

## ZCSP Report – Buildings

**WORK IN PROGRESS - This document may be incomplete and not peer reviewed.**

**Comments and corrections are welcome.**

### **Retrofit of existing domestic properties.**

Tim Baldwin, December 2020

80% of the domestic properties we will be living in by 2050 are already standing now. Domestic Homes contribute roughly 27% (SC docs CCS1 V9.3) of the CO<sup>2</sup> emissions in Shropshire. Therefore, if we are to have any hope of meeting our target of Zero Carbon emissions by 2030 it is vital that we deal with this major source.

It is important to say that while the focus of this piece is energy efficiency, the measures/systems promoted will not only improve this and reduce carbon emissions of homes, doing this work will also have a huge impact on the health and well-being of the occupants of the homes involved and reduce costs to the NHS and society that will likely outweigh the initial costs.

Approximately 30,000 people die every year in the UK as a direct result of living in cold, damp homes - and this is the tip of the iceberg, "For every death, probably five people had emergency admissions to hospital and 27 had additional visits to their GPs" (<https://www.theguardian.com/society/2018/dec/09/tackling-fuel-poverty-would-cut-winter-deaths-and-costs-to-the-nhs>).

"Whole House" or "Deep" retrofit are phrases that have come into common parlance including by central government. This is evident in its new schemes, such as the recently released Green Homes Grant scheme including the Local Authority Delivered (LAD) scheme, the Public Sector Decarbonisation fund and the Social Housing Decarbonisation Fund. Talk of "Building Back Better" and a "Green New Deal" is prevalent. Much research has been published to suggest the huge role that investment in retrofit at scale could play in both rebuilding the economy after Covid 19 and restructuring to help mitigate the damage being done by our present economic system to the environment and ultimately our climate.

Another major issue is fuel poverty, with the latest government figures suggesting that even without the impact of Covid 19 the figure is rising again in Shropshire having dropped for a couple of years. The figure for Shropshire as a whole is 12.3% but some areas are as high as 23.8%. This reflects the nature of Shropshire with above average numbers of older, "hard to treat" properties, as well as a greater percentage of areas outside of the gas network that are forced to rely on more expensive heating fuels. On top of that Shropshire has a low average wage and rurality leads to higher costs of living.

In the past funding for either energy efficiency or measures to reduce fuel poverty has been fundamentally flawed. It has prioritised single measures without any thought to a whole house approach. The funding has been too little and the timescales for delivery have been extremely short leading to unintended consequences that have damaged the reputation of the industry. At the same time the short-term nature of the funding has damaged the insulation industry with successive periods of famine and feast undermining growth and stifling its ability to train and retain good staff.

The Energy Company Obligation is a case in point. It has been the major government mandated scheme since its inception in 2013 when it replaced the previous schemes Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP). Though these schemes both had issues, especially for largely rural areas like Shropshire, between them they achieved reductions of over 313Mt/CO<sup>2</sup>.

Between 2013 and 2018, when ECO became specifically about fuel poverty and the target switched to bill reduction, ECO saved about 61Mt/CO<sup>2</sup> (<https://www.ofgem.gov.uk/environmental-programmes/eco/overview-previous-schemes>. Accessed 06/12/2020).

Since 2018 the focus has switched from insulation to replacing inefficient Gas Boilers. “T(t)here were 6,461 installations of loft and wall insulation during the last 3 months of 2018, a fall of 98% on the installations in 2010 during this period. (<http://www.endfuelpoverty.org.uk/energy-efficiency-improvements-drop-to-lowest-levels-since-launch-of-the-energy-company-obligation/>)accessed 04/12/20

In future, all new Energy Efficiency and Fuel Poverty alleviation schemes will be linked to a new British Standards Institute framework for “deep retrofit” called Publicly Available Specification (PAS) 2035. The aim of PAS 2035 is to “create a framework for deep retrofit projects that are high quality, safe and fit for the future”. PAS 2035 will provide individually tailored, “whole house” plans for each property that will be lodged with TrustMark.

The plans will layout the order and priority of changes that should be made to the property to safely maximise its energy efficiency starting with the envelope, the walls, roof, floor, windows and doors; then ventilation, heating and hot water provision, followed by lighting and “unregulated energy” (the energy for white goods and all other uses such as entertainment etc).

Years of focusing on insulation measures such as cavity wall and loft insulation have shown the dangers of not addressing ventilation, the unintended consequences of which have been an explosion in cases of damp and mould especially in the social housing sector. It is hoped that PAS 2035 will be a huge step forward for the retrofit agenda. Having this information available to all homeowners and installers as well as Local Authorities and others that hope to promote energy efficiency could be transformative. But these plans will only be transformative if the funding is there to enable them to be implemented.

After many years of neglecting its duty and leaving funding of energy efficiency to energy companies, the UK Government has started to respond to demands and look to fund measures itself. “No government money is going into making these leaky homes more energy efficient – that task is left to the utilities. Can we please have a focus on the dire state of our housing stock? This will mean investment by the government in energy efficiency, with money from the Treasury. There are millions of fuel-poor homes – each requiring tens of thousands of pounds spent on them if the occupants are to be warm despite their low incomes. We should be spending billions of pounds to reduce fuel poverty.” (Dr Brenda Boardman. Emeritus Fellow. University of Oxford. Quoted in the Guardian, see ref 2).

The government has now made available £2billion for retrofit works across all tenures of housing. While this is woefully short of the actual level of funding required it is a start. As mentioned above this is split across several schemes:

- **Green Homes Grants**

- Up to £5,000 per property but this must be accompanied by 1/3 investment by homeowner. This gives a total of £7,500 to spend.
- Split into Primary and Secondary measures. You can only access secondary measures if you also have primary measures.
  - Primary measures include: solid wall insulation, cavity wall insulation, underfloor insulation (solid or suspended), Loft insulation. Flat roof insulation, Room in roof insulation or Park home Insulation. Also it covers Low carbon heating such as Air Source Heat Pumps (ASHP), Ground Source Heat Pumps (GSHP), Solar Thermal (water heating) or Biomass Boilers.

- Secondary measures include: Draught proofing, Double/Triple Glazing (only where replacing single glazing), Secondary glazing, and Energy Efficient replacement doors (replacing single glazed doors or those fitted pre 2002)
  - Maximum value of secondary measures voucher is the same as the value of the primary measure up to a maximum of £5,000. Therefore, if the primary measure costs more than £2,500 you will get less for the secondary measure.
  - If the primary measure is less than £2,500 that will be the maximum you can receive for the secondary measure. For instance, if it is loft insulation and it costs £500 that is the most you can claim for the secondary measure.
  - If someone in the household is in receipt of a qualifying benefit you could get a voucher for up to £10,000 with no need to contribute to the cost of works. (for full list of benefits see Annexe 1)
  - Available to all tenures but Maximum value of £5,000 for private and social landlords.
  - All works must be completed by end of March 2022
  - To apply visit <https://www.simpleenergyadvice.org.uk/pages/green-homes-grant>
- **Local Authority Delivery (LAD) Schemes**
  - Fuel poverty/affordable Warmth based scheme. Voucher value up to an average of £10,000 no need for homeowner contribution. Only those Local Authorities that have applied for funding. Very tight deadline meant not many did. Ofgem originally expected to a lot £200m but not enough applied so had to run second round LAD 1B. Next round to begin at end of March 2021. Total of a further £300m available.
  - Same qualifying criteria as previous scheme (see annexe 1)
  - Measures to be determined by LAs but no primary or secondary classifications.
  - Shropshire Council has joined with Herefordshire Council in a successful LAD 1A bid.
  - Measures include Solid Wall Insulation, Air Source Heat Pumps, Double Glazing (where replacing singled glazed windows), energy efficient front doors (where replacing Single glazed or solid doors pre 2002)
  - All works to be completed by 31<sup>st</sup> March 2021.
  - For more information or to apply contact Keep Shropshire Warm. Tel: 0800 112 3743
- **Energy Company Obligation 3 Scheme**
  - As previously mentioned, this is run by the major energy companies. The scheme is was split over 3 obligations (Carbon Emission Reduction Obligation [CERO], Carbon Saving Communities Obligation [CSCO]) now only the Home Heat Cost Reduction Obligation remains. This is focused on those that are in fuel poverty and/or in receipt of certain benefits (see annexe 2) what is known as the Affordable Warmth group.
  - Apply to your energy supplier for more details.
  - Mostly supplies insulation and/or heating measures including First Time Central Heating, repair or replacement of Gas Boilers or low carbon heating systems.
  - Also, there are installers that are contracted by energy companies to utilise this funding. Installers are targeting people by telephone and in area-based schemes going door to door. If you are approached and want to check the authenticity of the company either contact Keep Shropshire Warm (Tel: 0800 112 3743) or Shropshire Council.
  - Mostly free of charge to householders but some schemes may insist on a contribution of up to £500.

- While there is a long list of eligible measures it mostly focusses on gas boiler replacements and simple insulation measures such as lofts and cavity walls.
  - For eligibility criteria see annexe 1
- **Local Authority Flexible Eligibility Criteria scheme**
    - An extension of the ECO3 scheme that allows Local Authorities to define the eligibility criteria for a portion of the funding spent in their area up to a maximum of 25%
    - To qualify LAs must publish a Statement of Intent on their website. They must also have a system in place to check the eligibility of all applications and sign a declaration of each job carried out in their area.
    - For further information on the scheme in Shropshire visit the Shropshire Council website (<https://www.shropshire.gov.uk/private-sector-housing/flexible-eligibility-statement-of-intent/>)
- **Warm Homes Fund, First Time Central Heating scheme (local Scheme: Warmer Homes Shropshire)**
    - This scheme is funded by Community Interest Company, Affordable Warmth Solutions. Using funding from Cadent Gas the Gas Distribution Network Operator for Shropshire.
    - Runs until end of February 2022
    - Provides First Time Gas Central heating systems for households in urban areas that are within 23m of a gas main. Also provides non gas systems for households in rural areas. These can be LPG or Low Carbon systems such as Air Source Heat Pumps or Biomass Boilers.
    - Existing heating systems that qualify include: electric storage or panel heaters, gas fires or solid fuel fires.
    - Eligibility criteria are the same as the above schemes.
    - Open to Homeowners and private landlords
    - For more information on Warmer Homes Shropshire contact Keep Shropshire Warm Tel: 0800 112 3743
- **Fuel Poverty Network Extension Scheme (FPNES)**
    - Used in conjunction with WHF to provide free connection from the house to the main if within 23m
    - Eligibility as for the above
- **Renewable Heat Incentive (RHI)**
    - Though both Domestic and Non-Domestic schemes available, this will only look at the domestic scheme. This will run until end March 22 while the Non-Domestic scheme will end at the end of March 21.
    - There will be a replacement schemes available but it is likely that the level of funding will be dramatically reduced.
    - Scheme aims to encourage the uptake of Low carbon heating systems by covering some of the extra costs incurred due to the higher price.
    - Similar to the Feed in Tariff scheme that is credited with reducing the cost of Solar PV systems by a 2/3 over the period it ran for.
    - Need to use an MCS accredited system and installer
    - Must apply for funding within 12 months of install

- Eligible systems
  - Air Source Heat Pumps
  - Ground Source Heat Pumps
  - Biomass only Boilers and Biomass Pellet Stoves
  - Flat plate and evacuated tube solar thermal panels
  - For more information visit: <https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/about-domestic-rhi>

The government has also recently released two “Whole House” retrofit schemes aimed at social housing providers (the Social Housing Decarbonisation Fund and Demonstrator Fund). The latter scheme provides a minimum contribution of 25% of the eligible costs but this can be “uplifted” to 60% if various conditions are met. The landlord then provides the rest of the cost as match funding. Although there isn’t a stated maximum value for the scheme contribution there is an expectation that the average figure will be between £15,000 to £30,000.

We do not discuss this in any detail here as it is not open to owner occupiers or private landlords, however there are 2 elements of the scheme that are particularly interesting. The first is that although the rules of the scheme do allow the Landlord to carry out works in adjoining properties that have come into private ownership via the Right to Buy scheme, in one of the often impenetrably odd decisions of government they are not allowed to charge the owner occupier any contribution. This means that if they do this the social landlord will have to pay the missing 60% for the homeowner, which is highly unlikely to happen.

The second thing of note is the switch away from merely demanding increases in the SAP score of a property this scheme sets a maximum heat demand for the upgraded property. In this case the maximum is 50kWh/m<sup>2</sup>/pa. Importantly it is also a requirement of the scheme that meeting this target is verified by testing.

### **Retrofit in Shropshire**

The breakdown of properties by tenure in Shropshire is roughly 70% owner and 15% each for social housing and private rented. As mentioned above social housing is the major focus of government spending in the past and at present. This will need to change in the future. Shropshire being largely rural and in large part off the gas network means it is particularly poorly served by the type of scheme that has been popular with government and the energy companies.

Urban areas with row after row of homogenous housing tightly packed together have fared well as they allow for economies of scale not possible in the rural areas. It is widely accepted that fuel poverty is concentrated in the private rented sector. For years government has used schemes like ECO3 to try to address this issue but largely failed in part due to two main reasons: one is single issue funding, and the other was reliance on the energy suppliers to lead on tackling the issue.

These are public limited companies legally mandated to make profits from the supply of energy. The obvious absurdity of putting these companies in charge of reducing demand requires no further discussion.

And neither should the subject of completely avoidable excess winter deaths - vitally, in tackling carbon emissions from buildings, we also have the opportunity to eliminate both fuel poverty and excess winter deaths at the same time. This will only happen however if we pursue that goal via a “whole house” focus that looks to reduce energy demand to a minimum for every property tackled.

There is an argument popular with energy companies that suggests we can solve our problems by ignoring energy efficiency and merely transferring to electric heating systems and then decarbonising the grid over time until heating is zero carbon. Not only is this a short-sighted idea it also removes the chance of addressing the potential co-benefits of removing the causes of excess winter deaths and fuel poverty, if anything it will increase both as the cost of electricity, already 3x times that of gas, will be driven much higher. This will occur due to both increased demand and the cost of enhancing the national electricity grid to cope with this extra demand.

As mentioned above there are various funding schemes open now aimed at carbon reduction or advancing affordable warmth across all tenures. At the same time these schemes are tasked with building the supply chain and driving jobs and training for the relevant measures. But while the social housing initiatives accept that the cost of these types of intervention are extremely high, at least £60,000 per property if the 25% minimum funding is followed, the funding for the private sector has a maximum of £10,000 per property (maximum voucher value for GHG for recipients on certain benefits).

The list of measures that can be funded by GHG vouchers for the “able to pay” sector (those that require a homeowner contribution) includes Solid Wall Insulation (SWI), under floor insulation (solid {potentially extremely expensive} and suspended), Flat roof Insulation, Room-in-Roof insulation and Park Home Insulation. It also includes low carbon heating systems such as heat pumps (Air and Ground), Solar Thermal and Biomass Boilers.

The Government quote figures for SWI of £7,000-£9,000 but also mention a literature review that suggested £6,800-£15,000 (BEIS, “WHAT DOES IT COST TO RETROFIT HOMES?” April 2017). The average cost of Air Source Heat Pumps based systems is £7,000-£9,000 but it can cost much more depending on the size of the property and the heat demand. It has also been suggested that the way this funding has been rolled out, including very tight time frames for local authorities to apply (6 weeks in the case of GHG LAD) and extremely short delivery times (all works completed between October 2020 and end of March 2021, again for GHG LAD), combined with the lack of capacity in the supplier/installer network that the scheme is tasked with addressing, will likely drive up the cost of these measures.

Given the individual costs of these measures and the lack of funding for, or even mention of Mechanical Ventilation with Heat Recovery (MVHR), it is difficult to see how this level of funding can be considered consistent with a “Whole House” approach.

It is highly likely that in most cases PAS 2035 will recommend first tackling insulation measures as a priority then a descending list through ventilation, low carbon heating, energy generation and storage and finally energy efficiency measures such as better heating controls and lifestyle changes such as heating less, using lids on pans and the very many other small things we can do that add up to meaningful savings in energy use and reductions in carbon emissions.

However without consistent long-term funding from government to address those major insulation issues initially, there is no way that the other measures can be effective in dealing with emissions, fuel poverty and excess winter deaths.

There is a very strong argument for carbon reduction to be treated as a “Public Good” in the same way as clean water and sanitation, public health and education have been. It is very well understood that neo-liberal economics does not work in the supply of public goods – historically we never would have reached full coverage of water and sanitation had it been left to private enterprises. The “market” would only provide services in areas that can pay, it is not capable of cross-subsidising low income and poorer areas or

even those in which it is more costly to provide the service such as rural areas with the excess profit made from the more affluent areas.

This investment would go along way to boosting the economy after Covid 19 and steering the economy on to a green pathway.

Once funding is in place, we then need to make sure that it is spent effectively and brings about the changes we are actually targeting. For example, it is widely accepted that new buildings do not perform as well in real life as would be assumed from their design. This difference is known as the "Performance Gap". Research suggests this difference can be considerable. "R(re)cent studies have suggested that in-use energy consumption can be 5 to 10 times higher than compliance calculations carried out during the design stage" ([www.designingbuildings.co.uk/wiki/performance\\_gap\\_between\\_building\\_design\\_and\\_operation](http://www.designingbuildings.co.uk/wiki/performance_gap_between_building_design_and_operation). Accessed 17:20 13/12/2020).

Given that this is the case for new build properties it is obviously vitally important that any investment carried out to reduce our carbon emissions and tackle the existential climate crisis does not fall foul of the same issues. Therefore an extremely robust method of measuring the effect of measures on the energy demand and therefore emissions of retrofitted properties is essential.

The present funding for those outside the social housing sector requires improvements to be measured using Energy Performance Certificates (EPCs) these are generated by Domestic Energy Assessors (DEAs) using SAP (Standard Assessment Procedure) methodology for new build and RdSAP methodology for existing dwellings. As our subject is retrofit we will focus on RdSAP.

RdSAP was designed to allow a potential buyer or renter understand and compare estimated running costs of properties. In the case of RdSAP this is a non-invasive assessment which means the software makes assumptions about the heating regime, the U-values of fabric elements based on the age of the dwelling, and hot water demand assumed by an estimated number of occupants depending on total floor area. It relies on the knowledge of the assessor and a good deal of guess work (educated guess work if you get the right DEA but that is not guaranteed).

The quality of EPCs is therefore of great concern; according to a recent report "Flawed practices could mean up to 2.5 million EPCs are inaccurate", (<https://www.showhouse.co.uk/news/flawed-practices-could-mean-up-to-2-5-million-epcs-are-inaccurate/> accessed 18:09 13/12/2020). Not only is the quality of EPCs an issue but they also don't focus on energy demand, they are more focussed on running cost. "An EPC is intended to give the homeowner an indication of how expensive their home is to run. The headline 'Energy Efficiency Rating' shown on the EPC is therefore actually an energy cost rating." (EPCs as Efficiency Targets. Lowering emissions, raising standards. Passivhaus Trust. April 2020).

As the figure below shows there is very little correlation between the energy demand of a property and EPC rating. There are C, D & E rated properties in that graph that have much lower energy demand than the most efficient of the B rated properties. According to the Passivhaus Trust, this "neatly illustrates the futility of using the EPC rating as a measure of energy efficiency".

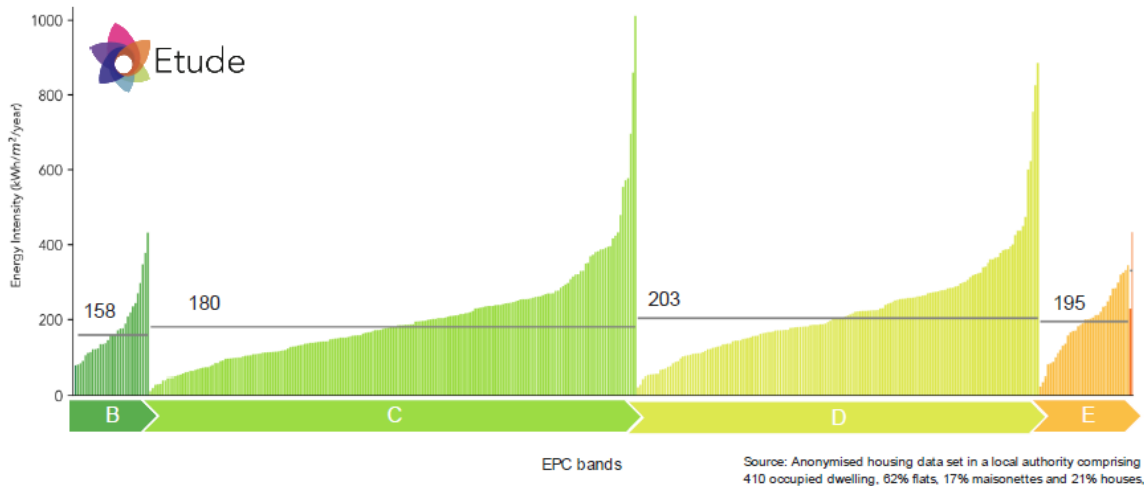


Figure 1: Illustration of disconnect between EPC bands and actual energy consumption in the domestic sector: Energy intensity of 410 homes across a local authority in England, by EPC rating. Each bar represents a single dwelling's energy intensity over the course of a year (credit: Etude)

Figure: EPCs as Efficiency Targets. Lowering emissions, raising standards. P7. Passivhaus Trust. April 2020.

Another downside to using EPCs to measure improvements include the fact that the cheapest way to improve an EPC rating is to fit Solar PV, but unless there is a battery storage system included demand from the grid is unlikely to change as most people use most of their energy at night and the PV produces its energy during the day feeding it into the grid – which is why some many people were shocked to find that once they fitted PV their energy bills didn't go down.

A further issue, is since gas is the cheapest energy for heating and hot water provision it will score better in an EPC than any other source including heat pumps, however the carbon factor for Grid supplied electricity is falling all the time and may be close to that of mains gas already. There is also the issue of the “winter gap”, where excess demand due to cold weather is matched by reduced supply for PV due to much lower level of solar irradiation.

EPCs do include an assessment of the Space heating demand for the dwelling in kWh/m<sup>2</sup>/pa and this could be used to model the improvements from installing measures, but it is only a model and is subject to the issues of accuracy mentioned above. Given the “performance Gap” we can not afford to guess whether we are heading for carbon zero or not, we need to measure every individual property to know the outcome for certain. Government seems to be acknowledging this fact by setting a maximum target for heat demand in the SHDF scheme and at the same time insisting on the outcome being measured in situ rather than merely having another EPC lodged.

The average figures for energy consumption for homes in Shropshire by archetype according to EPC data is as follows:

Bungalow	288.8kWh/m <sup>2</sup> /pa
Flat	286.6kWh/m <sup>2</sup> /pa
House	254.2kWh/m <sup>2</sup> /pa
Maisonette	347.9kWh/m <sup>2</sup> /pa



Park home

295.4kWh/m<sup>2</sup>/pa

Figures provided by Marches Energy Hub 02/112/2020 via email

These figures are not just for heating but also hot water & lighting. These figures are averages and should not be used for anything other than comparison and as a guide, but given heating is by far the major user of energy in our homes these figures are alarming. Enerphit the Passivhaus trust retrofit standard recommends 25kWh/m<sup>2</sup>/pa for heat demand whereas the SHDF is only targeting double that. Given the figures above it is not surprising that Enerphit suggests costs of £800-£1000/m<sup>2</sup> for “deep retrofit” (<https://www.homebuilding.co.uk/advice/enerphit>. Accessed 10.55am 14/12/2020)

Without a major government mandated national roll-out of these measures, it is difficult to see how we will get this work done even if all the funding were in place. It is normally suggested that this kind of “deep retrofit” is carried out when you are already planning major works on your home. Even Social landlords that have the economies of scale would normally look to do this kind of work during “void” periods when the house is between tenancies.

Certainly, approaching this in a piecemeal fashion is doomed to failure, “Taking into account that most retrofits are performed in a step-by-step manner, it is important to understand the consequences of lock-in effects: retrofit processes started now with shallow measures cannot achieve a high level of energy efficiency in 20-30 years. The risk is that by 2050, the reduction of the energy demand of the building stock will only be 50-60%”. (Europhit handbook. P8. Passivhaus Institute 2016).

This is not just a challenge for Shropshire. This will be one of the greatest challenges our nation in fact all nations will have faced, lets hope we are up to it!

## **FOR ANNEXE 1**

### **The qualifying benefits for GHG/LAD are:**

- Attendance allowance
- Carer's allowance
- Child tax credit
- Disability living allowance
- Housing benefit
- Income-based/contribution-based employment and support allowance
- Income-based/contribution-based jobseeker's allowance
- Income support
- Industrial injuries disablement benefit
- Pension 'guarantee' credit
- Personal independence payment
- Severe disablement allowance
- Universal credit
- Working tax credit

### **Qualifying criteria for ECO3 HHCRO**

Receipt of Pension Credit, Guaranteed Credit. Otherwise known as the Core Group under the Warm Home Discount scheme.

Other benefits include:

- Armed Forces Independence Payment
- Attendance Allowance
- Carer's Allowance
- Child Benefit (on the condition that the household's relevant income does not exceed the amount set out in Chapter 3 of our scheme guidance)
- Constant Attendance Allowance
- Disability Living Allowance
- Pension Guarantee Credit
- Income-related Employment and Support Allowance (ESA)
- Income-based Jobseeker's Allowance (JSA)
- Income Support
- Industrial Injuries Disablement Benefit
- Mobility Supplement
- Personal Independence Payment
- Severe Disablement Allowance
- Tax Credits (Child Tax Credits and Working Tax Credits)
- Universal Credit

EPC Rating	Number of Properties	As a % of Total
<b>A</b>	<b>156</b>	<b>0%</b>
<b>B</b>	<b>11287</b>	<b>11%</b>
<b>C</b>	<b>24550</b>	<b>24%</b>
<b>D</b>	<b>36919</b>	<b>36%</b>
<b>E</b>	<b>18830</b>	<b>18%</b>
<b>F</b>	<b>8411</b>	<b>8%</b>
<b>G</b>	<b>3391</b>	<b>3%</b>

Shropshire Council doc CCS evidence V9.3