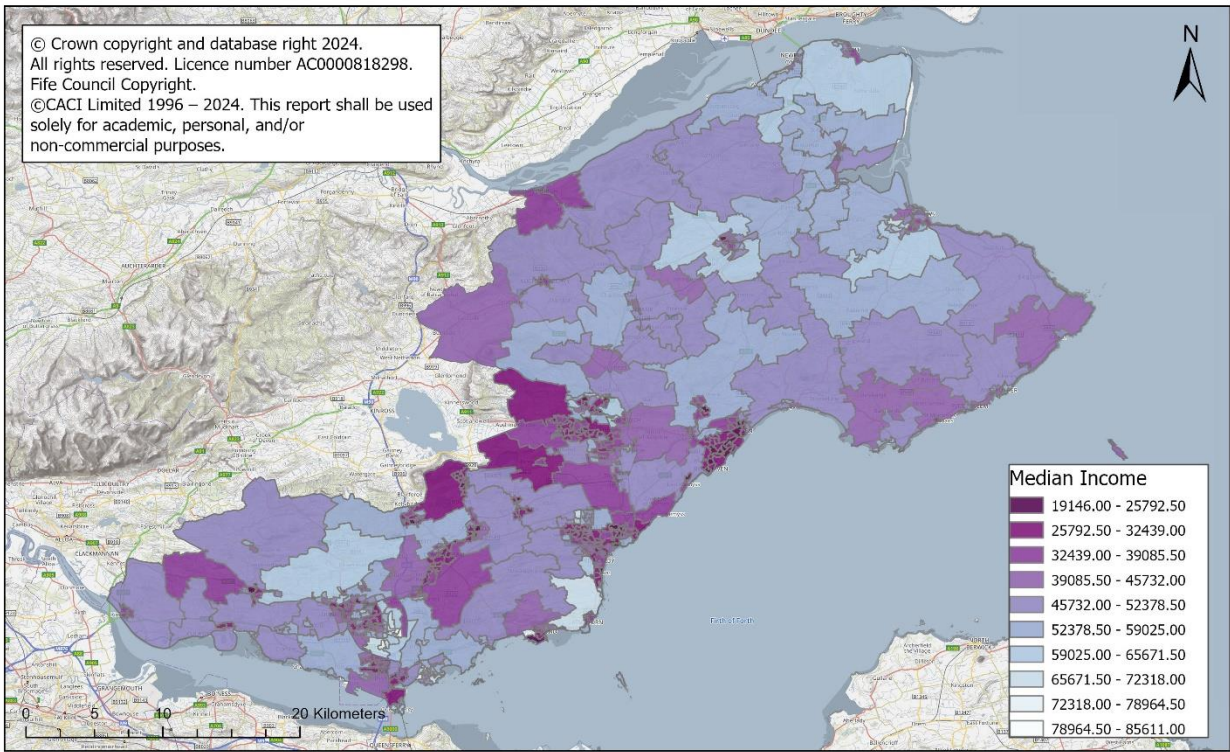
Percentage 65+ Years Population



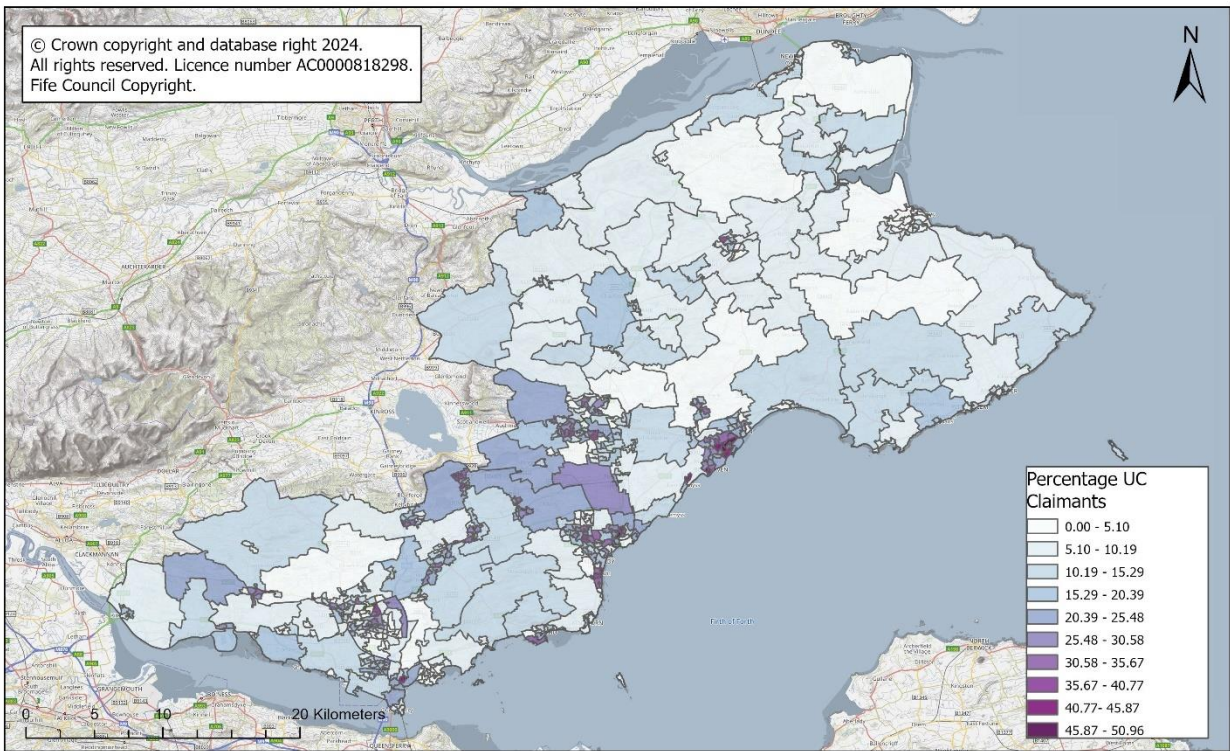
Percentage Properties 4+ Occupants



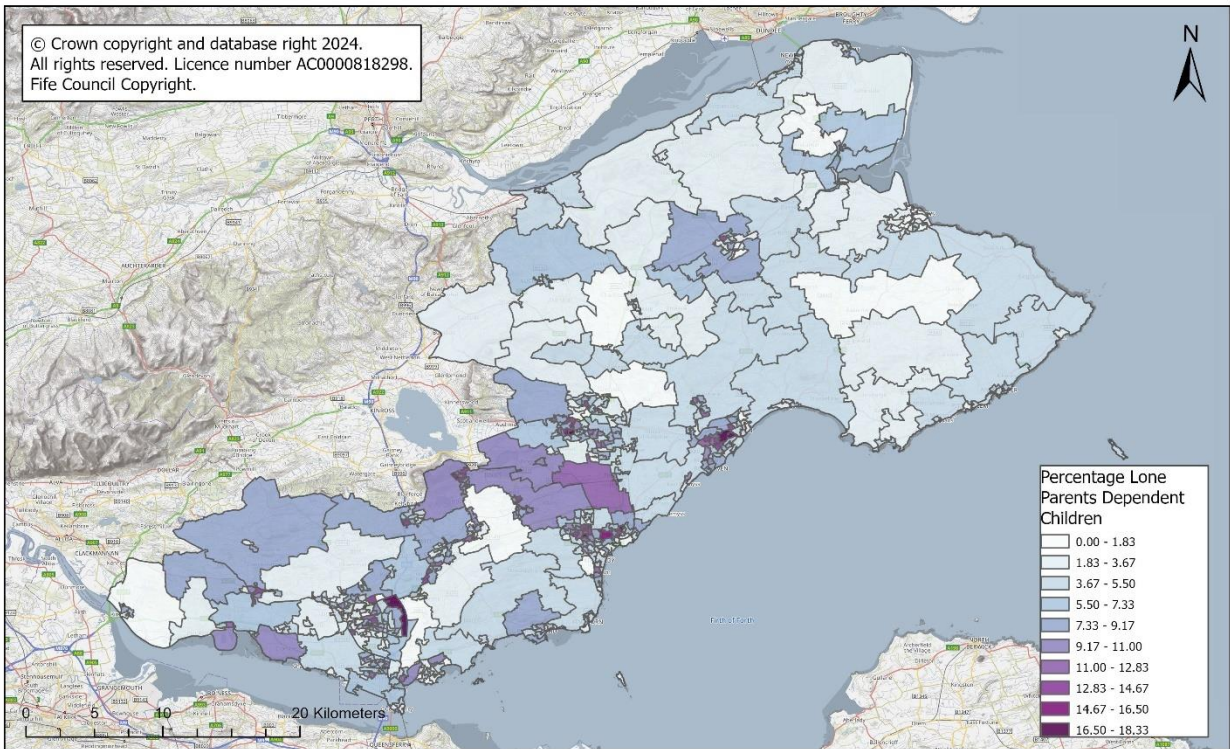
Comparative Illness Factor



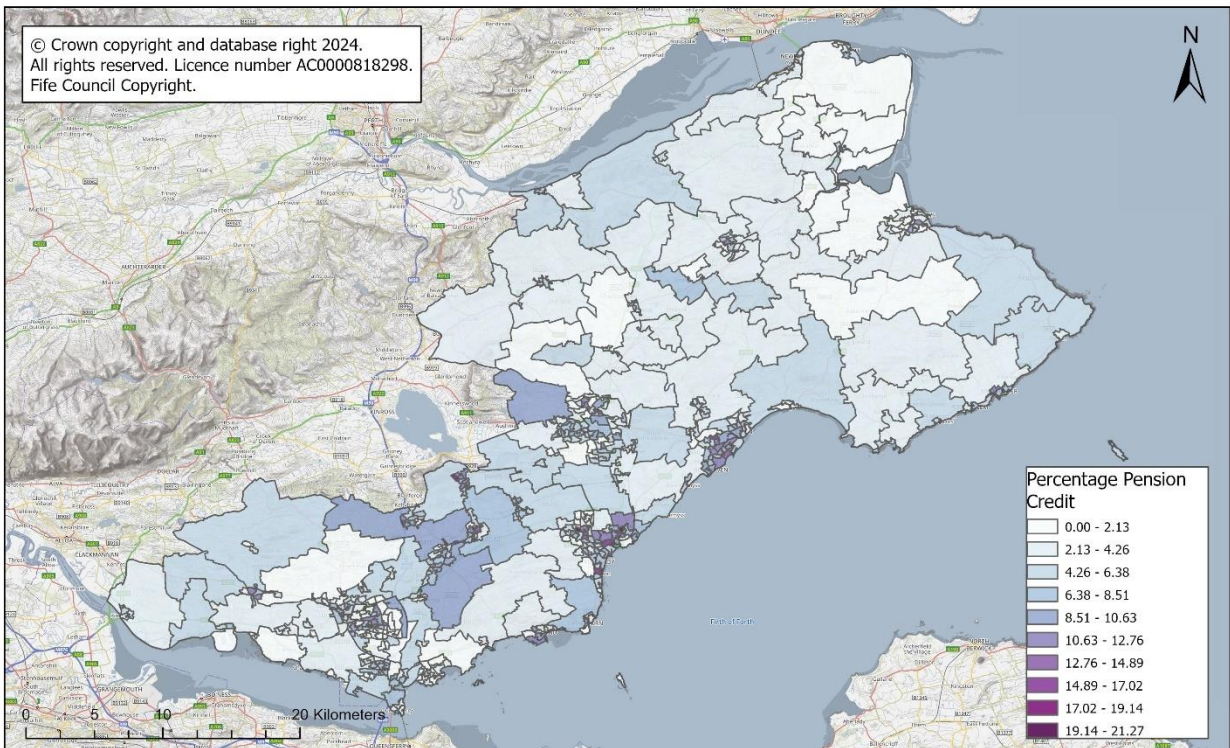
Median Gross Income



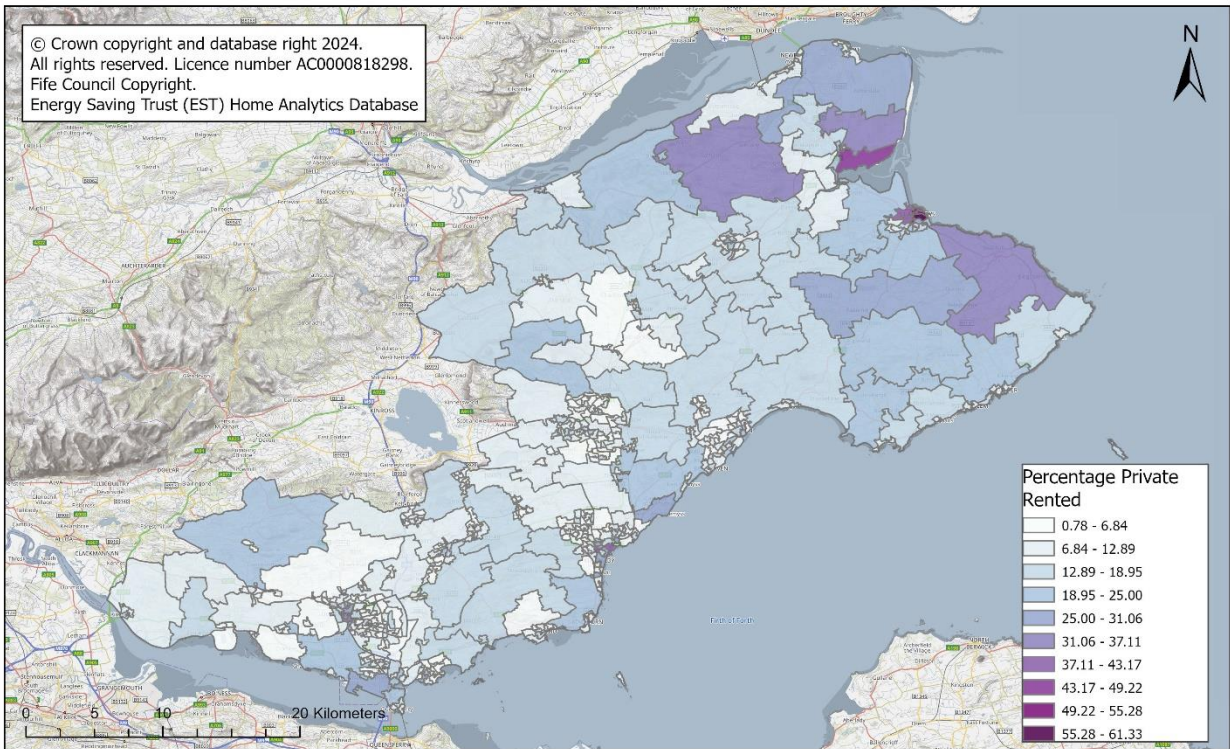
Percentage Universal Credit Claimants



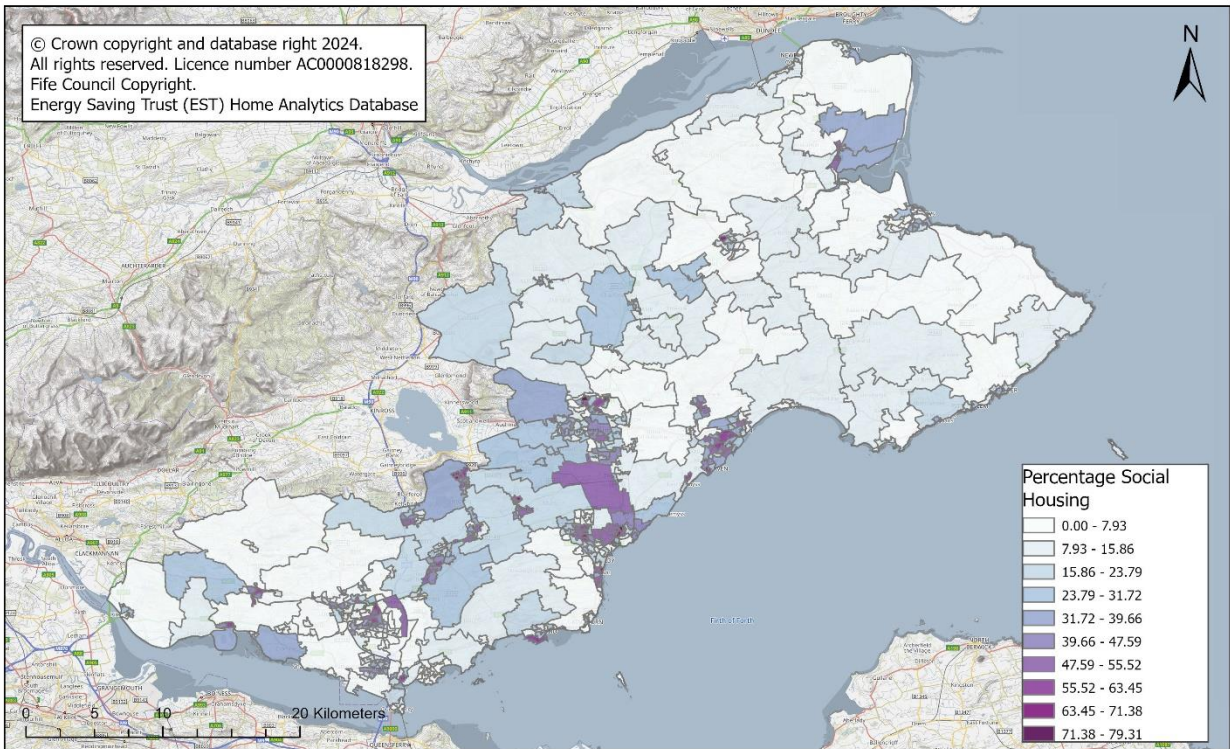
Percentage Lone Parents with Dependent Children



Percentage Guarantee Pension Credit



Percentage Private Rented



Percentage Social Housing

About this report

Fife Council Research and Insight Team works on prioritised projects to deliver strategic insight for the Council and community planning partners in Fife.

We aim to deliver engaging high-quality general insight for those involved in delivering public services across Fife.

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Important Notes on this Report

1. As part of the Local Heat and Energy Efficiency Strategy (LHEES) action plan, this research has been undertaken to enable better targeting of fuel poverty support in Fife.
2. Services identified that a more accurate measure of fuel poverty risk was required, that enabled services to target fuel poverty **need** more effectively as opposed to reacting to expressed **demand**.
3. The 2023 Fuel Poverty Needs and Demand Assessment identified several spatial approaches that would support the identification of areas of increased risk of fuel poverty.
4. The spatial approach, creation of a composite index (CI), was identified to capture the multidimensional nature of fuel poverty.
5. Geographic Information System (GIS) was used to integrate, weight and visualise indicators to show areas of low to high fuel poverty risk