Modelling Energy Usage and the Assessment of Energy Efficiency in the Rural and Remote Built Environments

A discussion paper for the Scottish Rural Fuel Poverty Task Force

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Introduction

This paper seeks to outline the significant components within the Government's approved national system of domestic energy efficiency modelling (Reduced data Standard Assessment Procedure - RdSAP) which may disproportionately impact on dwellings in more rural and remote locations in Scotland. As part of this process we will focus on those issues which are either unique to the rural and remote built environment, or are proportionately, a greater issue in these locations. NB matters which are more universal in nature across the housing stock will not be covered in this paper.

It is important to define the purpose and scope of RdSAP before postulating alternative approaches to help redress any perceived bias. Many of the issues which can be described as resulting from RdSAP are in fact process constraints or "conventions" agreed by Governments, Building Research Establishment (BRE) and operators of approved energy assessor schemes. In addition post calculation interpretations are placed upon the outputs from the methodology in its role as the energy model used to generate the Energy Performance Certificate to fulfil the EU Energy Performance in Building Directive – EPBD.

Therefore we must employ caution to ensure that any critique of RdSAP does not unduly ascribe negative qualities resulting from the practical constraints surrounding RdSAP. These seek to ensure quality and consistency, perhaps at the risk of sacrificing flexibility. We may also find criticisms of RdSAP resulting from the type and range of information found on an EPC, again these are not necessarily issues to which the methodology directly influences, often, these are further interpretations of the underlying SAP data included on the EPC to help educate and inform recipients about energy use in their own home.

Lastly, this paper is not describing an alternative methodology to RdSAP. That outcome would be subject to some considerable research work. It could take several years to define a new model to challenge the position of SAP as the Government's preferred methodology for assessing energy performance in properties. Any such endeavour of this nature would be subject to significant commercial constraints and intellectual property clauses as to make it unsuitable for the purpose of informing a discussion at this stage on the suitability of existing domestic energy models within the rural and remote environments.

Background and Purpose of RdSAP

RdSAP was developed over the mid 2000's in response to this country's requirement under the EU Directive for Energy Performance in Buildings. Specifically RdSAP was to be the domestic model, a rating system to describe how energy was being used in the home. What already existed at this time was the Standard Assessment Procedure (SAP) which was a BREDEM[1] based energy model to describe energy use in new, proposed properties seeking a building warrant. SAP had already been utilised to act as a way of unifying many different domestic energy rating systems present at that time and so this process was further developed to act as a standalone process.

The existing SAP2001 model would become the template for the further development of "Appendix S" to describe a way in which the full SAP methodology could be adapted for existing homes. To do this, many of the aspects of a building which would be known from plans and specifications where this was a new and proposed building, would have to be inferred from agreed defaults along built form and age characteristics. Many of these aspects would describe a performance which was the lowest common denominator rather than being an average, i.e. that worst case scenario would be the default in lieu of any better information.

With the development of Appendix S, the full SAP model could now be applied to existing homes with a degree of consistency and also with a set of conventions, the majority of buildings could be interpreted to 'fit' this and so begat the RdSAP methodology. Both Appendix S and the RdSAP Conventions have gone through many revisions since their inception under the then SAP 2005 methodology (now redundant). Appendix S has had 6 revisions from version 9.81 to 9.92 and the conventions document is currently at version 8.1.

The primary purpose of RdSAP was to fulfil the Government's duties to provide an approved methodology to comply with the EU EPBD. It is within this context that we must view the performance of RdSAP. We should not ascribe a purpose to RdSAP which is not within this context; this includes but is not restricted to analysis of fuel poverty. Since its adoption in 2008, the RdSAP methodology has been adopted as the default tool to describe the energy efficiency of dwellings for a wide range of policies. This is for the most part expediency as RdSAP, or to be more exact the provision of an EPC is supported by an extensive network of practitioners and approved bodies and so is eminently more accessible than any other energy model in the market.

However this is where many of the tensions with the application of RdSAP arise. Whilst the methodology itself is entirely impartial to the outcome, the practitioners of the model may introduce bias into the scoring either as a result of professional malpractice or mis-practice. These outcomes are well recognised within the industry, and Government is taking steps to reduce the observed operational variance[2].

In the past, Government was only concerned with performance in the provision of EPC's in so far as this fulfilled the requirements of EPDB. The performance factors may not have satisfied the scrutiny as required by other policy processes, however the EPC was not designed for other policies, as so how it was utilised for these was not of immediate concern for the Department(s) responsible for EPBD delivery.

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[1] Building Research Establishment Domestic Energy Model - http://www.bre.co.uk/page.jsp?id=3176

[2] http://www.elmhurstenergy.co.uk/uploads/040329_Letter_of_Approval_to_Schemes_for_Smart_Trial_L_mc.pdf

There are many examples of alternative building energy models developed by Scottish universities, e.g. Tarbase[3] and HUE[4]. There have also been attempts by the Scottish Government to develop its own domestic energy model. In response to the deployment of policies to fulfil the EPBD in Scotland, the then Scottish Building Standards Agency (now Building Standards Division) developed the Scottish Energy Rating Tool. This was ultimately shelved in favour of the UK Government's preferred approach which relied on the use of RdSAP to generate the EPC and brought the Scottish policy direction back into line with the rest of the UK's devolved nations.

[3] http://www.hw.ac.uk/schools/energy-geoscience-infrastructure-society/research/cesbd/urban-energy-research-projects.htm
[4] http://www.esru.strath.ac.uk/Programs/EEff/

Geographic Equitability of RdSAP in Scotland

In approaching the question, is RdSAP good for rural and/or remote properties in Scotland, we have to be clear about why we are asking the question about the energy efficiency of the property. In the context of a national indicator of housing standards, the use of RdSAP and the resultant SAP score is totally independent of the location i.e. the assessment of the property's efficiency is not penalised or enhanced by its location. If our question is about whether the property meets a band 'D' for the purpose of accessing a better rate for Feed-in Tariff, then again its location is not going to be a factor.

Will the assessment of the risk of fuel poverty be adversely impacted by the limitations, perceived or otherwise from the outputs of an EPC? The very short answer for this question is no. An EPC, RdSAP or SAP for that matter is never used to assess the risk of fuel poverty in a home. The Scottish Government and all other nations of the UK currently use BREDEM 2012 to generate the energy predictions which are then combined with the income model outputs to define a household as being in or out of fuel poverty.

Thus the real question is not about EPC's, it is actually in relation to BREDEM 2012 (version 1.1, January 2015) which has been incorporated into the current version of the Scottish House Condition Survey.

This does then make this a very short discussion paper, as within the context of fuel poverty, the EPC is totally irrelevant. However it is perhaps worth pointing out some areas in respect of the energy model which may not serve rural and/or remote properties in Scotland well.

BREDEM 2012 - Issues for Consideration

1. Location

The location of a property confers a set of average monthly environmental factors namely; temperatures, wind speeds and solar irradiance which will impact on the calculation of energy load required for space heating and the performance of certain renewable technologies. These location factors are aggregated for 21 locations in the UK, for Scotland, there are 9 regions for Scotland.

Since the implementation of version 9.92, RdSAP operates on a greater level of geographic sensitivity. RdSAP and so the EPC methodology, aggregates properties by the outward code (postcode area and district). This can produce some very different results for properties in the extremes of altitude and exposure within one of the 9 regions across Scotland.

Some of this was already discussed at the meeting of the SRFPTF 20-10-2015.

2. Heating Season in Scotland

The underlying principle for BREDEM is that properties only require heating in 8 months of the year. Thus monthly space heating energy requirements are only accounted for between Jan to May and October to December, 'the heating season'. Whilst this may be reasonable for most parts of the UK in population density terms, arguably, this basic assumption does not serve Scotland well. There have over the years since the original development of BREDEM been calls to have a longer heating season accounted for in Scotland.

3. Thermal Transmittance of Dwelling Heatloss Elements

Whilst BREDEM-2012 will work with any U-value assigned to it, the nature of the SHCS data collection means that expedience requires adoption of the appendix S methodology to assign default values. This in particular may impact more adversely on non-traditional construction types that may not be well served by the assignment of 'worst case scenario' U-values for the age of construction. There are some other appendix S elements that are passed into the BREDEM-2012 model e.g. defaulted glazed areas based upon built form and age of construction rather than actual measurement of these areas.

Looking to the more rural and/or remote environments, a common building form is one which allows for a lower profile building which can accommodate living apartments into the roof space. Utilising appendix S methods is likely to result in a modelled 'room in the roof' which does not reflect well upon the reality of the situation, either by area or U-value of these areas.

4. Off-peak Utilisation

When converting the energy required for space and water heating to a cost, there is a recognition that for some households' energy is charged at different rates over a 24 hour period. Getting the best out of cheaper/off-peak energy required the use of systems that can consume energy when it is cheap and retain this for when the occupants have a demand. In order to do this, there is a basic set of assumptions which determine the proportion of off-peak energy that specific heating systems utilise.

BREDEM expects that over a 24 hour period, heat is demanded 2 hours in the morning and 7 hours in the evening. Thus for systems operating with an 10-hour tariff, this does tend to

mean that over the 9 hours, it is only likely that 50% of the time the system would be operating on the cheaper rate.

5. Use of Electric Showers for Hot Water Provision

It may be more common that in rural and/or remote areas, particularly in the summer months when solid fuel and LPG systems are switched off, that hot water supplied form electrically heated systems e.g. an electric shower. BREDEM does not allow for two means of heating water throughout the year, by default, this come from the main system, even if that system is not operational for certain times of the year.

This can become quite a marked deviation from the actual where occupants have no capacity for storing hot water i.e. no hot water cylinder e.g. where a combination boiler is present. In this case the model will assume that all hot water requirements over the year come from the main system, even in situations where the only means of bathing comes from an electric shower i.e. no mixer shower present. This situation can be accounted for in the model, however it is more that there is no convention to allow for a situation where a property has no bath, has been converted for a shower only bathing facility and that the majority of hot water is heated from an electric system over the year.