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The role of energy bill modelling in mortgage affordability calculations

CAMPAIGN FOR A SUSTAINABLE BUILT ENVIRONMENT

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ABSTRACT/SUMMARY

Currently, the median housing-related energy costs accounts for 7.2% of a household's weekly expenditure in Great Britain. These costs are directly related to both the energy efficiency of the property and the energy-related services sought by the household (i.e. hot water, cooking, lighting and appliances). However, despite high and rising energy costs, the energy performance of housing has so far failed to impact property values in the UK market. This is due in part to the limited understanding, and therefore importance, of energy performance when purchasing a home, along with its relatively low priority against other motivating purchasing factors (i.e. neighbourhood, commute, local schools, access to services, etc.).

However, what if mortgage lenders were to make use of energy performance ratings when providing a loan? Under the Mortgage Market Review (MMR), lenders are now required to assess what repayments a customer can afford considering both their income and major expenditures. In meeting these requirements, many UK lenders already consider energy costs to some extent, but only as part of a broad estimate of household expenditure with no reference to the energy performance of the building.

In this work we explore the extent to which mortgage lenders could estimate energy costs using data that is already readily available to them, including properties' Energy Performance Certificate (EPC) rating. The analysis shows that these estimates could significantly improve upon those currently used in mortgage affordability calculations, potentially allowing banks to better manage the risks associated with their lending, while also helping prospective purchasers to better understand the real costs of the property they are about to purchase. In doing so, lenders could play a role in helping to raise the profile of EPCs in property transactions, creating a virtuous circle that would see their accuracy – which is currently variable – improve over time. Within a short period of time, this could lead to much closer relationship between properties' EPC rating and their value, which would act as a major driver for energy efficiency of the UK's homes and for take up of Government schemes.

Introduction

For many years, green building advocates have hoped for a day when the energy performance of homes is reflected in their value. If such an outcome could be achieved, then it is reasonable to expect that property owners would view energy efficiency in the same way as they view new kitchens and bathrooms: as an investment that would help them command a higher sales price for their home. This is important as, up to now, the value of energy bill savings from retrofit measures have been insufficient by themselves to incentivise mass non-government aided take-up.

While some – including the Department of Energy and Climate Change (DECC) - have sought to demonstrate that this phenomenon is already starting to take hold on the UK market[1] along with some limited evidence elsewhere[2][3]. This is perhaps likely to change over coming years as Government policies start to bite – especially, for example, the 2018 Minimum Energy Efficiency Standards (MEES) regulations covering the private rented sector – and perhaps also as public attitudes shift. But what if this could be accelerated by involving a key part of the property market – the finance sector – in the process?

An apparent opportunity to do this has arisen as the result of the Mortgage Market Review (MMR). Under the MMR, lenders are now required to pay greater attention to prospective borrowers' outgoings when calculating the affordability of the expected repayments. DECC estimate that the median UK energy costs are £1,300 (£729 for gas and £577 for electricity), and the ONS estimate the median after tax income is £18,000 (£20,300 before tax). This means that half of all households spend at least 7.2% of their after tax income on housing heating and power. This proportion has increased rapidly in recent years (see Figure 1), and as such it seems reasonable that responsible lenders should be seeking to take likely energy costs into account when deciding how much to lend. The logical implication of them doing so, all other things being equal, would be that those buying efficient homes could be offered larger or cheaper loans than those purchasing homes that are badly insulated and draughty.

While it is perhaps a big leap to imagine that lenders could be persuaded to adopt new, energy-conscious lending practices overnight, the principle merits further investigation to find out how significant the improvements in information could be in the process of estimating bills. This paper therefore looks at how lenders currently account energy costs; whether and how the accuracy these calculations could be improved; and the impact this could therefore have on lenders' risk profiles. It also looks at the role of Energy Performance Certificates, and the long-term implications that their inclusion in mortgage affordability calculations could have for their accuracy and quality.

[1] See https://www.gov.uk/government/news/energy-saving-measures-boost-house-prices

[2] Australian Bureau of Statistics 2008 Energy Efficiency Rating and House Prices in the ACT, Report for Department of the Environment, Water, Heritage and Arts

[3] Deng, Y. Li, Z. and Quigley, J. 2011 Economic Returns to Energy-Efficient Investments in the Housing Market: Evidence from Singapore, Regional Science and Urban Economics, 42, 685-694

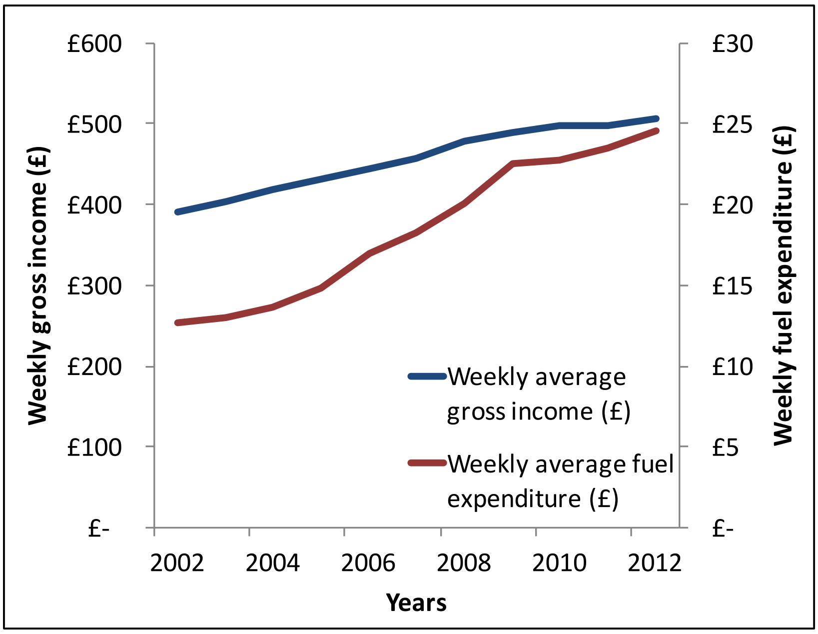


Figure 1 - Weekly income and fuel expenditure in English households (2002-2012); Source: ONS Annual Survey of Hours and Earnings (ONS, 2014)

Methods

To examine this issue, a number of energy bill models were developed, from ongoing research at the UCL Centre for Energy Epidemiology, to test the implications of using a dwelling's energy performance information to estimate its actual energy expenditure (including the extent to which EPCs could be used in mortgage lenders' bill estimation process). In this work, we used a dataset that included detailed information on the energy performance and other physical characteristics of English dwellings, as well as the households that live in them. In setting up the models, a focus was placed on using data points that should be readily available either from the prospective buyer (from the property's EPC or other property info/survey results) and/or from the mortgage lender's normal mortgage application process. In the following, we describe the data used in this analysis and the approach to the modelling in further detail.

Data set

The results shown in this paper were derived from ongoing research using parts of the 2011 Energy Follow-Up Survey (EFUS)[4]. The EFUS is a sub-sample of the English Housing Survey (EHS), which is a representative survey of English dwellings and households therein. The EFUS included: a) all self-completed survey asking about details of their dwelling and their heating practices; and b) gas and electricity meter readings in a sub-sample of homes used to estimate a yearly consumption. The sample size for EFUS was N=2616; meter readings were available for N=1345 households.

Variables used in subsequent analysis

As highlighted above, for the purposes of the modelling, the predictors used focused on building features (i.e. factors that are pertinent to the building and would be collected as part of the EPC input) and household characteristics that would normally be

[4] [1] DECC, BRE. Energy Follow Up Survey, 2011 2014. doi:10.5255/UKDA-SN-7471-2.

collected by a mortgage provider. The variables were chosen based on previous research[5,6], and limited by what was available in the EFUS data.

Independent variables

Table 1 summarises the selected building and household variables used in the analysis. Again, though other characteristics of the dwelling and household may play an important role in determining the amount of fuel used (i.e. occupancy patterns, temperature settings, heating controls, appliance ownership/use, etc.), only those variables likely to be available to lenders were considered. This avoided the complications that would be associated with self-reported variables which could, for example, change in a new property compared to the mortgage applicant's previous dwelling.

Variable (abbreviation)	Categories (N)
Floor area (FloorArea)	n/a (continuous: M = 91.12 m^2, SD = 43.07)
Dwelling type (DwType)	Converted & purpose built flat (151), detached (234), end terrace (119), mid-terrace (119), semi-detached (305)
Government Office Region (GOR)	East (108), East Midlands (68), London (106), North East (73), North-West (176), South East (134), South-West (96), West Midlands (97), Yorkshire and the Humber (133)
Dwelling age (DwAge)	pre 1919 (142), 1919-44 (171), 1945-64 (229), 1965-80 (233), 1981-90 (77), post 1990 (139),
Wall type (WallType)	9-inch solid wall (139), cavity uninsulated (302), cavity with insulation (489), other (63)
Double glazing (DblgGlaz)	entire house (786), more than half (117), less than half (38), no double glazing (35)
Loft insulation (LoftIns)	150mm or more (457), 100 up to 150mm (257), none – up to 100 mm (172), not applicable - no roof directly above (105)
Fuel type (Fuel)	electrical system (46), gas system (945)
SAP rating (SAP)	C (134), D (552), E(256), F&G (49)
Household size (HHSize)	n/a (continuous: M = 2.37, SD = 1.24)
AHC (After-Housing-Costs) equivalised income quintiles (Income)	1st quintile – lowest (145), 2nd quintile (218), 3rd quintile (209), 4th quintile (209), 5th quintile- highest (210)

Table 1 - Overview of building variables and their frequencies

[5] Huebner G, Hamilton I, Shipworth D, Oreszczyn T. People use the services energy provides - but buildings and technologies determine how much is used. In: ECEEE Summer Study Energy Efficiency; 2015.
[6] Hamilton IG, Steadman PJ, Bruhns H, Summerfield AJ, Lowe R. Energy efficiency in the British housing stock: Energy demand and the Homes Energy Efficiency Database. Energy Policy 2013;60:462–80.

Dependent variable: Annualised combined energy cost

The analysis used the annualised energy consumption in kWh converted into a total annual cost (in £). This value either reflected the sum of both gas and electricity data, or just electricity consumption for households that were not connected to the gas grid. To avoid potential variation in the price paid for fuel at an individual household level, 2011 values for gas and electricity (as p/kWh) for each region were used (see

Table 2). The values are drawn from DECC regional energy price statistics for the residential sector7.

	Fuel Prices (pence/kWh)					
	Electricity			Gas		
Region	Credit	Direct debit	Pre-payment	Credit	Direct debit	Pre-payment
North East	15.8	14.5	15.8	5.1	4.6	5.0
North West	15.8	14.6	15.9	5.1	4.6	5.1
Yorkshire	15.68	14.27	15.6	5.08	4.58	5.07
East Midlands	15.3	14.3	15.5	5.0	4.6	5.1
West Midlands	15.88	14.48	15.84	5.21	4.71	5.09
Eastern	15.4	14.3	15.5	5.1	4.7	5.1
London	15.6	14.5	15.7	5.2	4.8	5.1
South East	15.6	14.5	15.7	5.2	4.7	5.0
South West	16.42	15.31	16.57	5.13	4.7	5.03
UK	15.83	14.65	15.93	5.11	4.68	5.06

Table 2 - 2013 Regional fuel prices for gas and electricity

Statistical analysis

Linear regression analyses were used to test the predictive power of different selections of variables in explaining annual energy costs. A baseline model (model 1) was built to reflect the type of information mortgage lenders currently use to model energy bills (region, income, household size). Additional models were then built to illustrate a) the effect of adding EPCs as part of the base model, and b) of adding further information known to have an impact on energy use. The models' (2-5)

[7] https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics

respective explanatory power was compared to determine a preferred model. The preferred model (model 5) encompassed the relevant predictors that could be attained by the mortgage lenders from an EPC and a mortgage application.

Results

As shown in Figure 2, the modelling results for the 'mortgage lenders' model (model 1) illustrates that using only a limited amount of information to predict dwelling energy costs (gas and electricity) produces a model with low explanatory power (i.e. ~18%, derived from R-square value). As would be expected, as more information is added to the model, the greater the explanatory power of those selected predictors. A preferred model (model 5), which used variables that are readily available to mortgage lenders from the EPC and the mortgage consultation with prospective purchases, was shown to predict approximately 38% of fuel costs. Although this may not seem exceptionally higher, this is a doubling of the power of the current 'mortgage lenders' model, achieved for relatively little additional effort.

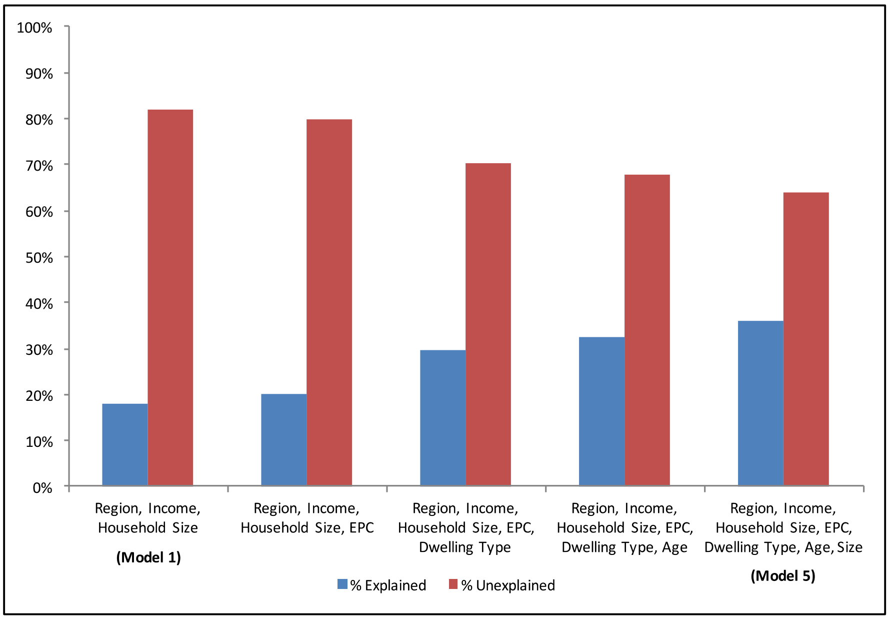


Figure 2 - Comparison of regression models of energy costs using EFUS data

The above Figure 2 shows the power of the model 'average'. Equally as important, and a more visible difference, is how well the models can predict the variation of fuel costs against the true distribution of costs. Figure 3 shows an example of the variation in fuel 1costs for dwellings built pre-1900 for model 1 and model 5. What is clear from the figure is how much more of the spread the model with more information is able to estimate, despite predicting relatively similar averages for the group. It therefore reasonable to conclude that it does a much better job of reflecting the real variation in fuel costs.

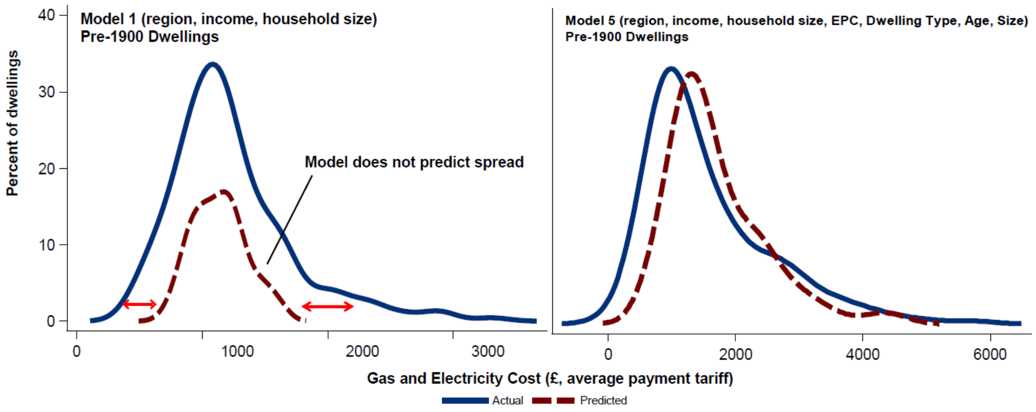


Figure 3 - Distribution in predicted and actual fuel costs using model 1 and model 5

The difference in using these models for an individual dwelling, as might be presented to a mortgage lender, is illustrated in Figure 4. The figure shows an example of the difference between the two models for estimating the energy costs of a 3-bedroom, semi-detached, dwelling in the North West region with differing age and EPC bands (i.e. a typical 'New Build' and 'Existing' dwelling) using Model 1 and Model 5. The difference in the predicted and actual fuel costs for Model 1 are considerable, particularly with the 'New Build' dwelling prediction which is 2.4 times greater. While these specific examples were picked to illustrate property types that, in general, are likely to show a relatively large difference in the models' predictions, it is important to note that the overall explanatory power of the model 5 is greater than model 1 (see Figure 2). The differences will be even more pronounced at extreme ends of the property spectrum, i.e. particularly efficient and inefficient homes.

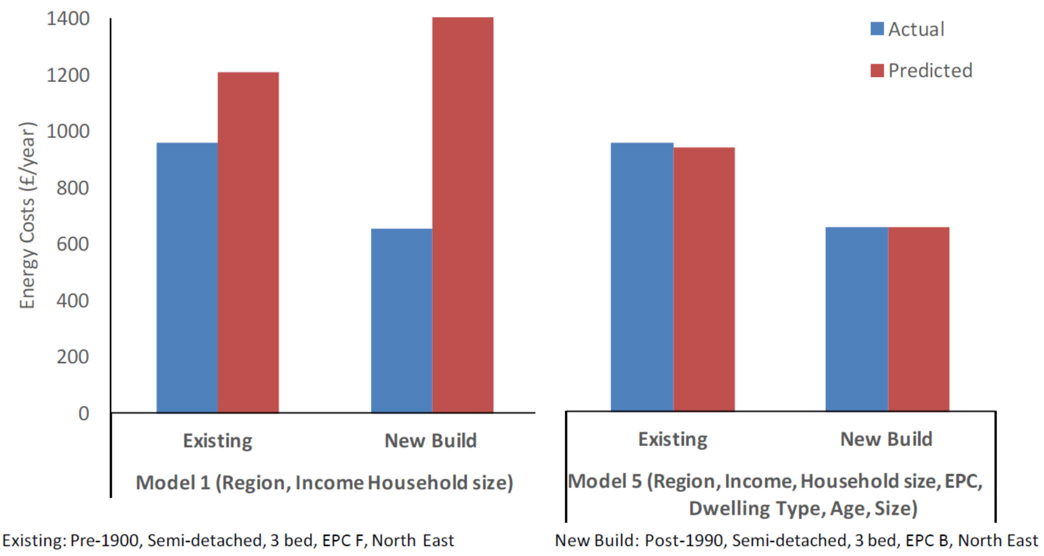
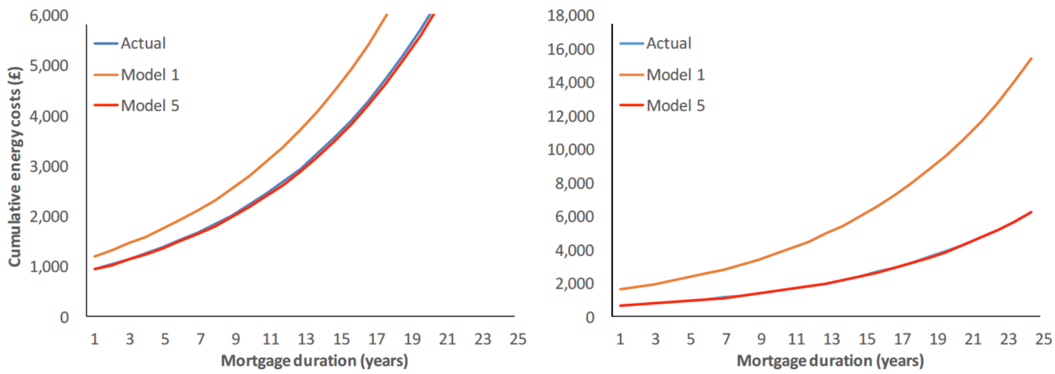


Figure 4 - Estimated fuel costs for a 3-bedroom, detached, pre-1900 dwelling in the North West region using two models.

The implications of this difference in estimated fuel costs when entered into a mortgage lenders calculator could have an important impact on risk associated with the amount lent. If the differences between the two models are compounded over the course of the 25 year mortgage and are adjusted for potential energy price increases, the value of the error becomes quite significant from a mortgage lender's risk management perspective. Using the examples described above of the 'New Build' and 'Existing' dwellings, the 'Existing' could have an annual estimated bills of £1200 (Model 1) or £940 (Model 5), compared to the mean actual bill of £960, see Figure 5. With an annual energy price increase of 5%, the total difference between Model 1 and the projected actual bill over the typical duration of a mortgage (25 years) is £11,455 (compared to only £955 for Model 5). This rises to £23,603 if the annual rate of energy price inflation were to increase to 10%.

The estimated annual bill for the 'New Build' using Model 1 is £1600 and Model 5 predicts £650, compared to the actual bill of £650. Under the same mortgage and energy price conditions outlined above, the cumulative difference between Model 1 and the projected actual bill is just over £45,000 using a 5% energy price rise. This rises to almost £95,000 if the annual energy price rise were 10%.



Existing: Pre-1900, Semi-detached, 3 bed, EPC F in North East   New Build: Post-1990, Semi-detached, 3 bed, EPC B, in North East

Figure 5 - Estimated cumulative fuel costs using two models

Conclusions

The analysis shows that significant improvements could be made to the way in which lenders account for energy costs in their mortgage calculations. Importantly, these improvements can be made by using a model that relies on data that they *should* already be gathering about the properties they are lending against, or which should be readily available to them or the borrowers themselves (such as the current EPC rating). The research shows that mortgage lenders could include more accurate estimates of energy costs in their lending assessments, which could reduce the risk of over- or under-lending by many thousands of pounds over the life of the mortgage.

At the more extreme ends of the scale, in properties that are highly inefficient or highly efficient, this could be substantially higher. And, aggregated across large mortgage portfolios, it could quickly run into many millions or even billions of pounds. If lenders could be persuaded to start using a more detailed model to calculate energy costs, they would therefore have an opportunity to significantly reduce risk in their lending. In the light of recent concerns around irresponsible mortgage lending, the relative ease with which this could be achieved could prove an attractive proposition for those seeking to tighten up their practices.

While the research shows that EPC ratings have a role to play in these calculations, it is also clear that they are not, alone, currently as good an indicator of likely energy costs as they could be. To some extent, this is a result of the shortcomings of the EPC methodology as they are only able to account for a limited amount of information of the dwelling's energy performance. However, limitations from their usefulness also come from the low value that is currently attached to EPCs, which in turn leads assessors and households to pay limited attention to their accuracy[8]. By including EPCs as part of a mortgage calculation model, however, this issue could be coincidentally addressed, i.e. they would assume significantly more importance and value in the transactions process, with a greater incentive for them to be done to a high standard.

If these changes could be set in motion, they could provide a significant motivator for retrofit in the UK. Up to now, the incentive provided by the financial savings that result from installing energy efficiency measures has proved to be insufficient to drive demand at a level commensurate with the UK's need to reduce energy demand and cut greenhouse gas emissions. This is most clearly demonstrated by the low take up of the Government's recently defunct Green Deal scheme. With a strong home improvement culture in the UK, the prospect of energy efficiency being seen as a way for household to add value to their properties would be a welcome one for the green building sector. Importantly, it would also provide a boost that would not rely on temporary grant and incentive schemes, or politically unpopular regulation.

Areas for future research, development and advocacy

Others, most notably the Buildings Research Establishment (BRE) and the Wales Low Zero Carbon Hub (WLZCH), have recently started to look into this issue, with similar results[9]. The BRE/WLZCH also concluded that energy efficient homes could and should attract more mortgage finance than their poorly performing peers. Their, and our, initial engagement with lenders suggests that they would be open to considering energy efficiency in affordability calculations.

As ever, though, achieving change is likely to depend not only on the strength of the evidence, but also on the willingness of the industry to move in unison, and their ability to do so with minimal disruption to borrowers. As such, an urgent challenge will be to engage with the industry *en masse*, to persuade them to make improved energy cost calculations normal rather than best practice. Given the benefits that higher rates of retrofit would bring to the UK, and the public ownership of some key lenders, Government may see value in encouraging this process. In doing so, they would also see one of their key energy efficiency tools, the EPC regime, improved without their needing to invest time and money.

To make this change as easy as possible, a helpful step would be to develop a calculation tool which could be used by any lender wishing to follow this route. This would not be a complicated task, but it would need to be analytically rigorous and regularly updated to reflect new evidence. We (UCL, UK-GBC and the BRE) will be working with a number of partners on an Innovate UK funded project to build on this report including the possible creation of such a tool, and to begin the advocacy process with Government and the financial community.

[8] DECC. 2014. Green Deal Assessment Mystery Shopping Research.

[9] http://www.cewales.org.uk/cew/wp-content/uploads/EPCs-Mortgages1.pdf

ABOUT THIS REPORT

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