

Introduction

FRESH (Foundation data for Robust Energy Strategies for Housing) is a powerful data mapping system managed by Warm Wales CIC with sponsorship from Wales and West Utilities. The system is based on an innovative carbon cluster mapping system developed at Cardiff University by the Low Carbon Research Institute and Welsh School of Architecture, funded under the EU Solcer project.

The main use of FRESH is to identify areas in most need of action within Local Authority neighbourhoods. The mapped data analysis will inform the deployment of resources and will act as an enabling tool to co-ordinate existing agencies, moving from a reactive referral system to proactive targeting of locally defined areas of highest need.

The FRESH Energy Performance Certificate (EPC) Data Report presents an overview and a geographical breakdown of cross-tenure housing stock within the Local Authority boundary, typically pinpointing areas of high energy consumption and fuel costs. This data is combined with overlays of vulnerability, enabling local councils to engage proactively in discussions with Local Communities and ECO Energy Providers and helping formulate bids for internal resources and external sources of funding.

Presented maps are based on the Office for National Statistics' (ONS) Super Output Area (SOA) geography. The geographical system is designed to report statistics for small areas of similar population size, number of households and social homogeneity (ref). Most of the maps will be presented at the lowest geographical level - Output Area (OA), each containing approximately 120 dwellings. Data not available at this level will be mapped at Lower Super Output Area (LSOA) level which contain between 400 and 1,200 dwellings with a population of between 1,000 and 3,000.

Maps presented in this report are based on a process of ranking OAs from worst performing to best performing. OAs are then divided into 5 quantiles, each with an equal number of OAs. OAs in the first quantile are the worst performing 20% and OAs in the 5th quantile the best performing. Maps that consider more than 2 variables are created by combining ranked data with equal weighting to form a new ranking and quantile groupings for OAs.

Modelling approach

The modelling approach used allows the housing stock's characteristics to be considered at a lower geographical level than the freely available Local Authority statistics. A database of all available EPCs is used alongside Census data to approximate the condition of all dwellings, taking into account the location of properties and typological differences. Consequently, the model formed provides information on the condition of all properties within the Local Authority broken down to smaller geographical areas. The grouping described in table 2 is used on OA level for the FRESH process, creating 360 possible property groups.

Table 5 displays the grouping of all available EPCs whilst table 6 shows the modelled grouping of all properties within the Local Authority based on the OA level model.

Table 1: Property Grouping Description - OA level

Typology (4)	Size (2)	Rating (3)	Fuel (5)	Age (3)
D (Detached)	L (Large)	ABC	B (Biomass)	1 (pre 1919)
F (Flat)	S (Small)	DE	E (Electricity)	2 (1919-1983)
SD (Semi)		FG	G (Gas)	3 (post 1983)
T (Terrace)			O (Oil)	
			S (Solid)	

Table 2: Property Grouping of EPCs in Cardiff – LSOA Model (need to change to OA)

ALL EPCs IN CARDIFF (74081)			Gas (63375)			Oil (81)			Solid (50)			Electricity (10575)			Y		
			ABC (21980)	DE (39861)	FG (1534)	ABC (12)	DE (54)	FG (15)	ABC (1)	DE (13)	FG (36)	ABC (5950)	DE (3526)	FG (1099)			
 Detached (5906)	Pre 1919 (250)	Large (147)	8	77	41				8	6							
		Small (103)	8	64	21				2	1				1	6		
	1919-1982 (3792)	Large (1939)	253	1532	117	1	15	1	1	1		5	9	4			
		Small (1853)	227	1408	53		1	1			2	94	62	5			
	Post 1982 (1864)	Large (971)	663	288			3			1		8	6	2			
Small (893)		531	338	1							7	14	2				
 Semi (15016)	Pre 1919 (773)	Large (573)	25	441	88				2	2			1	12			
		Small (200)	15	148	18				2				3	14			
	1919-1982 (13016)	Large (8485)	1521	6643	192		1	1		2	6	12	46	61			
		Small (4531)	987	579	65		1			2	4	18	43	32			
	Post 1982 (1227)	Large (714)	637	64								9	4				
Small (513)		412	92								5	4					
 Terraced (25611)	Pre 1919 (11756)	Large (8523)	427	7504	482				2		4	4	89				
		Small (3233)	345	2670	123		1			1	5	5	26	57			
	1919-1982 (11536)	Large (6199)	1902	4193	81					3	1	26	47	36			
		Small (5337)	135	871	26					1	1	113	152	38			
	Post 1982 (2319)	Large (1336)	1221	82								23	10				
Small (983)		865	75								24	19					
 Bungalow (2351)	Pre 1919 (28)	Large (15)		11								1	2				
		Small (13)		8	3								1	1			
	1919-1982 (2187)	Large (1059)	136	853	50				5				5	10			
		Small (1128)	315	783	13				2	1			6	7			
	Post 1982 (136)	Large (77)	61	12					2				1	1			
Small (59)		43	6				1					8	1				
 Flat (25197)	Pre 1919 (6495)	Large (2960)	616	1875	75				2		96	142	152				
		Small (3535)	953	1481	48				3	1		174	556	319			
	1919-1982 (16721)	Large (8520)	259	1860	28	2	1			1	1	484	1065	119			
		Small (8201)	389	1180	9	8	1					272	921	121			
	Post 1982 (1981)	Large (1039)	550	10								286	189	4			
Small (942)		476	3								283	180					

Table 3: Modelled Property Grouping of All Properties in Cardiff – LSOA Model (need to change to OA)

ALL DWELLINGS IN CARDIFF (146763)			Gas (130201)			Oil (169)			Solid (122)			Electricity (16271)			Y		
			ABC (48287)	DE (78608)	FG (3306)	ABC (14)	DE (117)	FG (38)	ABC (3)	DE (35)	FG (84)	ABC (8724)	DE (5779)	FG (1768)			
 Detached (14979)	Pre 1919 (480)	Large (385)	12	231	80				25	21							
		Small (95)	4	63	20				6	2							
	1919-1982 (6249)	Large (3906)	504	3034	312	3	34	1	3	3		3	2	7			
		Small (2343)	330	1869	122		2	2			6		5	7			
	Post 1982 (8250)	Large (4452)	2790	1564			13			7		56	12	10			
Small (3798)		2195	1583	9							5	6					
 Semi (33845)	Pre 1919 (2094)	Large (1690)	53	1364	216				4	9			13				
		Small (404)	13	310	60								6	15			
	1919-1982 (26777)	Large (18787)	2881	15196	478		2	2		4	9	5	71	139			
		Small (7990)	1477	8229	148		3			6	7	6	55	59			
	Post 1982 (4974)	Large (2755)	2391	340								6	18				
Small (2219)		1575	539								37	68					
 Terraced (52084)	Pre 1919 (24001)	Large (17412)	808	15382	1010				5		24	2	5	176			
		Small (6589)	648	477	277		4			2	12	5	44	120			
	1919-1982 (18861)	Large (11266)	3475	750	135					6	2	13	39	56			
		Small (7595)	2780	4531	49					2	1	39	141	52			
	Post 1982 (9222)	Large (3853)	3536	222								62	33				
Small (5369)		3559	557								101	152					
 Bungalow (4465)	Pre 1919 (10)	Large (10)										10					
		Small (10)															
	1919-1982 (3765)	Large (2350)	245	1944	115				10				7	29			
		Small (1415)	319	1041	27				2				12	14			
	Post 1982 (690)	Large (90)	61	29													
Small (600)		560	40														
 Flat (41390)	Pre 1919 (10803)	Large (4897)	1052	3182	123				1			81	202	252			
		Small (5906)	1595	2536	82				4	1		262	903	523			
	1919-1982 (12371)	Large (6188)	2714	2293	34	1	1			1	2	492	519	131			
		Small (6183)	3432	1334	9	10	1					678	604	115			
	Post 1982 (18216)	Large (10069)	779	150								3340	1782	18			
Small (8147)		3499	28								3536	1084					

Households vulnerable to living in cold homes

A review of recent literature presented in (CSE report ref) identifies associations between certain characteristics of individuals or households and having an above average likelihood of living in a cold home and/or being likely to be particularly vulnerable to the harmful effects of living in a cold home.

The vulnerability characteristics identified are:

- Older people (over 65 / or more likely to be vulnerable if over 75)
- Dependent children (under 18 / or more likely to be vulnerable if under 5)
- Health problem
 - Disability or long term health condition
 - Respiratory or circulatory disease
 - Mental health condition

Based upon the findings of this report, the target group to receive assistance through a future energy efficiency scheme should be any household which meeting all four of the following characteristics:

- In a home that is owner occupied or privately rented
- In a home that is energy inefficient
- On a relatively low income
- With an additional vulnerability

Energy Inefficiency

According to DECC's 2016 statistics on the number of Energy Performance Certificates lodged by Local Authority and Energy Efficiency Rating (ref), Cardiff's distribution of properties within rating bands is slightly better than that of the whole of Wales (figure 8). Cardiff has a lower percentage of F and G rated properties (4% compared to 10% in Wales) and higher proportion of C rated properties (30% compared to 24% in Wales).

The CSE report (ref) recommends that homes with SAP ratings of E, F or G are defined as being energy inefficient and be targeted in future schemes which account for 21% of Cardiff's stock (figure 8). However, this criterion could be widened to include cost effective work to properties rated D, a further 41% in Cardiff, totalling 62% of the housing stock (figure 8).

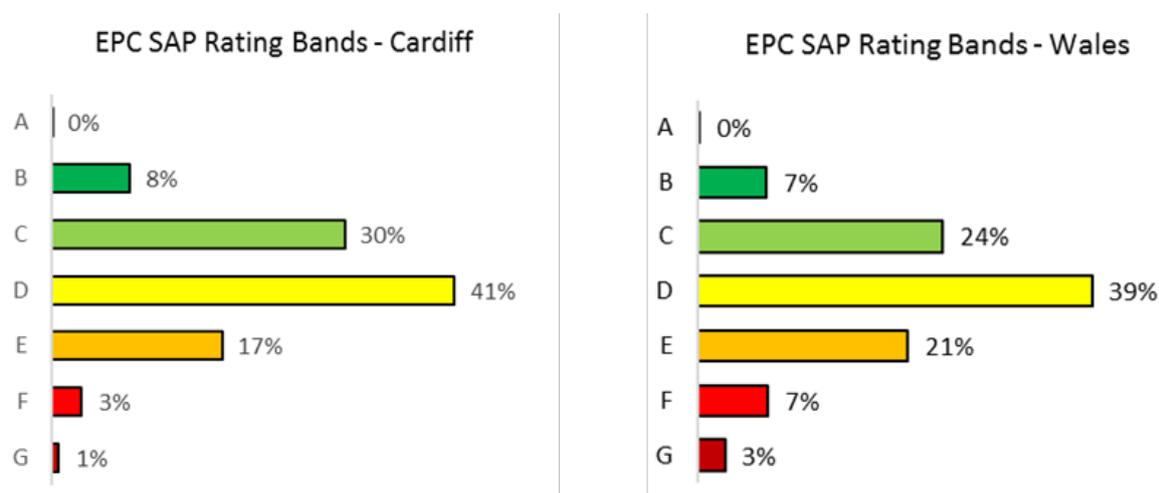


Figure 1: Energy Performance Certificates by SAP Rating Bands - Cardiff and Wales

Property Types

A high proportion of Cardiff's dwellings are terraced properties and flats (figure 2). Properties built before 1919 usually have solid walls and are categorised as hard to treat. Compared to other Welsh Local Authorities, Cardiff has the 8th lowest proportion (25.5%) of housing built before 1919 (figure 3 and 4), with the majority of this age group belonging to the predominant house type within the Welsh stock – the pre 1919 terraced house (16.4% of Cardiff's stock).

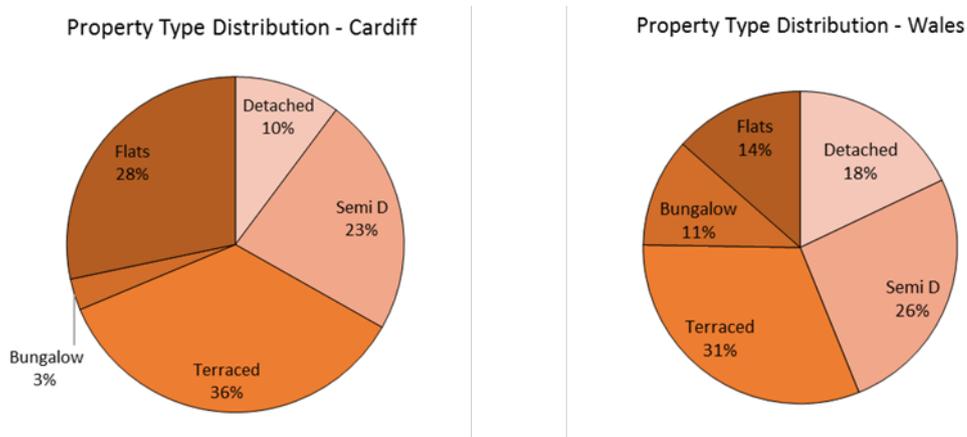


Figure 2: Property Type Distribution - Cardiff and Wales

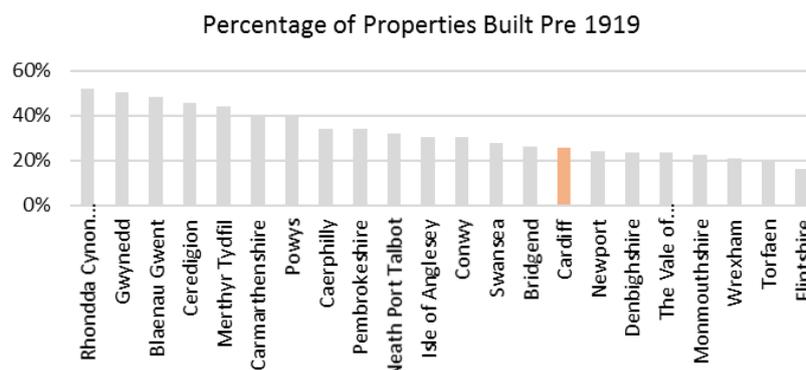


Figure 3: Percentage of Properties Built Pre 1919 per Local Authority

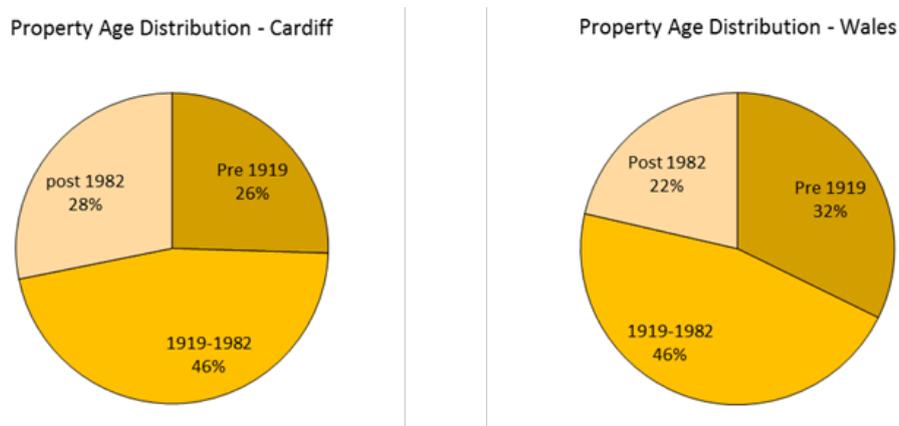


Figure 4: Property Age Distribution - Cardiff and Wales

Gas Network Connectivity

According to DECC's 2014 estimates of homes not connected to the gas network (ref), 6% of Cardiff's dwellings were not connected to the network (figure 5). Modelling results based on all available EPCs in 2016 approximate that 11.3% of Cardiff's properties use fuels other than mains gas or LPG as their main fuel (figure 6). Compared to other Welsh Local Authorities, Cardiff ranks as the 10th best Local Authority in terms of gas network connectivity and has a lower proportion of off gas than the Welsh average of 15% (figure 5).

DECC's 2013 gas network connectivity data (ref) estimates the distances of properties to their nearest gas connection and has been aggregated to LSOA level. According to this data source, there is a higher proportion of dwellings (26%) not connected to the gas network (figure 7). DECC approximates that around 10% of the non-gas properties' addresses counted within this dataset have not been identified and consequently not matched to their gas meters. Therefore, the true value is likely to be reduced by approximately 10%.

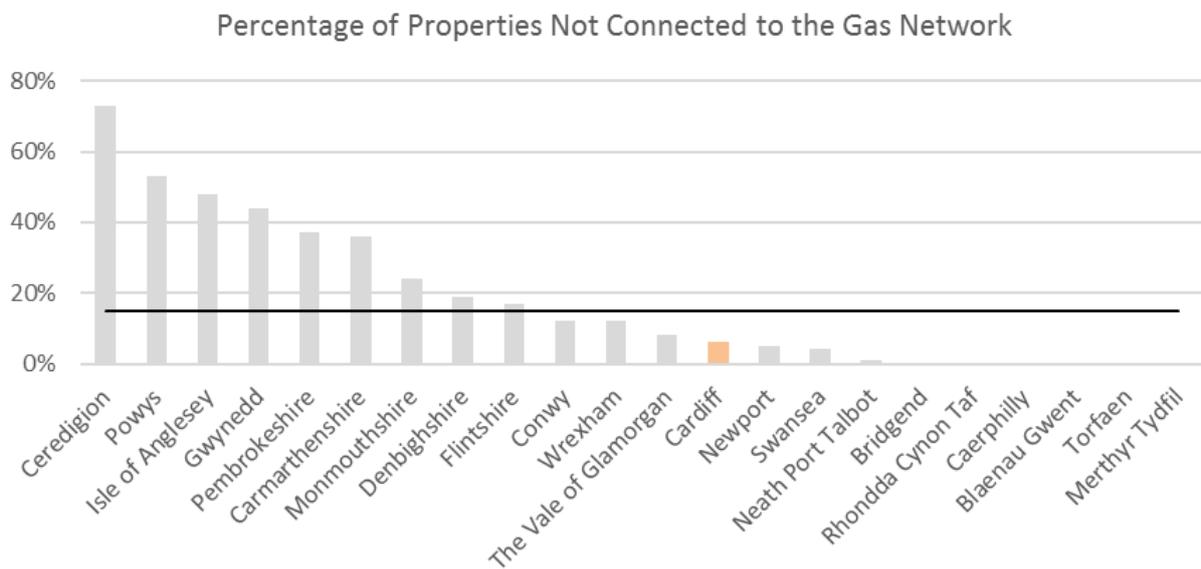


Figure 5: Percentage of Properties Not Connected to the Gas Network - DECC 2014

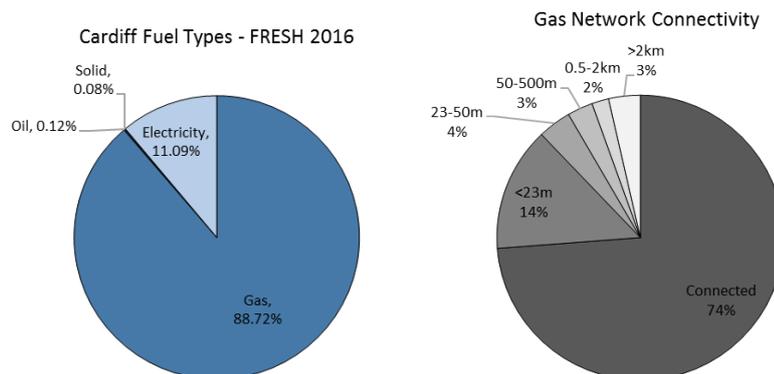
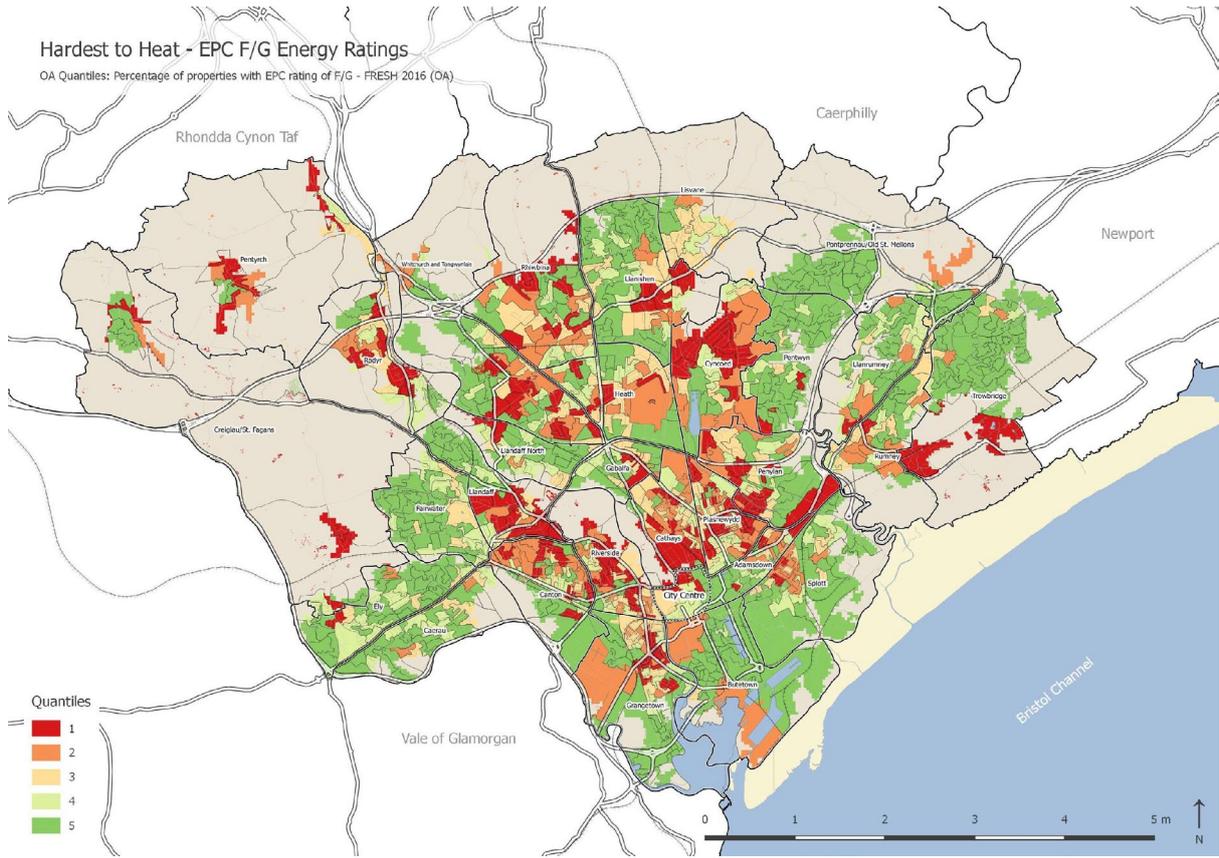


Figure 6: Modelled Fuel Type Distribution in Cardiff's Households - FRESH 2016

Figure 7: Gas Network Connectivity and Distance to Network - DECC 2013

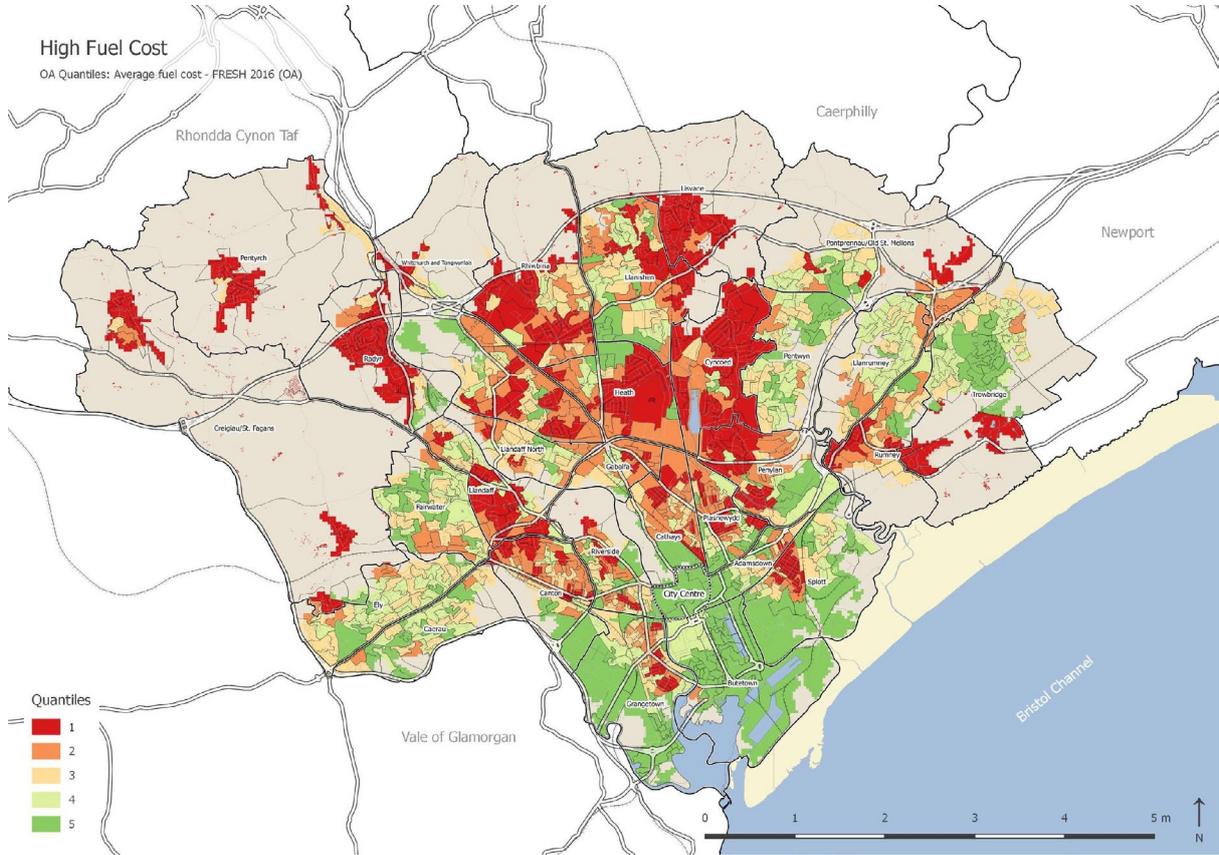
Hardest to Heat - EPC F/G Energy Ratings

OA Quantiles: Percentage of properties with EPC rating of F/G - FRESH 2016 (OA)



High Fuel Cost

OA Quantiles: Average fuel cost - FRESH 2016 (OA)



Low Income

Low income households are a key target group as they have limited financial means to be able to heat their homes to adequate levels of warmth in cold winters (Centre for Sustainable Energy, 2010). Low income households may come up against a “heat or eat” dilemma whereby they have to make a decision between heating their home and buying food (Marmot Review Team, 2011). The limited financial means of low income households also reduces their ability to pay for energy efficiency improvements to their homes, in order to make them easier to heat and cheaper to run.

Commonly in the UK, the standard definition of low income specifies that households on an income below 60% of the national median are on low incomes (or in relative poverty). In this definition, incomes are equivalised for different household types and can be expressed either ‘before housing costs’ (e.g. rental or mortgage payments) or ‘after housing costs’. (CSE report) also states that the main way that households will be able to demonstrate eligibility due to low income is through proof of benefit correspondence from HMRC/DWP, with the following list of benefits considered the most appropriate set of existing means tested benefits:

- **Pension Credit** (Guarantee Credit Element), which covers low income older people
- **Child Tax Credit** and with income below a certain threshold, which captures low income households with dependent children
- Income related **Jobseekers Allowance and Child Benefit**, which includes other low income households with dependent children
- Income related **Employment Support Allowance (ESA)**, identifying low income households with additional vulnerabilities
- Benefits that were replaced by ESA (**Incapacity Benefit, Income Support** paid because of illness or disability, **Severe Disablement Allowance (SDA)**), which covers some low income disabled people
- **Income support**, for which low income and pregnant mothers, carers, lone parents with a child under 5, or long sick or disabled are all eligible.
- **Universal Credit** (combines six existing benefits into one: Income Support; income related Job Seekers Allowance; income related Employment Support Allowance; Child Tax Credits; Working Tax Credits; and Housing Benefit)

The 2014 Welsh Index of Multiple Deprivation defines income deprivation as the percentage of the population in receipt of income related benefits (income support claimants, jobseekers allowance claimants, pension credit claimants and income based employment and support allowance claimants), in receipt of Tax Credits (children or adults with families that are in receipt of working tax credits and child tax credits with an income less than 60% of the median income for Wales before housing costs); or a supported asylum seeker.

- 18% of Cardiff’s population is in income deprivation compared to 17% in Wales
- 43% of Cardiff’s LSOAs (91 out of 214) have a greater percentage of their population in income deprivation than the Welsh average of 17% (see figure ...)

Figure 1 shows the percentage of the population in income deprivation in Cardiff’s LSOAs compared to the Welsh average.

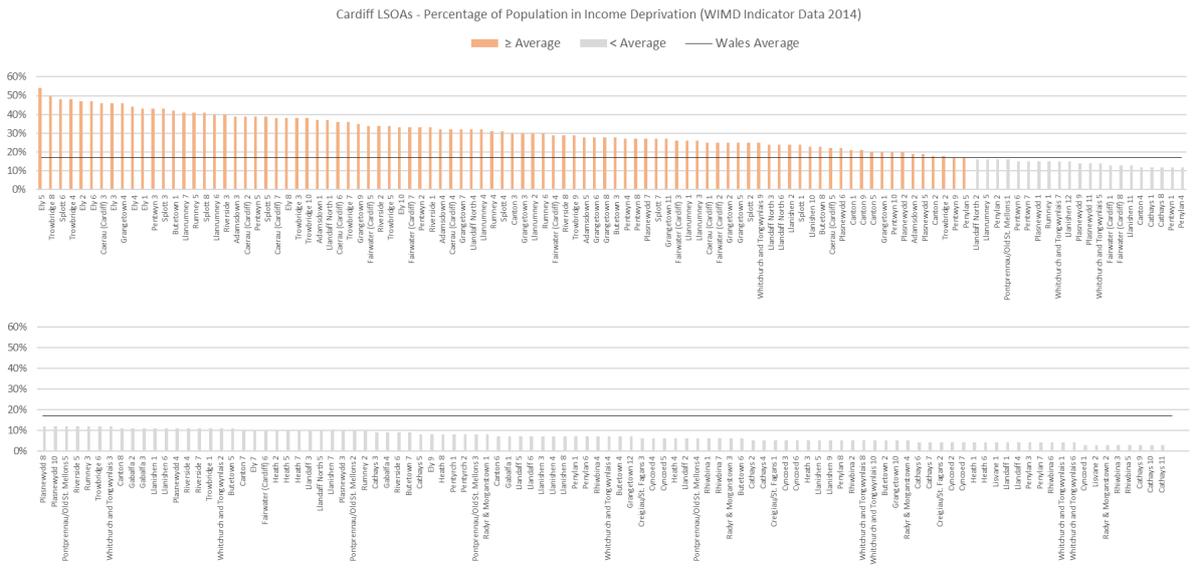
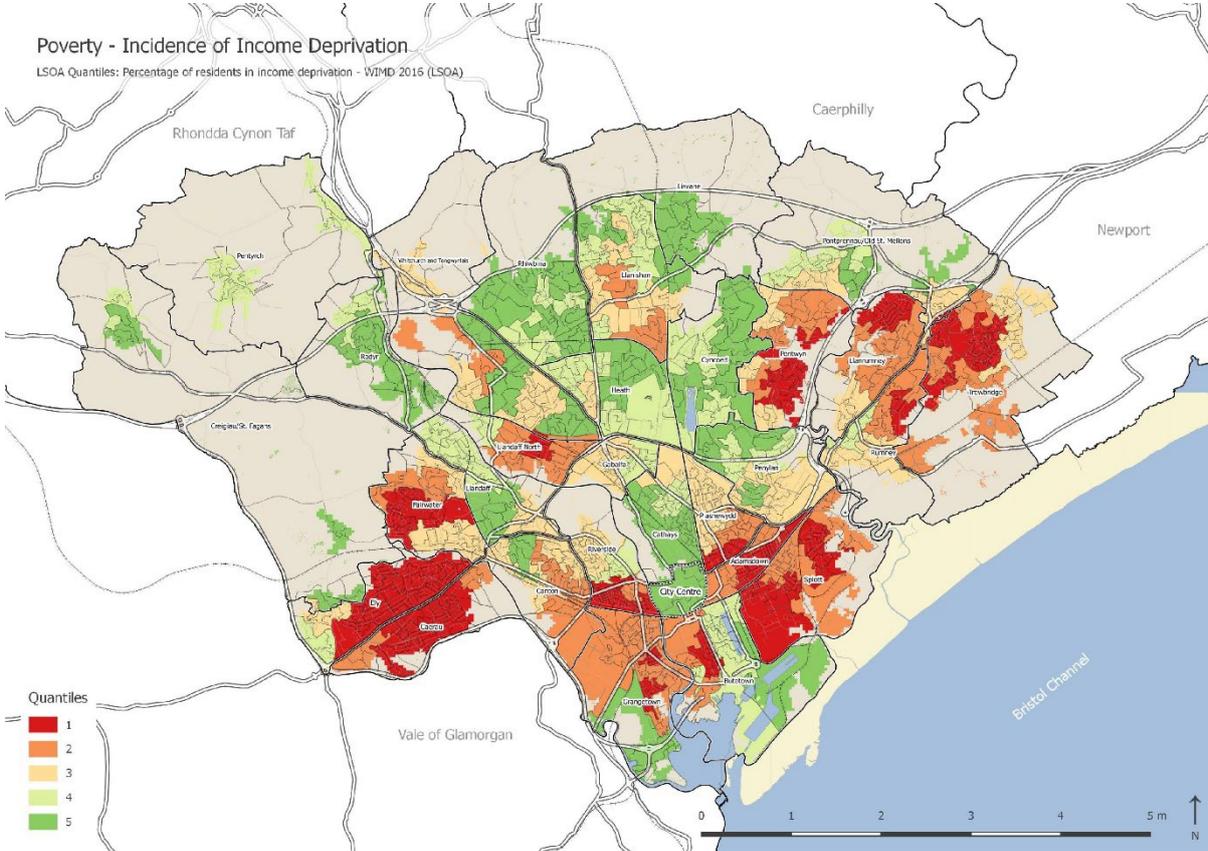


Figure ... categorises LSOAs into 5 quantiles based on the percentage of population in income deprivation (where 1 - red represents the worst 20%).

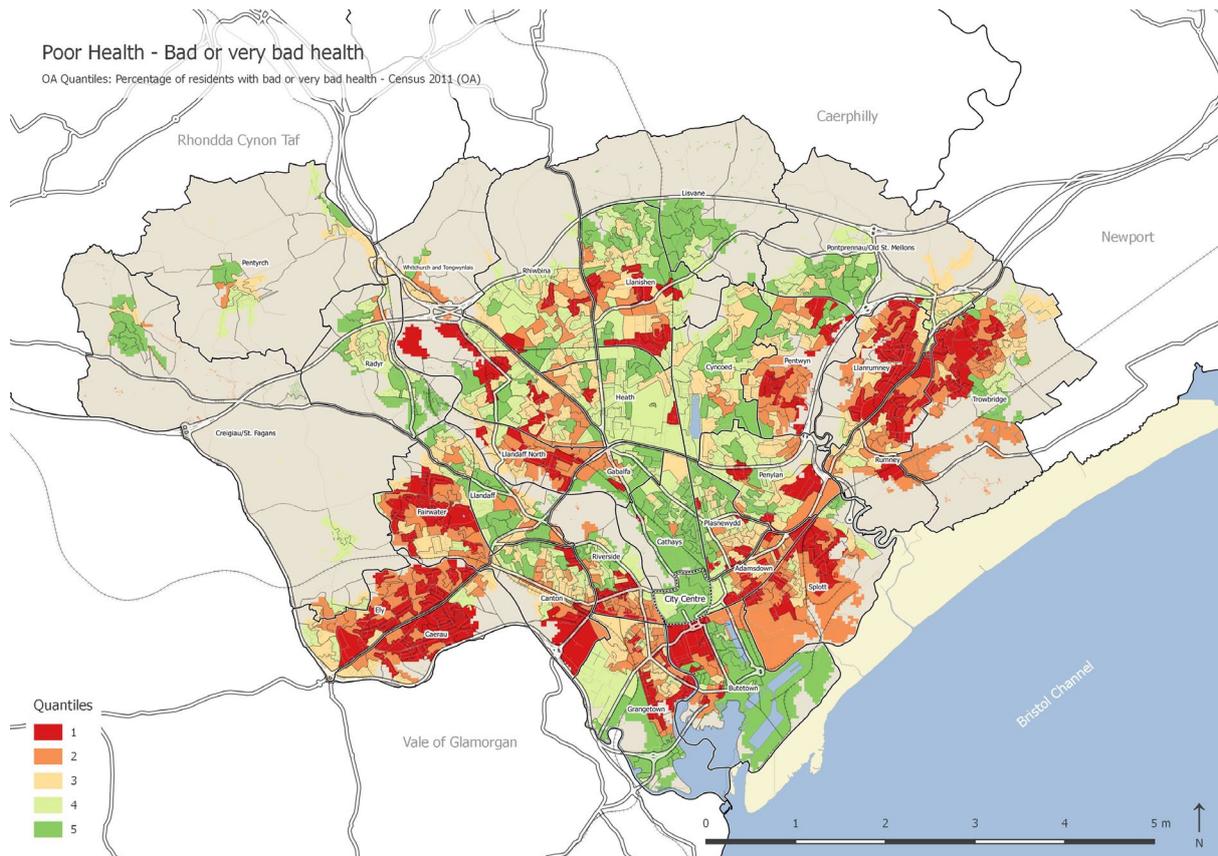
Figure ... indicates the likelihood of areas having high average fuel costs and a high proportion of the population in income deprivation using a 5x5 grid of quantiles. The red (1x1) areas are the most likely to have high average fuel costs as well as to contain a high percentage in income deprivation whilst the darker green areas are likely to have low fuel costs and low percentage of the population in income deprivation.



Poor Health

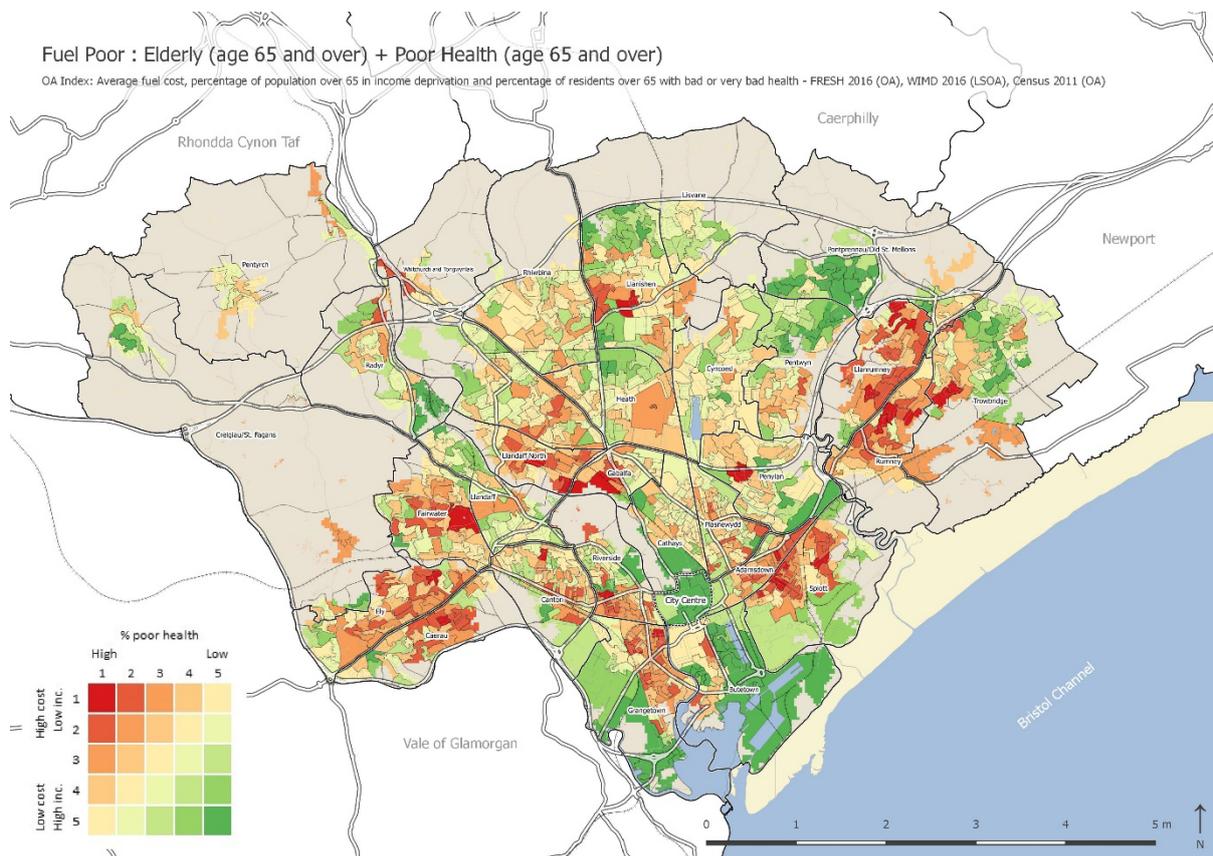
People with disability often struggle to pay their bills and keep their homes warm enough (Gore and Parckar, 2009). Below-average employment rates amongst disabled people and associated below-average incomes mean that disabled people have a greater than average risk of living in a cold home (Disability Action, 2011). Furthermore, high rates of unemployment amongst disabled people increase the likelihood of spending more time at home, and potentially in a cold home (CSE).

Figure ... categorises LSOAs into 5 quantiles based on the percentage of population with bad or very bad health based on census 2011 data (where 1 - red represents the worst 20%).



Based on the Living in Wales (LiW) Survey 2008, (CSE report) states that nationally, 30% of low income households are older adult households with 69% of those households containing people who are disabled or with a long term illness (see fig ...).

Figure ... indicates the likelihood of areas having high average fuel costs, a high proportion of older people in income deprivation and high levels of poor health amongst the elderly. The red (1x1) areas are the most likely to have high average fuel costs and high percentage in income deprivation as well as high levels of poor health.



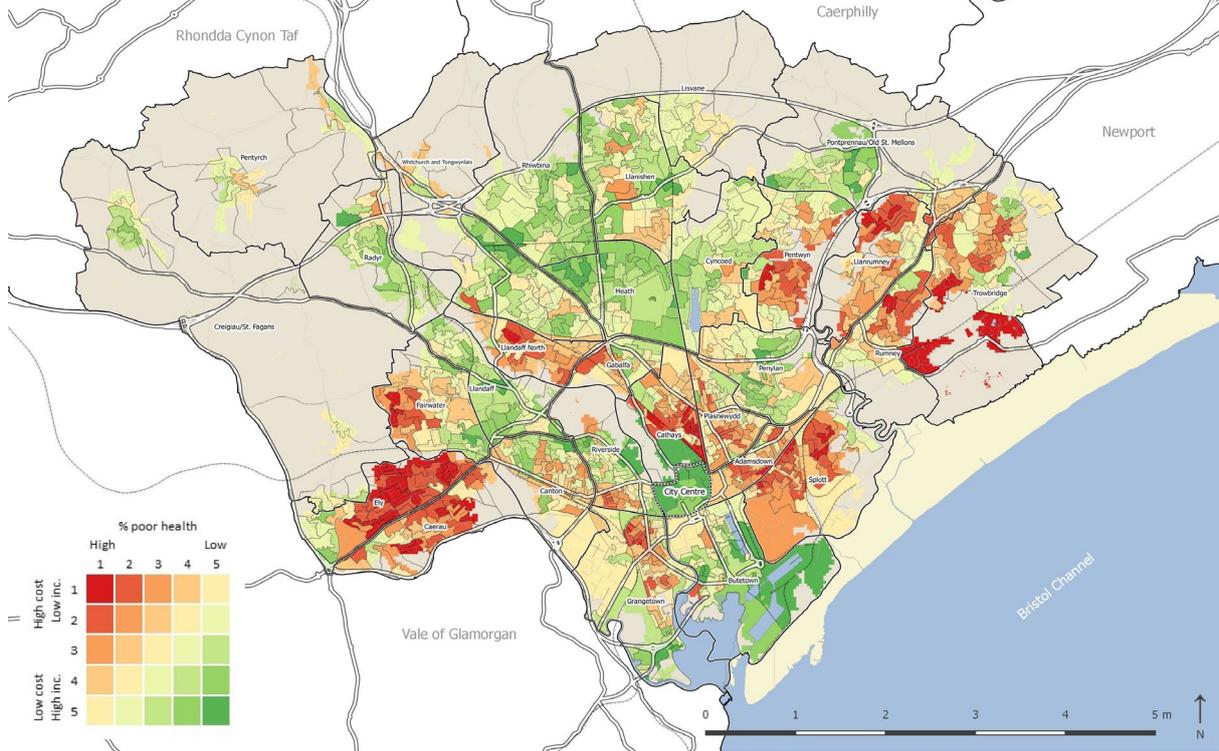
Areas with high fuel costs, children in income deprivation and high levels of poor health in households with children

According to (CSE report), members of households with children, particularly children under five, spend an above-average amount of time at home, increasing their exposure to the harmful health effects of living in cold homes. Based on the Living in Wales (LiW) Survey 2008, (CSE report) states that 14% of low income households are households with dependent children (see fig ...). Based on the Living in Wales (LiW) Survey 2008, (CSE report) states that nationally, 4% of all low income households contain dependent children and people who are disabled or with a long term illness. It is also indicated that 30% of all dependent children living in low income households live in households with people who are disabled or have a long term illness (see fig ...).

Figures ... and ... indicate the likelihood of areas having high average fuel costs, a high proportion of children (under 5 and under 18 respectively) in income deprivation and high levels of children living in households where 1 or more occupants have poor health. The red (1x1) areas are the most likely to have high average fuel costs.

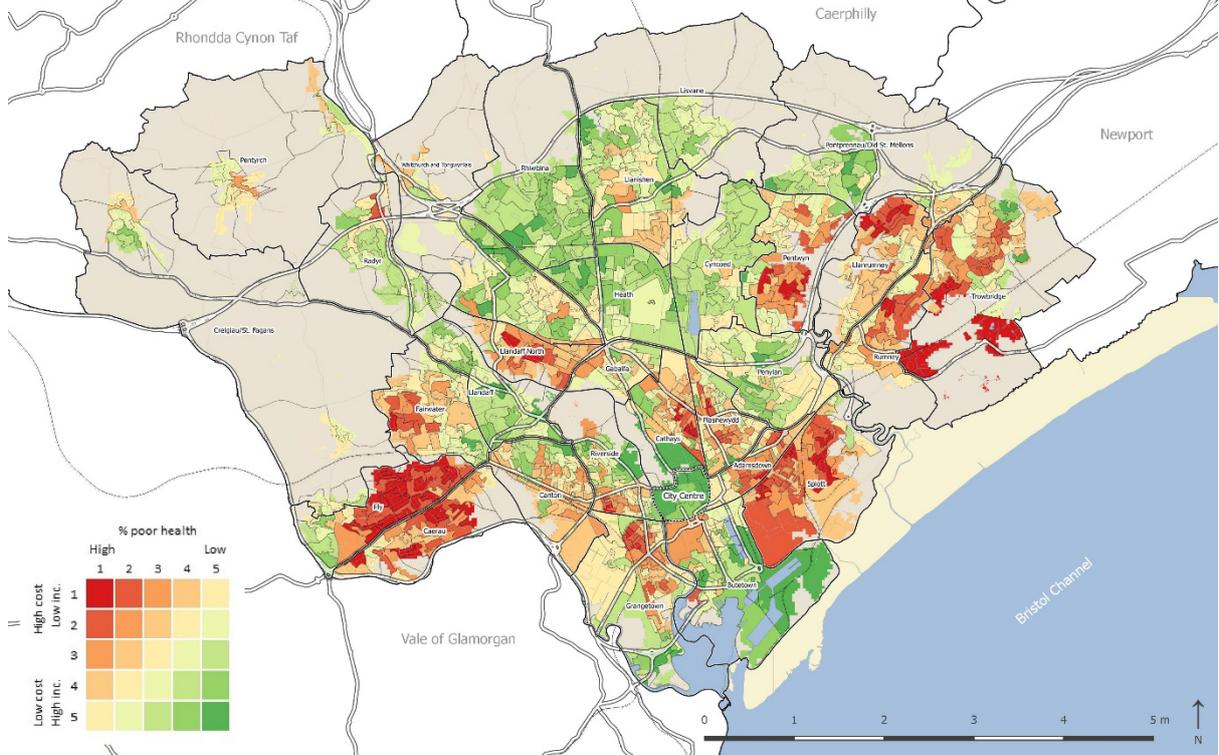
Fuel Poor : Pre School Children (age 0-4) + Poor Health (households with children)

OA Index: Average fuel cost, percentage aged 0-4 in income deprivation and percentage of households with dependent children and 1+ with a health problem - FRESH 2016 (OA), WIMD 2016 (LSOA), Census 2011 (OA)



Fuel Poor : Children (age 0-18) + Poor Health (households with children)

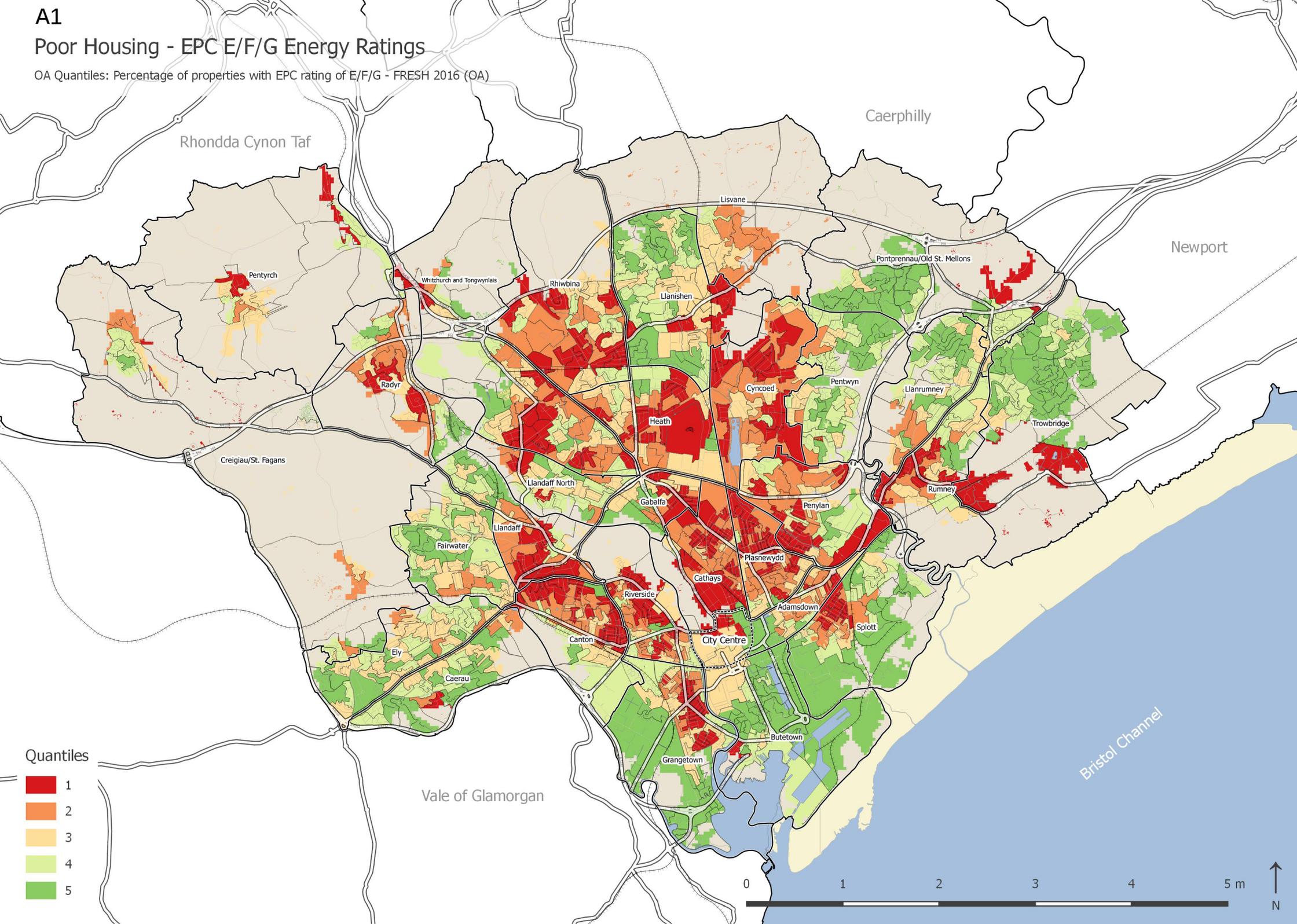
OA Index: Average fuel cost, percentage aged 0-18 in income deprivation and percentage of households with dependent children and 1+ with a health problem - FRESH 2016 (OA), WIMD 2016 (LSOA), Census 2011 (OA)



A1

Poor Housing - EPC E/F/G Energy Ratings

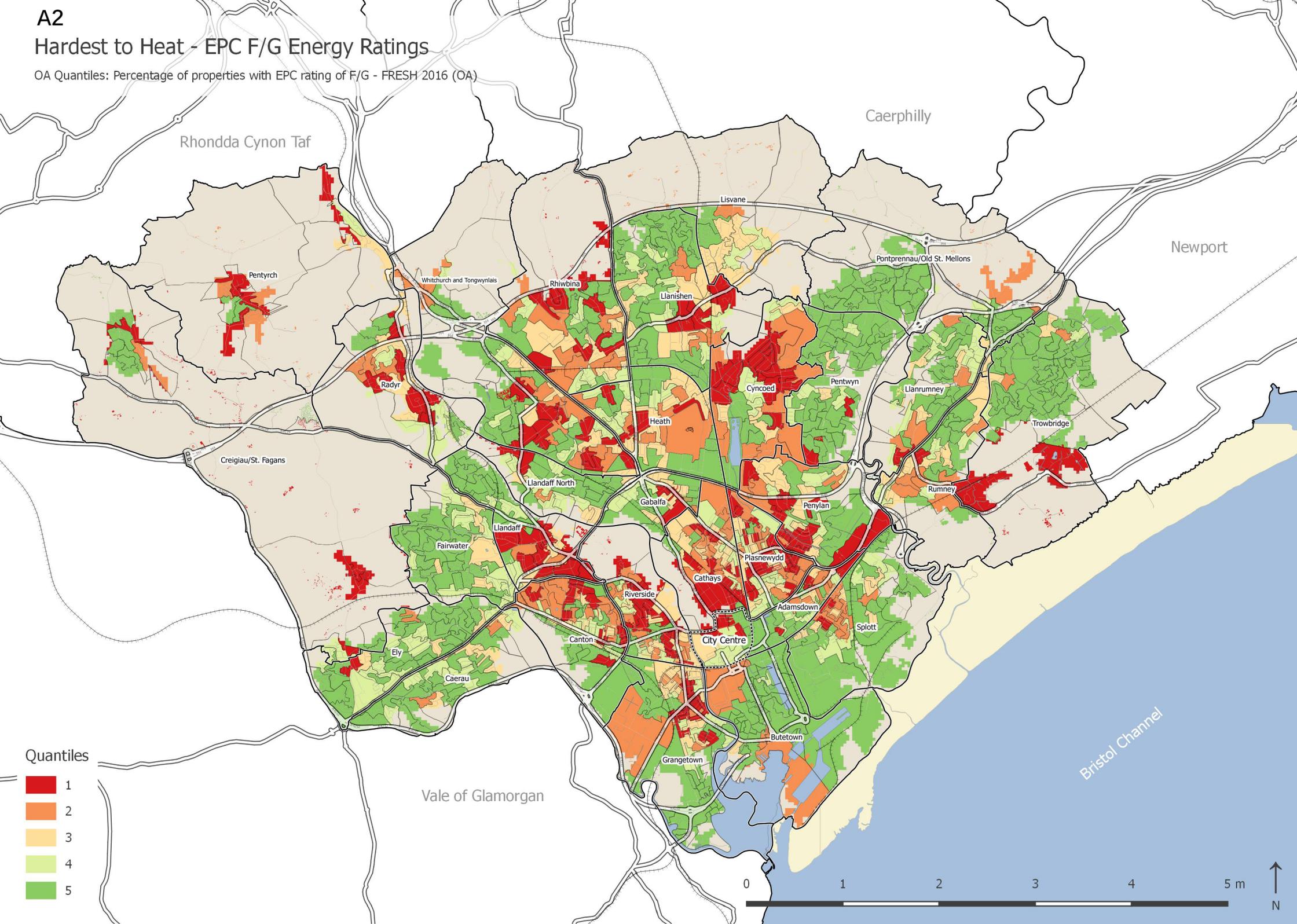
OA Quantiles: Percentage of properties with EPC rating of E/F/G - FRESH 2016 (OA)



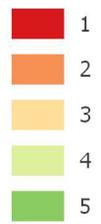
A2

Hardest to Heat - EPC F/G Energy Ratings

OA Quantiles: Percentage of properties with EPC rating of F/G - FRESH 2016 (OA)



Quantiles



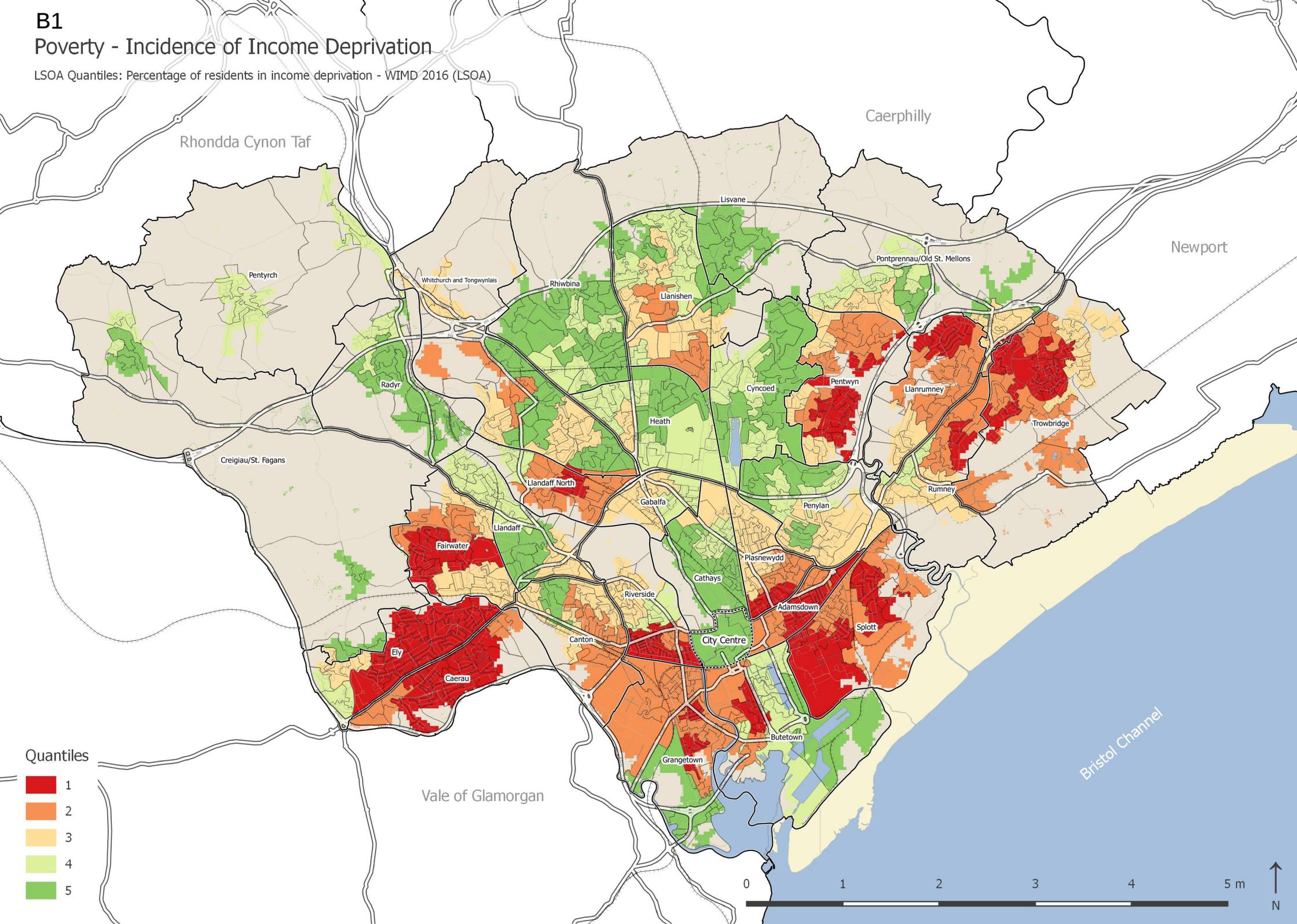
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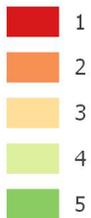
B1

Poverty - Incidence of Income Deprivation

LSOA Quantiles: Percentage of residents in income deprivation - WIMD 2016 (LSOA)



Quantiles



0 1 2 3 4 5 m



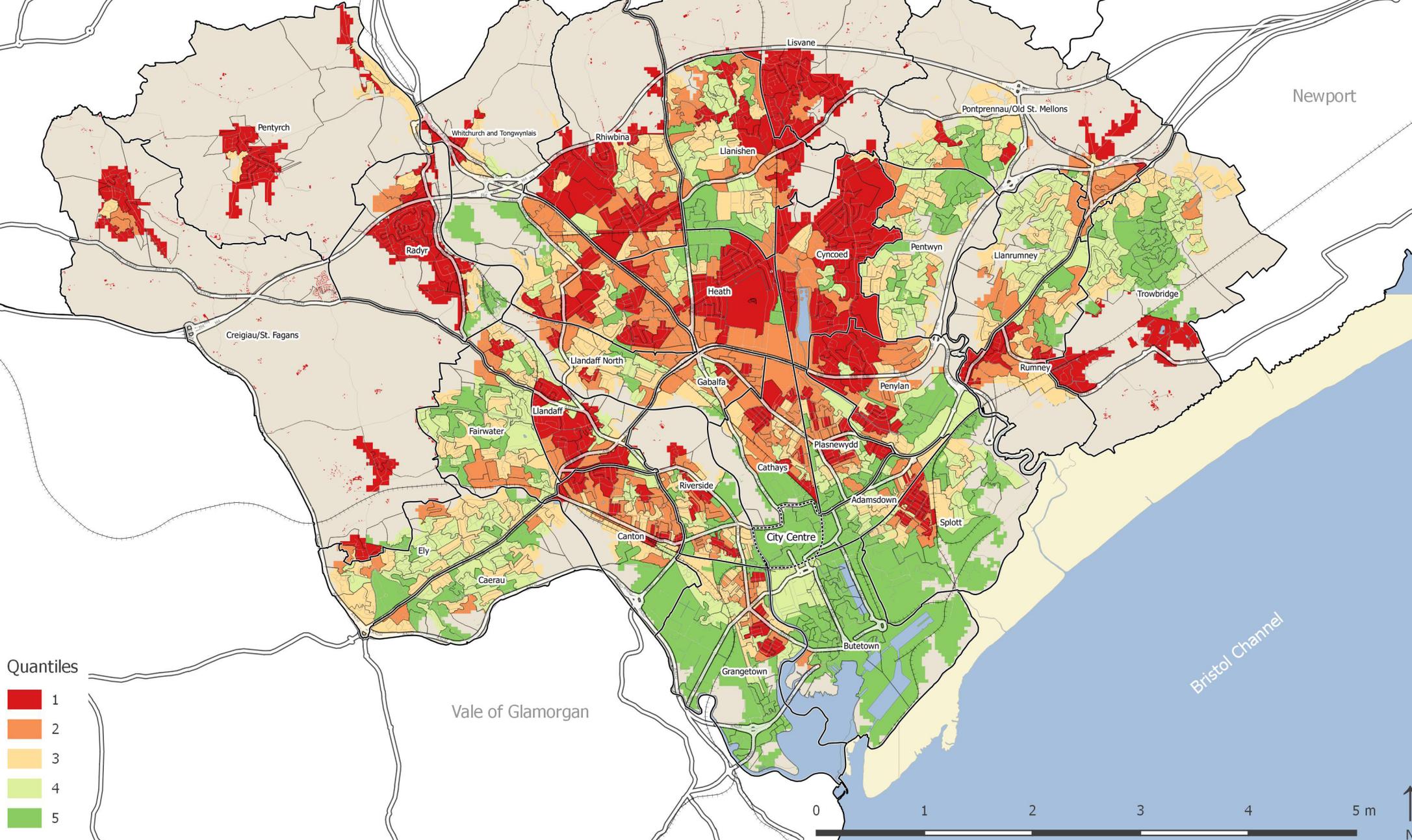
B2 High Fuel Cost

OA Quantiles: Average fuel cost - FRESH 2016 (OA)

Rhondda Cynon Taf

Caerphilly

Newport



Quantiles



Vale of Glamorgan

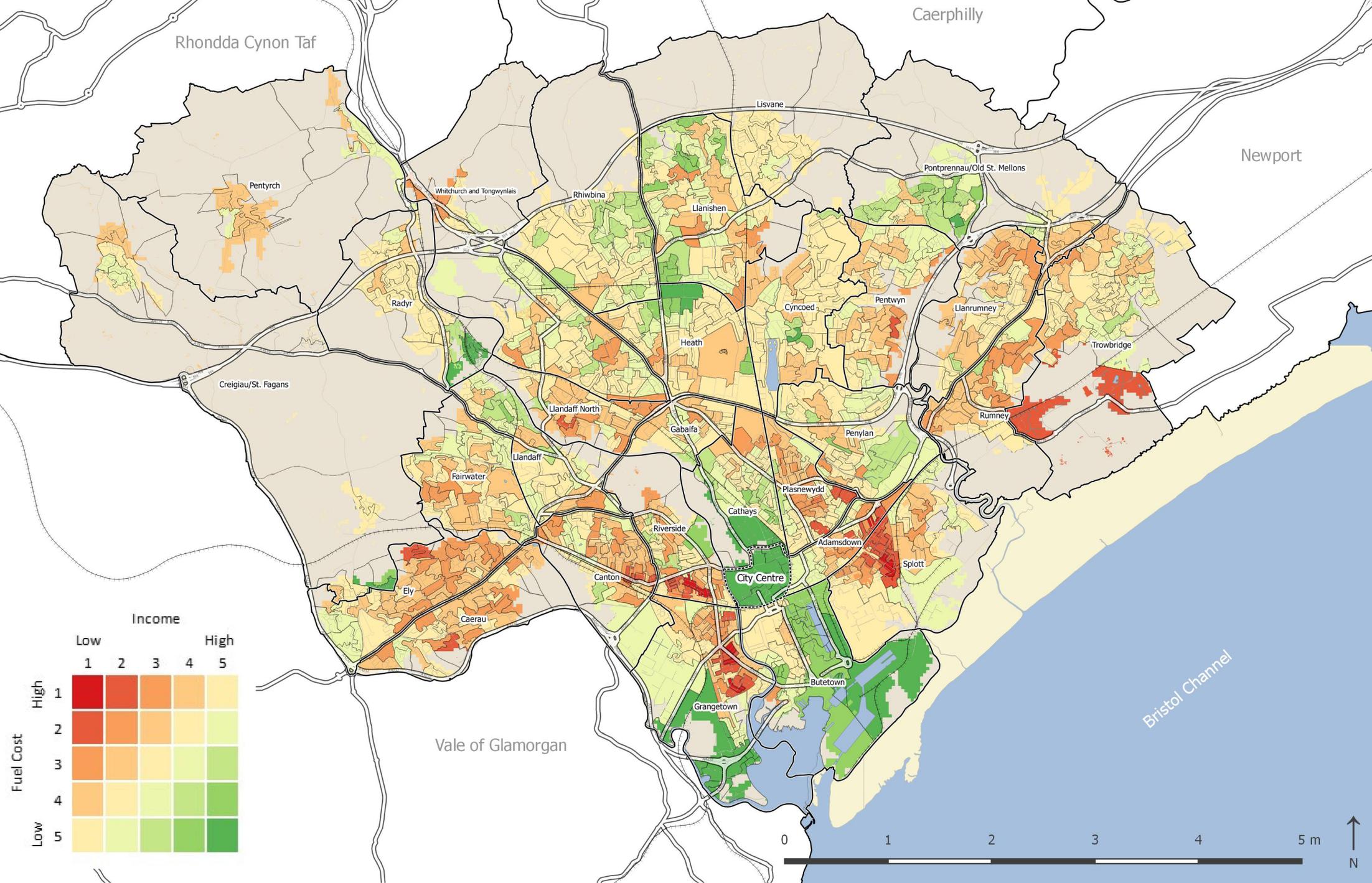
Bristol Channel



B3

Fuel Poor (High fuel cost + Low income)

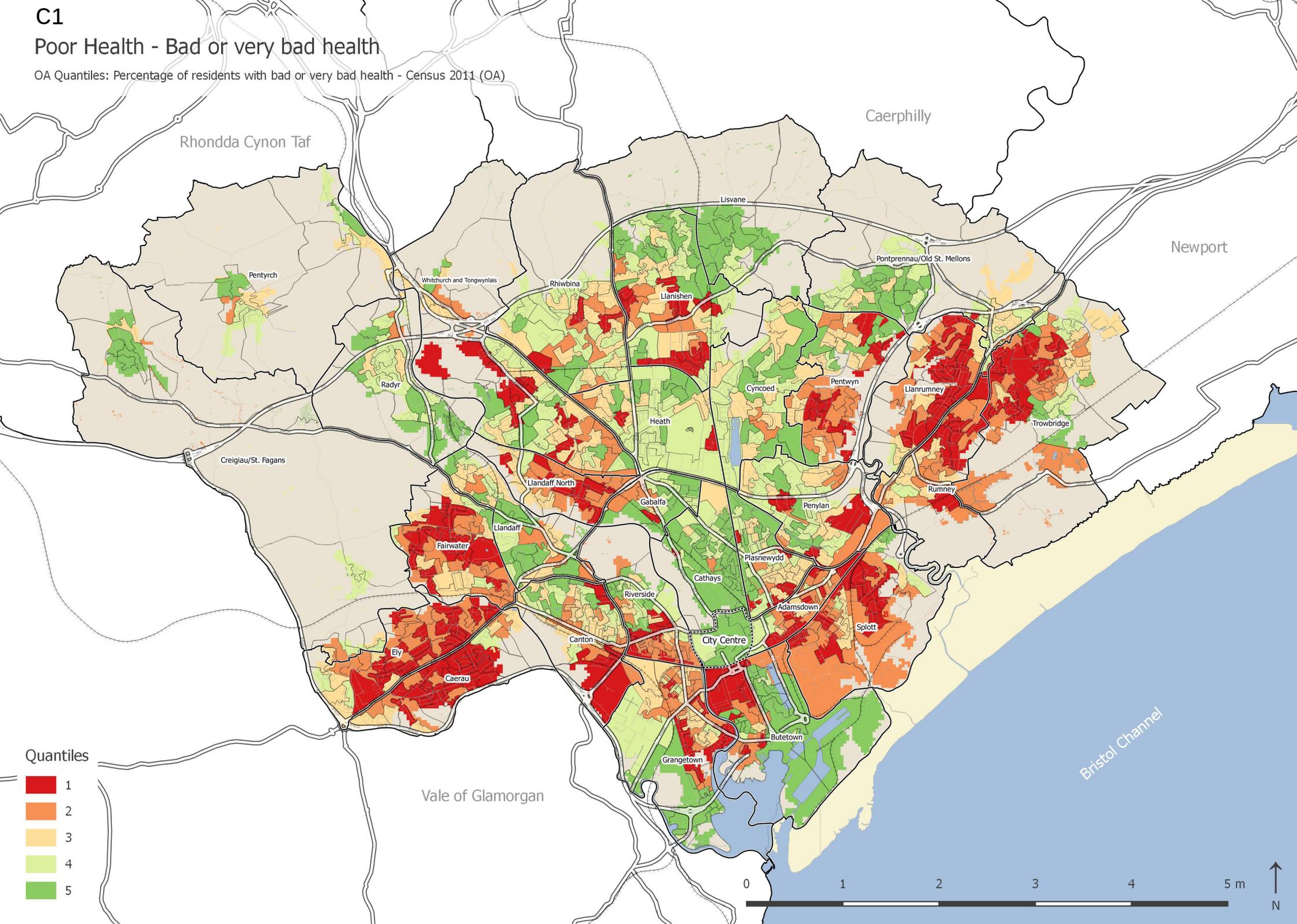
OA Index: Average fuel cost and percentage of population in income deprivation - FRESH 2016 (OA), WIMD 2016 (LSOA)



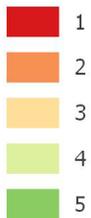
C1

Poor Health - Bad or very bad health

OA Quantiles: Percentage of residents with bad or very bad health - Census 2011 (OA)



Quantiles

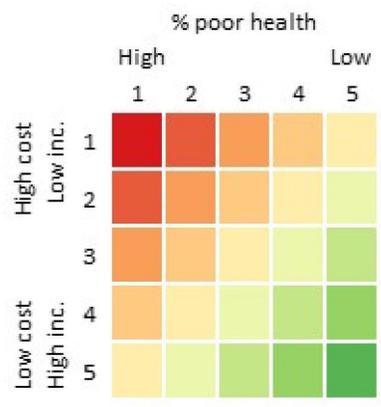
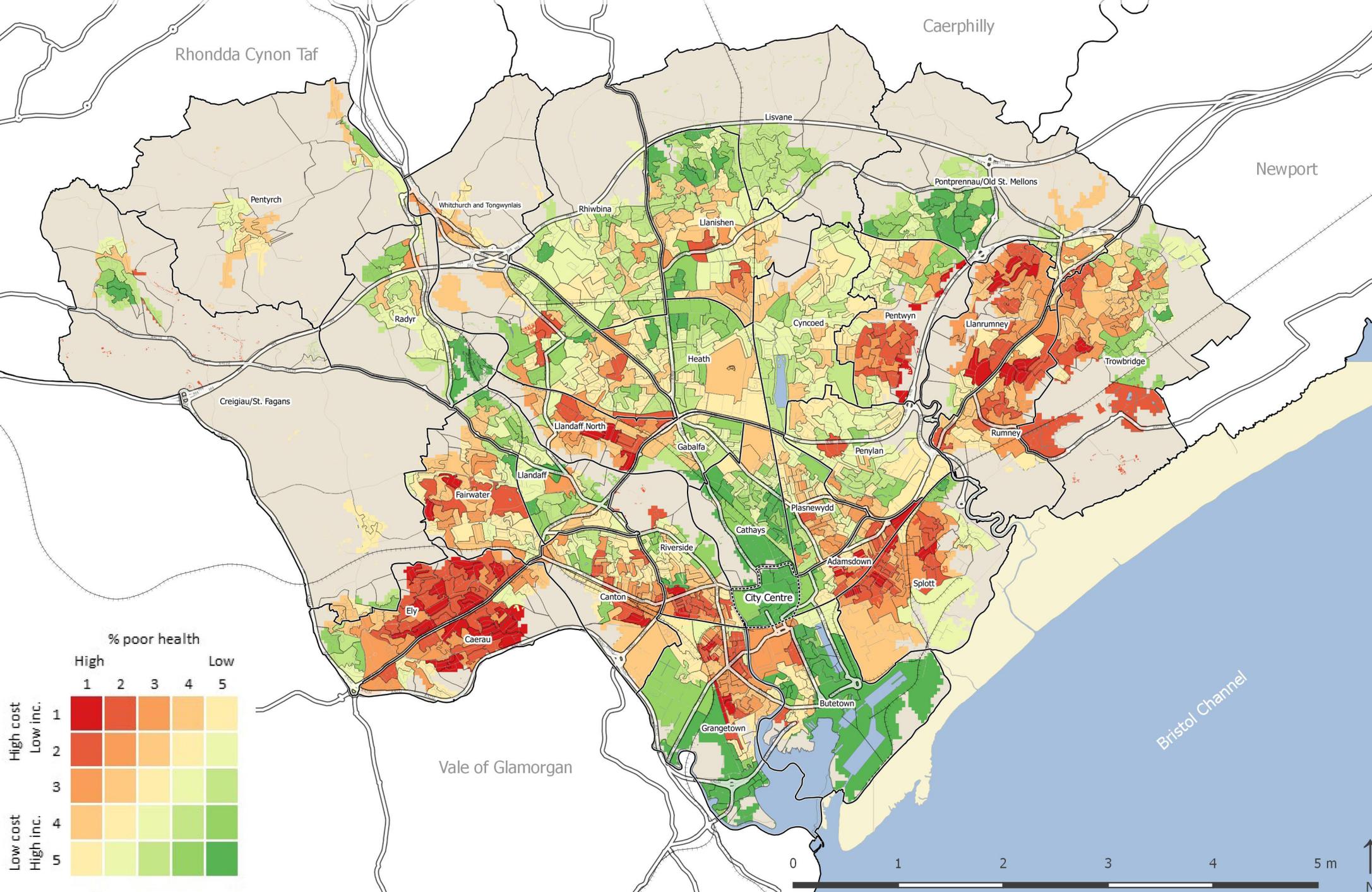


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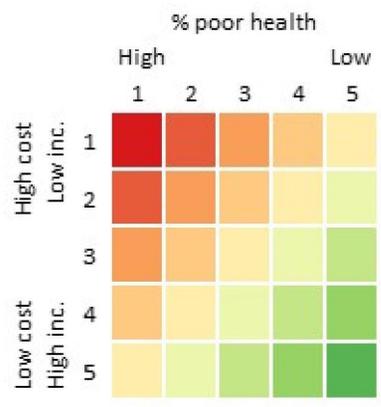
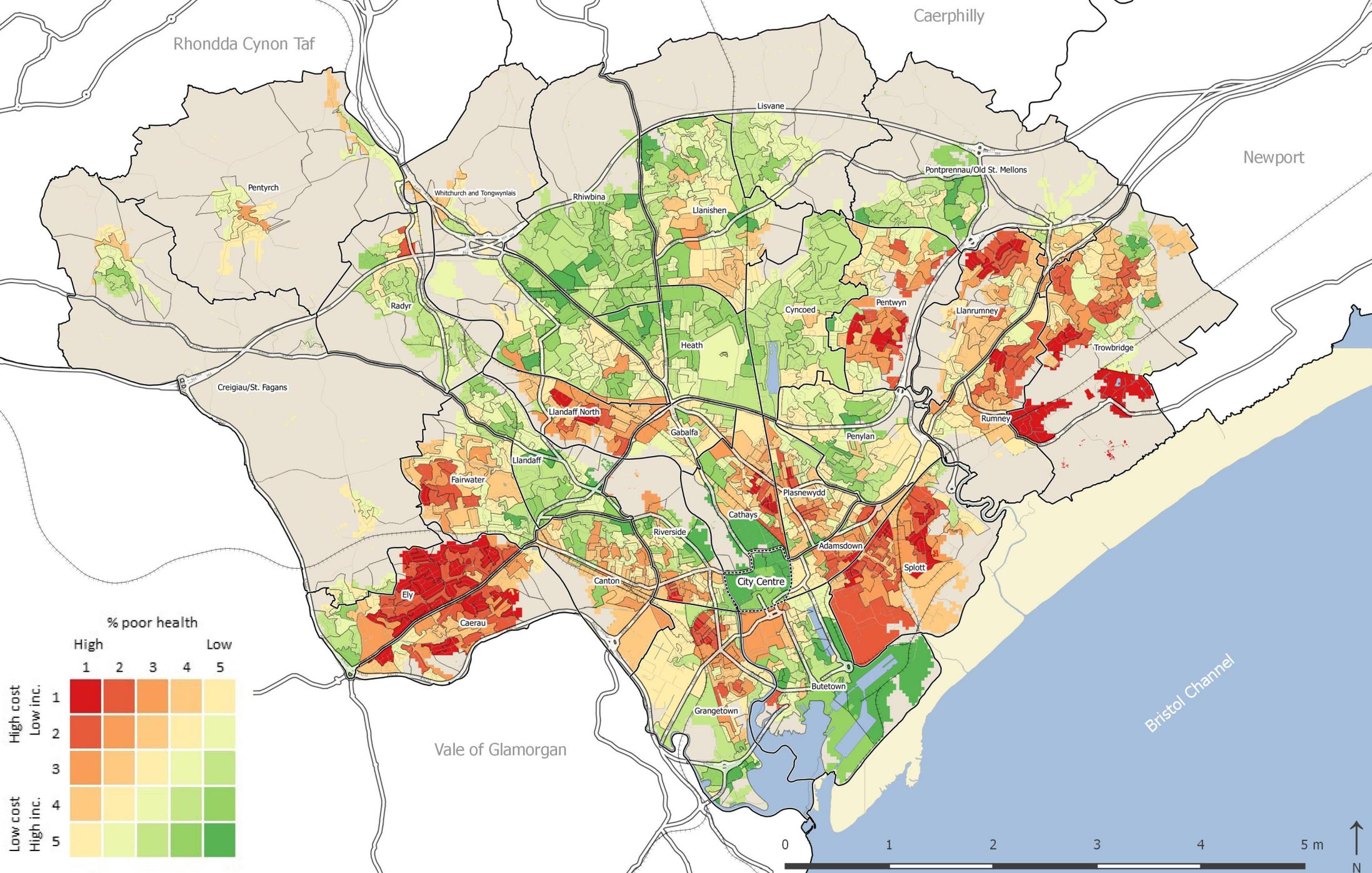
C2 Fuel Poor + Poor Health

OA Index: Average fuel cost, percentage of population in income deprivation and percentage of residents with bad or very bad health - FRESH 2016 (OA), WIMD 2016 (LSOA), Census 2011 (OA)



D1 Fuel Poor : Children (age 0-18) + Poor Health (households with children)

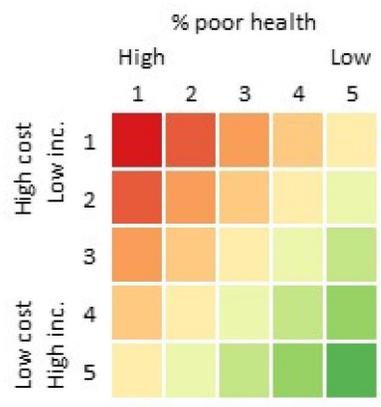
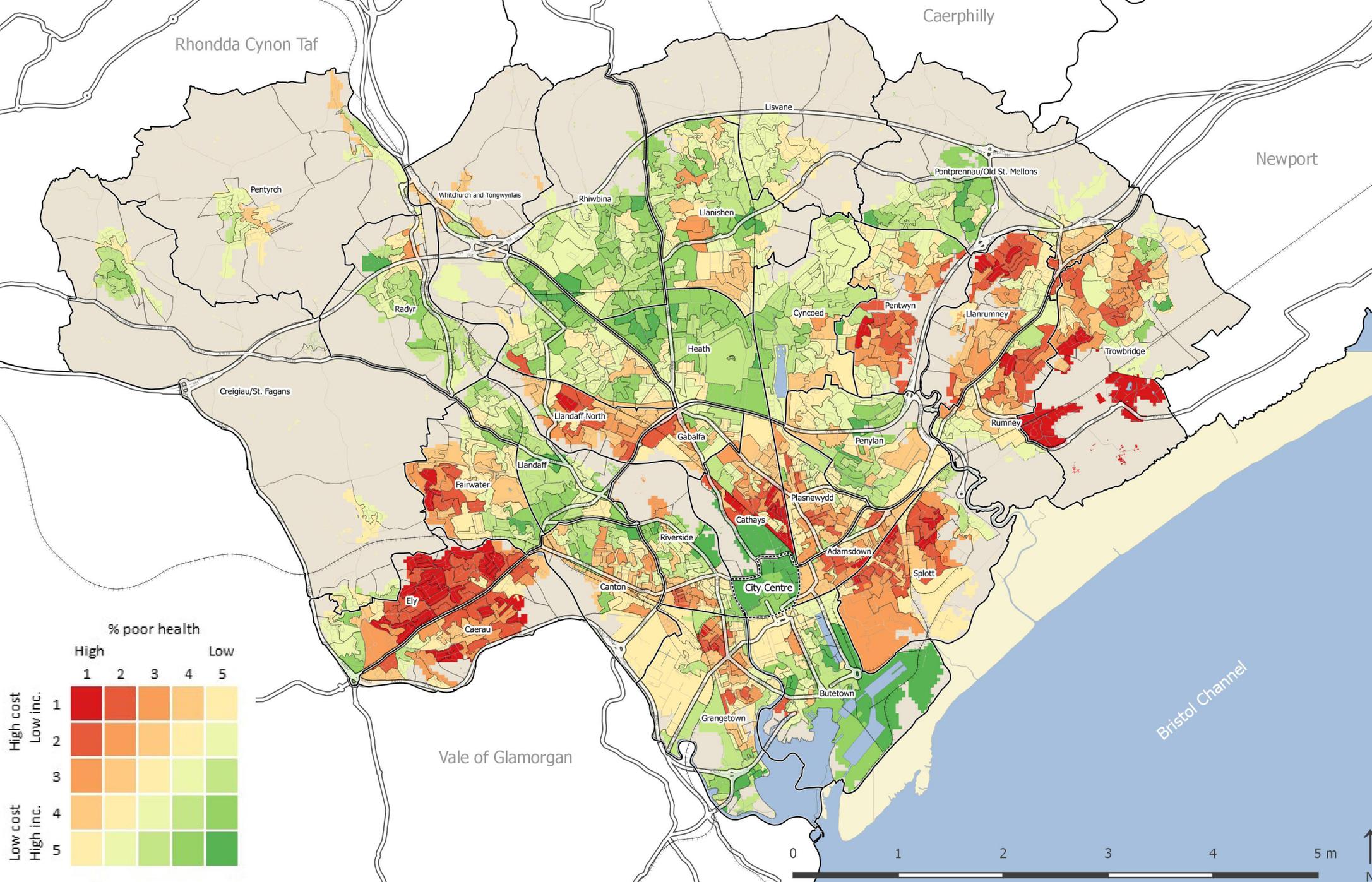
OA Index: Average fuel cost, percentage aged 0-18 in income deprivation and percentage of households with dependent children and 1+ with a health problem - FRESH 2016 (OA), WIMD 2016 (LSOA), Census 2011 (OA)



D2

Fuel Poor : Pre School Children (age 0-4) + Poor Health (households with children)

OA Index: Average fuel cost, percentage aged 0-4 in income deprivation and percentage of households with dependent children and 1+ with a health problem - FRESH 2016 (OA), WIMD 2016 (LSOA), Census 2011 (OA)



D3 Fuel Poor : Elderly (age 65 and over) + Poor Health (age 65 and over)

OA Index: Average fuel cost, percentage of population over 65 in income deprivation and percentage of residents over 65 with bad or very bad health - FRESH 2016 (OA), WIMD 2016 (LSOA), Census 2011 (OA)

