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Common Weal Policy

ENERGY PERFORMANCE CERTIFICATES: AN ALTERNATIVE APPROACH

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BRIEF SUMMARY

Common Weal is of the view that:

— The aims of the European Union's Energy Performance of Buildings Directive (EPBD), which requires EPCs to be produced for all new buildings and those being sold or rented out, are fundamentally sound and should serve to drive improvements in energy performance. However, in Scotland and the UK, the method by which EPCs are produced are fundamentally flawed. In particular, this is due to the reliance on using modelled energy consumption data rather than actual (measured) data.

— In light of the increasing reliance on using EPC ratings as a key driver for Scottish Government policies on energy efficiency and fuel poverty, including proposals to mandate home and building owners to upgrade their properties to achieve higher ratings, there is an urgent need to understand the highly significant uncertainties around both the ratings and the appropriateness of the improvements recommended by EPC assessments. Then if the Scottish Government seeks to persist in using EPCs as a policy driver it should develop an alternative method for producing them which both more accurately reflects actual energy consumption and includes a more realistic and appropriate list of recommended improvements. Doing so is entirely within its devolved powers, and such an alternative approach would be more aligned to the EPBD's guidance for producing EPCs.

— This policy paper sets out such an alternative approach, and how it would achieve greater alignment with the EPBD. The approach is based on the fundamental principle of maximising the use of real data in order to provide buyers and tenants with accurate, robust, relevant, and useful information. The approach is also designed to maximise the use of data already being collected by the Scottish Government and public bodies in order to be cost effective. We present this approach as an answer to the frequently asked question of 'if not EPCs, then what?', and would welcome comments from other experts and stakeholders as to how it could be refined further.

CONTENTS

PREFACE

Energy Performance Certificates (EPCs) were introduced across the European Union in 2007 as a means of providing prospective buyers and tenants of homes and non-domestic buildings with information on their energy consumption and greenhouse gas emissions, as well as information on how these could be reduced. However, whilst Common Weal welcomes any measures that serve to reduce the environmental impact of our homes and workplaces, we are also strongly of the view that the way they are currently produced is deeply flawed and does not present a sufficiently accurate or useful picture to buyers and tenants.

The fundamental problem with EPCs is the current emphasis on using models to generate the figures for energy and emissions performance, and the further savings that could be gained accompanying list of recommended improvements. Numerous studies have shown huge discrepancies between the modelled and actual performance of buildings assessed for EPCs, yet the way they are produced has remained largely unchanged since they were first introduced. Whilst the accuracy of the models has improved to some extent, modelled data is no substitute for real data; and what minor limitations there are on using real data are increasingly being eroded by the increased collection and accessibility of energy data, and by new technologies. There is now no reason why the use of modelling should not be limited only to new buildings, and then only until a new building has been occupied for a sufficient period to collect real data.

When EPCs under-estimate actual energy consumption the occupants face higher than expected energy bills, particularly affecting the occupants of public and commercial buildings and householders on low incomes; and when they over-estimate actual energy performance they deter occupants from making behavioural changes and investing in making energy efficiency improvements. Furthermore, not only are the predicted savings in the list of recommended improvements frequently inaccurate and the measures sometimes inappropriate due to site-specific conditions, but also making more substantial improvements such as installing renewable energy technologies invariably requires more detailed on-site inspection.

However, the problems caused by EPCs are now being further exacerbated by the Scottish Government's reliance on EPCs as a primary policy driver for improving household energy efficiency as a means of reducing fuel poverty. And yet even if the Scottish Government chooses to continue to ignore the wealth of evidence on the invalidity of EPCs as a policy driver, it is entirely within its powers to adopt an alternative approach to generating them, and one which could be in greater alignment with European Union legislation.

This policy paper sets out both a critique of EPCs and an alternative approach that would, we argue, be both more accurate and useful for prospective buyers and tenants, whilst also being more in line with the requirements EU's Energy Performance of Buildings Directive, implementable with minimal changes to existing data collection processes, and able to incorporate the growing volumes of real data being made easily accessible by new technologies.

INTRODUCTION

The requirement for Energy Performance Certificates (EPCs) to be produced for all new buildings and those being sold or rented came into force across the UK in August 2007, and the details of how they should be produced are set out under the European Union's Energy Performance of Buildings Directive (EPBD)[1].

In Scotland, which implements EPBD as part of its devolved powers, as well as the wider UK, EPCs are produced using the BREDEM 12 model for dwellings and the SBEM model for non-domestic buildings. These also underpin the Standard Assessment Procedure (SAP) and are rarely precise and frequently highly inaccurate assessments of both dwelling energy

performance and the impact of energy efficiency and renewable energy upgrades. As regards SAP, an authoritative study conducted by Jones Lang Salle in 2012 concluded that "SAP is not an accurate modelling tool for existing homes". This study assessed 150 homes across England, using metered energy data and monitored data on internal and external temperatures, and pre and post the interventions recommended by SAP[2]. This is one of many such studies that have repeatedly demonstrated the limitations of SAP and EPCs, for example [3 - 19].

A further problem here is the assessment of EPCs themselves. The Operating Framework introduced by the Scottish Government's Building Standards Division requires Approved Organisations to check 2% of domestic EPCs to check that 95% of those EPCs are correct to within plus or minus 5% of the correct SAP rating and plus or minus five points of the correct environmental impact rating. Checking this is a significant task as inputs should themselves be correct to three significant figures. However, this assessment only measures how correctly the calculations match the actual SAP rating, and not how accurately they model the actual energy performance of the dwellings. As regards this assessment, we have concerns both over the statistical validity of the sampling regime and the benefits and cost-effectiveness of the overall exercise.

The impacts of inaccurately assessing the real energy consumption of a dwelling or non-domestic building as part of producing an EPC can be wide-ranging and significant. Where actual energy use is higher than modelled the new occupants will face higher energy costs, most notably affecting occupiers of public and commercial buildings and poorer householders, and where actual energy use is lower than modelled occupants may be discouraged from making behavioural changes (and may even adopt higher energy using behaviours) and further investments in energy efficiency. We draw particular attention to the findings of a 2018 study by researchers at the Barcelona Institute of Economics (IEB) which used dynamic modelling to analyse the impact of EPCs on social welfare:

"Although EPCs always improve social welfare, their impact on energy use and investments is ambiguous. This implies that, in a second-best world where energy externalities are under-priced and/or homeowners have behavioural biases hindering investments (myopia), EPCs can damage social welfare. This calls for using mandatory energy labelling in contexts where additional instruments efficiently mitigate the other imperfections."[20]

So, under ideal conditions EPCs improve social welfare but there is no significant impact on leveraging behavioural changes or encouraging occupiers to invest in new measures. However, under non-ideal conditions (e.g. those that might be found in any vaguely deprived area of Scotland) EPCs may actually damage social welfare.

Yet despite this significant volume of evidence and constant criticism of EPCs from academic and professional experts the Scottish Government currently plans not only to retain EPCs as a key policy driver, but to further increase their use as a driver for energy efficiency. Under proposals set out under the three main policy packages, the Local Home Energy Efficiency Strategy, the Fuel Poverty (Target, Definition and Strategy) (Scotland) Bill, and the Scottish Energy Strategy, EPCs will not only remain the primary measure of building energy performance, but will ultimately be used to enforce building owners to invest in energy efficiency improvements.

Whilst we are of the view that enforcing mandatory improvements to improve the energy efficiency of our built environments would be a significant and important step towards further reducing Scotland's greenhouse gas emissions, such a significant step must be based on sound science and authoritative evidence if the Scottish Government is to avoid significant unintended consequences. One simple example of an unintended consequence is the case of buildings with high thermal mass, a common feature of the design of many traditional Scottish buildings and one common cause of why their actual energy consumption can be lower than the modelled consumption (if they are well-maintained). Under the current circumstances an EPC would likely recommend (and in future, mandate) installing new insulation as part of the recommended measures. This would then result in them overheating, and the subsequent impacts on their occupants: using more energy for cooling; using more water; impacting on health conditions; loss of income for homeworkers; etc; and law suits would surely follow. Therefore, as things stand

we call upon both the Scottish Government and the European Union to apply the Precautionary Principle[21] to all existing and any further use of EPCs as a policy driver.

One solution would, of course, be for the Scottish Government to invest heavily in either a Scotland-specific fork of BREDEM-12, or even to commission and develop a bespoke Scottish building energy model, before using EPCs to enforce owners to invest in energy efficiency measures. However, the former would require significant investment and the costs of the latter would be prohibitive. Neither is realistic, but that does not mean the Scottish Government could not do better with the tools at its disposal. In order to better understand why we need to understand the requirements of the EPBD.

THE ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE

The production and display of EPCs for both domestic and non-domestic buildings are required under the EU Energy Performance of Buildings Directive (EPBD)[22], which states:

"The energy performance of buildings should be calculated on the basis of a methodology, which may be differentiated at national and regional level. That includes, in addition to thermal characteristics, other factors that play an increasingly important role such as heating and air-conditioning installations, application of energy from renewable sources, passive heating and cooling elements, shading, indoor air-quality, adequate natural light and design of the building. The methodology for calculating energy performance should be based not only on the season in which heating is required, but should cover the annual energy performance of a building. That methodology should take into account existing European standards." (EPBD, para 9).

SAP is currently the statutory methodology chosen by both the Holyrood and Westminster governments for producing domestic EPCs however, whilst EPBD encourages the harmonisation of assessment instruments it is not proscriptive:

> "When setting energy performance requirements for technical building systems, ***Member States should use, where available and appropriate, harmonised instruments***, in particular testing and calculation methods and energy efficiency classes developed under measures implementing Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products and Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, with a view to ensuring coherence with related initiatives and minimise, to the extent possible, potential fragmentation of the market." (EPBD, para 12, emphasis added)

The key word here is appropriate, as if SAP assessments are deemed not appropriate then the Scottish Government should be actively seeking to adopt an alternative. Furthermore, EPBD also sets out a clear position on what should be deemed appropriate:

> "The prospective buyer and tenant of a building or building unit should, in the energy performance certificate, ***be given correct information about the energy performance of the building and practical advice on improving such performance***. Information campaigns may serve to further encourage owners and tenants to improve the energy performance of their building or building unit. Owners and tenants of commercial buildings should also be encouraged to exchange information regarding actual energy consumption, in order to ensure that all the data are available to make informed decisions about necessary improvements. The energy performance certificate should also provide information about the actual impact of heating and cooling on the energy needs of the building, on its primary energy consumption and on its carbon dioxide emissions." (EPBD, para 22, emphasis added)

And finally, Annex I, which sets out a common general framework for the production of EPCs notes that:

> "The energy performance of a building shall be determined on the basis of the ***calculated or actual annual energy that is consumed in order to meet the different needs associated with its typical use*** and shall reflect the heating energy needs and cooling energy needs (energy needed to avoid overheating) to maintain the envisaged temperature conditions of the building, and domestic hot water needs." (EPBD, Annex I, para 1, emphasis added)

There are two points to note here. First of all, EPBD explicitly allows for the use of actual (measured) consumption data as part of the production of EPCs. SAP, being based on BREDEM 12, is a modelled assessment method. Secondly, being primarily a building envelope model has always struggled to cope with usage factors such as occupancy and appliance ownership and usage[23]. Indeed, this latter failing was recognised by the Scottish Government by its adoption of the alternative National Home Energy Rating model as the main model for assessing dwelling energy efficiency for the Scottish House Condition Survey until 2013, and the SHCS still reporting NHER figures as late as 2016[24]. It is entirely within the powers of Holyrood to adopt such an alternative approach.

It should be stressed that adopting an alternative approach to generating EPCs is entirely within the scope of the powers devolved to the Scottish Government, and with regard to this we note the comments made by Lord Deben at the meeting of the Environment, Climate Change and Land Reform Committee on 23rd October 2018[25]:

> "I really wish that Scotland would set sensible standards for house building instead of those that we have at present, which are not sensible. Devolution gives you an enormous ability to do something of that sort. You could do to house builders what should be done throughout the United Kingdom and say, "I'm sorry, but if you want to build a house, you cannot build it on the basis that it will be retrofitted later. It's got to be built more or less to Passivhaus standards.*" If you did that, you would find that it did not increase the cost of houses in any real sense. In so far as it is more expensive, that would be reduced by the fact that such building would become mass production rather than niche production, and also because the cost goes into the cost of the land; it actually lowers the price of land, because that is how the price of land is fixed."

Reverting to NHER is no longer an option, and the costs of developing a bespoke Scottish model would almost certainly prove prohibitive, and yet because of the continued belief amongst policy makers that using modelled data is appropriate, this is invariably as far as any discussion of an alternative gets. However, nothing in EPBD prohibits an alternative approach based around using actual (measured) data, providing it meets the criteria set out under Annex I. Furthermore, beyond meeting the requirements of EPBD there is no legislation outwith the powers of the Scottish Government that binds it to using SAP / BREDEM. Therefore, what would be the alternative?

UNDERSTANDING BUILDING ENERGY DATA

Before setting out an alternative it is first necessary to understand what real data on building energy use does, and more importantly, doesn't tell us, and therefore why modelled energy use frequently varies substantially from measured data.

For domestic dwellings of all the factors known, or thought to have, a directly causative and near-linear relationship with energy consumption, by far the most significant is their total floor area[26]. Within a standard usage category, e.g. dwellings or offices, this is to be expected due to the

** Note that we are not of the view that building all new properties to PassivHaus™ or equivalent standards is necessary the only or best solution for meeting future housing needs. We are of the view that naturally 'passive' solutions that do not require additional energy uses (in the form of mechanical ventilation etc) may be equally or more appropriate, and that the Building Standards should work to encourage both.*

dominance of heating as a proportion of overall building energy consumption, although even here factors such as ceiling heights and insulation will introduce elements of variation. Beyond this the evidence for the assumptions that other variables can be used to precisely and accurately model energy demand rapidly break down, even for highly homogeneous domestic dwellings. The key example of this is occupancy, for which there is a statistically significant relationship with energy consumption, but for which there is such a high level of individual variation even amongst highly homogeneous dwellings that its validity as a predictive variable for individual dwellings is at best questionable. And yet beyond total floor area, occupancy has consistently been found to be the variable that next most closely correlates with dwelling energy consumption[27 - 20].

This is not to say that it would be impossible to develop some form of highly precise and accurate building model, or that one may already exist in a research institute somewhere, but SAP / BREDEM already require on-site surveys by accredited professionals if they are to be used meaningfully and limit the use of assumptions underlying the eventual EPC. Furthermore, under current Scottish Government proposals the number of EPCs needing to be produced per year is set to escalate, raising concerns over the ability of the market to deliver assessors. Such a more sophisticated energy model would, by virtue of the additional volume of real data needed, increase the time needed on-site, the time needed to process the data, and the subsequent cost of inspections, to the point where they could easily become prohibitive due to both cost and the availability of qualified assessors. Therefore, and within the limitations of EPBD, any alternative must be a departure from the status quo.

Finally, returning to the requirements of the Energy Performance of Buildings Directive, it is now necessary to consider what the directive aims to achieve as regards the information they are intended to provide to householders and prospective buyers and tenants (EPBD para 22). Arguably, under any reasonable definition of the word, a SAP / BREDEM assessment does not usually provide 'correct' information on dwelling energy consumption, and whilst the recommendations for upgrades included in an EPC serve as a checklist for householders and may spur action, they frequently include measures inappropriate for the specific dwelling or household. In this respect they serve little value beyond being a semi-filtered checklist of options ranging from the simple (e.g. adding loft insulation) to those which would anyway require a follow up inspection (e.g. installing renewable energy technologies). Furthermore, the aspects of a building that are required to be reported in EPCs under Annex I of EPBD are anyway required as part of surveys as part of construction and prior to sale, so EPBD merely extends this requirement to rentals. That data collection requirement is not lost if it is not required for modelling. As such, there is nothing preventing the Scottish Government from abandoning the use of modelled energy consumption and including real energy consumption data in EPCs.

AN ALTERNATIVE DOMESTIC EPC

It is entirely possible to construct an alternative EPC that meets the both the requirements and the intentions of EPBD without resorting to modelled data on the energy consumption of an existing building. For a domestic dwelling this would replace this modelled data with measured energy consumption (and, noting the tariff, cost) as an annual figure, and per square metre, and be for the previous year as of the date of the inspection unless the property has been void for a significant period of time. This would meet the EPBD criterion for 'correct information'. However, in order to be 'practical' and reflect 'typical use' some additional, and suitably anonymised, contextual information on the previous occupants would be added on their household type and occupancy regime sufficient for a potential buyer or tenant to relate these to their own circumstances, and therefore infer how much their own energy use may differ*.

** In reality, as many buyers and tenants already meet the previous occupants this merely formalises an otherwise common informal exchange of information.*

As regards the relationship between internal temperatures and energy consumption, there are a growing number of options for how this useful information could be included as part of an alternative EPC. Ultimately, the proliferation of smart technologies and in-home sensing equipment may well make recording and accessing internal temperature profiles much easier than the traditional approach of using temperature loggers however, in the immediate future there may be value in incentivising sellers and landlords to record, or at least report, these voluntarily for inclusion in an EPC as a further steer for buyers and tenants.

For domestic properties the rationale for this approach lies in what information is most useful to lay persons making a complex, and often stressful, decision that requires assessing a large amount of information, of which energy performance is only one component, and one which they may struggle to relate to and process as part of that decision-making. Given the level of uncertainty in modelled assessments, and particularly for adjusting for occupancy and behaviour, it would be far more reasonable to provide potential buyers and tenants with an actual consumption figure and allow them to use their tacit and contextual knowledge to adjust that based on how similar or different their circumstances and lifestyles are.

However, removing the need for modelling from this component of EPCs still leaves the need for EPCs to include information on recommended improvements, and to be generated for new build. For new build, it is inevitable that the initial EPC will be based on modelled data due to the need for production pre-occupation. However, this presents a number of opportunities to improve building models that would have other spin-off benefits. New smart technologies will gradually enable greater and more sophisticated data that can be used to improve models and feed back into further innovations, but as housing construction rates are miniscule compared to the turnover of existing homes this process cannot be expected to proceed at the pace needed to meet the Scottish Government's targets simply because the necessary volumes of data will not be generated. Therefore, the alternative approach would be to require second EPCs for all new buildings one year on from first occupation, with the modelled energy figures then replaced by real ones. This would be merely a simplification of the 'soft landings' approach to post-occupancy evaluation of new non-domestic buildings[31] (see 'An alternative non-domestic EPC'). Furthermore, a stick could be introduced whereby developers modelling energy consumption significantly lower than measured post-occupation would face financial penalties according to the degree of difference. This would also serve to reduce developers' temptations to shave costs on energy efficiency measures.

The section of the EPC dealing with recommended improvements can essentially be split into simple measures, such as improving insulation levels, which can be directly related to the Building Standards and for which good (enough) figures that are more appropriate for use in Scotland are already available from the Scottish Government's internal modelling work[32]. Although this work is based on using SAP it would provide the basis for a Scottish fork designed to meet the needs of the alternative EPC, which would report savings on a more general basis (using the 355 archetypes) than an individual one – again the level of uncertainty in the modelling makes this a no less reasonable option, and a more cost-effective one. For more significant interventions, e.g. installing renewable energy technologies, the new EPC would again report the potential savings at this more general level, and with a clear note that these technologies can be highly site-specific in terms of performance, and that a second assessment by a specialist is always needed before investing. A further change here would be that the alternative EPC would also be filtered by the on-site assessor to remove any recommendations that are obviously inappropriate, as the current process does little to weed these out.

Another contention against the present format of the recommendations section is the development of the Scottish Sustainability Label (SSL)[33, 34]. Although this is currently only voluntary, only for new build, not yet fully developed for non-domestic buildings, and uses a format different to that common to EPCs and other EU energy labels, the SSL presents an opportunity to include a more holistic set of recommendations as part of an EPC. The resource use section of the SSL already replicates the current EPC, but

(for domestic buildings) the additional sections include improvements that may also directly or indirectly lead to reduced energy consumption (e.g. water efficiency measures, improved natural lighting, etc). Given the need for a more holistic approach to driving energy efficiency, and that the SSL criteria relate directly to the Scottish Building Standards, it is a missed opportunity that EPCs do not include these simply because the savings are highly difficult to model even within the substantial range of accuracy allowed for measures already included. If only as suggested options that may (or may not) reduce energy consumption but would be beneficial in other ways.

An alternative EPC could, within the limits of EPBD, adopt the SSL approach, with the presentation reformatted to that of the current EPC. This change could be made immediately for domestic buildings and later for non-domestic buildings as soon as the SSL is fully developed. However, as this expansion of the EPC would require proportionately more time on site to assess a building the process would be streamlined by a seller or landlord self-disclosing any upgrades, which the assessor would simply check have been made. Additional criteria or limits, e.g. a ten-year time limit, could be used to set a mandatory requirement for when a new full assessment is needed before a property is sold or rented out.

This alternative approach would leave the general appearance of EPCs unchanged and meet with the requirements of the EPBD, and would provide a much more realistic and tangible assessment of energy use and general building performance to potential buyers and tenants. It would also introduce an element of enforcement, but one which would also serve to drive improvements in modelling and discourage 'optimistic' assessments of energy performance. And it is entirely within the powers of the Scottish Government to adopt it.

AN ALTERNATIVE NON-DOMESTIC EPC

An alternative EPC for non-domestic buildings would be both visually and practically similar to the domestic EPC. The actual building energy consumption figures and contextual information would still appear, and whilst this would within the limits of commercial confidentiality it would serve to favour disclosing more detail on more energy efficient buildings. However, as half-hourly metered data is available for non-domestic buildings this opens up the option for owners to disclose load profiles, and for developers to be required to disclose modelled load profiles for new build.

The main difference would be a greater emphasis on the use of post-occupancy evaluation, including the mandatory adoption of the soft landings[35] approach for all new buildings, with EPC assessments required before sale and one year following occupation. Given the greater complexity of managing energy use in a non-domestic building, further energy efficiency improvements would be leveraged through a second mandatory assessment at 3-5 years post-occupation. This could be introduced as mandatory for public procurement, and as a voluntary measure for the private sector.

Whilst the categories assessed by Scottish Sustainability Label for non-domestic buildings remain to be expanded to those for domestic buildings there seems no reason as to why these could not be finalised in parallel with the development and implementation of an alternative EPC, if necessary with a view to further revision before any use of EPCs to enforce improvements.

Again, this approach carries all the benefits of the alternative domestic EPC and is entirely within the powers of the Scottish Government to implement.

CONCLUSIONS

This policy paper arose from the urgent need to address the question of, if Energy Performance Certificates as they stand are not a valid driver for policy, what should replace them? Through a deconstruction of the legislation and the modelling that underpins EPCs we have shown both the limitations and implications of using EPCs in their current form as a policy driver, and

have presented an alternative approach which meets all the necessary legislative requirements and which can be implemented directly under currently devolved powers. Although this work is focussed on domestic EPCs we have set out how it can be applied directly to non-domestic EPCs through harmonisation with the future development of the Scottish Sustainability Label.

This alternative approach not only directly addresses the requirements of the Energy Performance of Buildings Directive, it is a better way of implementing those requirements, and serves to counter the potential for damage to social welfare under non-ideal circumstances. Furthermore, the costs of adopting the alternative approach, even without offsetting against the wider economic savings, are far from the scale of the only two viable alternatives, whilst also reducing the need for and costs of modelling.

We present this alternative approach for further discussion and as a step towards the formalisation and implementation of a more accurate, robust, realistic, appropriate and workable method for producing EPCs, and look forward to further engagement with the Scottish Government, stakeholders and experts to resolve the problems caused by the current approach.

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