LENDERS

Improving energy costs in mortgages
Promoting energy efficiency in homes

Core Report

July 2017

"This report and its findings are a timely and valuable contribution that could improve the robustness of mortgage affordability assessments based on household energy costs. This could allow energy efficiency to be better reflected in mortgage lending practices and has the potential to lead to new forms of energy efficiency finance. With their existing relationships with millions of customers, mortgage lenders are well placed to support energy efficiency improvements to the nation's homes. I look forward to seeing the industry's response to this report."

Claire Perry, Minister for Climate Change and Industry

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Online Household Fuel Bill Estimator:
A free, working example LENDERS estimator tool can be found at **www.EPCmortgage.org.uk**

Executive Summary

LENDERS Project

Privately owned residential properties represent approximately 15% of the UK's overall carbon emissions, but the 14.9 million privately owned homes are also one of the most difficult built environment sectors in which to implement energy efficiency improvements.

With approximately £127bn of mortgage lending each year, the mortgage process presents a potential opportunity for influencing homebuyers' views on energy performance and encouraging property energy improvements. At present though, lender calculations, used to determine how much mortgage customers can repay, take no account of how their fuel bills vary with the property's energy efficiency.

The LENDERS project was set up to analytically examine the link between property energy efficiency and fuel bills, and ways in which this link could enable homes with better energy performance to be able to demonstrate lower fuel costs in a way that can be passed on as a tangible benefit to homebuyers.

Through use of comparatively large data sets, the project has been able to map the relationship between property energy performance and household fuel bills. It has created a working calculator through which homebuyers can access, with the provision of limited property and household information, estimates of their likely bills before they have purchased the home.

Based on larger data sets than those underpinning the existing calculators, the project has demonstrated it is possible for mortgage lenders to utilise better energy performance estimation to demonstrate within their lending decisions that funds not committed to fuel costs in low energy homes can support higher maximum mortgage lending amounts.

Fuel Bills & Mortgage Affordability

Currently, 90% of mortgage lenders use cost data taken from the Office of National Statistics "Family Spending Report" (ONS FSR), which includes fuel bill data from 4,900 UK households, to inform their affordability calculators. Typically, mortgage providers adjust the ONS FSR data with their own occupancy, income and other profiles to estimate overall household expenditure; by doing this the process does estimate every individual cost element such as fuel but is only intended to be considered in aggregate. Whilst ONS base data gives a fuel bill range of £65 per month for the lowest 10% of household incomes up to £146 per month for the highest 10%, after adjustment fuel can account for a decreasing percentage of total expenditure as household income and actual costs increase.

Whilst it has not been possible to comprehensively map mortgage lenders' current affordability calculations for commercial reasons, the LENDERS project has demonstrated a significant variance between the implied fuel costs and the evidence available for actual fuel bills. Furthermore, LENDERS research shows that no known affordability calculation takes direct or indirect account of the energy efficiency.

Key Findings

Having identified the issue, the project investigated whether these more accurate predictions of future fuel bills could be utilised at different points in the mortgage process, and whether it is appropriate to apply the more accurate LENDERS assumptions on fuel expenditure to affordability calculators.

The findings suggest that there are likely to be opportunities for mortgage lenders to improve the accuracy of the data that they use when assessing affordability to more closely reflect the actual energy performance of a home and its occupants. This could then be used to inform and encourage homebuyers

Existing Housing Stock in the UK

of the benefits of owning an energy efficient property by highlighting the potential savings on their fuel bills and the impact the increase in disposal income could have on their borrowing capacity. The project has found that the monthly savings from fuel bills in a higher rated home (equivalent to two EPC bands), could equate to around £4,000 in additional mortgage finance.

The project acknowledges any process to incorporate these changes is not straight-forward: There is not a one size fits all solution (due to the range and complexity of lenders' systems), and the disparity between different lender's assumptions of overall expenditure costs mean homebuyers would currently see more variation in maximum offer here than resulting from energy performance. The project also recognises only a minority of homebuyers borrow to near their maximum affordability; it is these customers that could benefit from increases in disposable income through lower energy bills which could then be allocated to higher mortgage payments.

However, the project has believes that the benefit of inclusion at the right point in the mortgage process may have a behavioural impact beyond the direct financial benefit, influencing homebuyers' perception of value implied through higher borrowing limits. To this end, whilst changes to financial structures are rarely quick, more immediate and simpler changes can be implemented off the back of the Project's findings: A fuel bill calculator has been developed and made freely available to homebuyers, lenders and related parties for use as advice alongside the mortgage sales process, acting as a 'nudge' to consumers.

In the long term, we believe that the projects findings will act as a catalyst for the incorporation of energy performance linked fuel costs being a factor in lender affordability calculations.

The largest survey of data regarding the existing housing stock comes from the National Census data, this determined that in 2011 English and Welsh homes comprised 23.36 million dwellings, of which the vast majority were owned either outright (30.8%) or with a mortgage (32.7%). Smaller but similar proportions were then found for dwellings rented from social landlords and private landlords (17.6% and 16.7% respectively). The NEED[1] dataset gives picture of dwellings by EPC[2] band and reveals that the housing stock is largely made up of dwellings that pre-date modern energy efficiency regulations. This dataset combines EPC "A" and "B" rated dwellings, the most energy efficient, and shows they only account for 4% of homes. By far the largest categories are the next bands, C and D encompassing 71% of the total. The large percentage found here represent post war properties with existing refurbishments and energy efficiency measures applied such as more modern heating systems[3]. Fewer properties are in the remaining, least energy efficient bands, 19% at E and 5% at F, with just 1% in Band G.

Government statistics show that the existing stock is growing, with 152,000 homes completed in the UK as a whole in 2014/15. Of these homes by far the largest percentage have been built for the private sector (77%) with Housing Associations (21%) and Local Authorities (2%) completions some way behind this. If the UK were solely reliant on new homes to replace older stock, absolute replacement of all dwellings would take almost 160 years[5]. It can be seen therefore that approaches which tackle the majority of existing housing stock i.e. the 31% of homes owned outright (and thus available to return to the market) and the further 33% of dwellings owned with a mortgage, are an important priority.

The Census data[6] shows that 17% of English and Welsh homes are privately rented, with a lower proportion at 11% in Scotland. From an energy perspective, these properties split the benefits of energy savings from the capital costs of energy performance enhancements between tenant and landlord respectively. They become subject to the MEES[7] from April 2018 meaning properties with an EPC below "E" cannot be let or re-let (with notable exceptions).

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1   NEED: the National Energy Efficiency Database, comprising approximately 4 million homes.
2   Energy Performance Certificate
3   e.g. Condensing Boilers
4   https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building - accessed 29/7/16

5   140-150k of 23.4 million in England & Wales = under 0.6% of new homes/year without population growth.
6   2011 Census Snapshot: Housing: ONS
7   MEES: Minimum Energy Efficiency Standard, introduced through the Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015

Existing Mortgage Lending in the UK

EPC Band variation in DECC "NEED" Database of 4 million Homes

EPC Bands / Number of homes

🟩	**A or B**	150,742	🟧	**E**	795,884
🟩	**C**	1,166,080	🟥	**F**	203,805
🟨	**D**	1,721,652	🟥	**G**	48,279

Whilst a different ownership is therefore present for privately rented homes, a significant proportion of these are held with Buy-to-Let mortgages. MEES could therefore be anticipated to generate a demand for access to finance to undertake energy performance enhancements in the future.

Overall, whether rented or otherwise, approximately 81% of homes are in private ownership and are therefore available or already used as security for a mortgage, remortgage or mortgage further advance.

Overview

The UK mortgage market is the largest in Europe, with numerous lenders of various sizes and business models. In 2016, a combined total of £233.7bn was lent to first time buyers, home movers, those remortgaging and buy-to-let landlords[8]. It is not a single market as such, as it serves a diverse set of customers and transaction types including first time buyers, new homes, self & custom build, affordable housing, lending to older borrowers and buy-to-let. It is governed by a complex range of sometimes overlapping regulation and legislation which creates a complex and sometimes dynamic market.

Since 2007-8, changes in regulation and risk appetite have stabilised the mortgage market. Access to finance in this low rate environment is often limited by the prudent regulatory buffers in the affordability calculation. Lender, consumer and regulatory confidence have all since slowly returned to the market since the credit crunch.
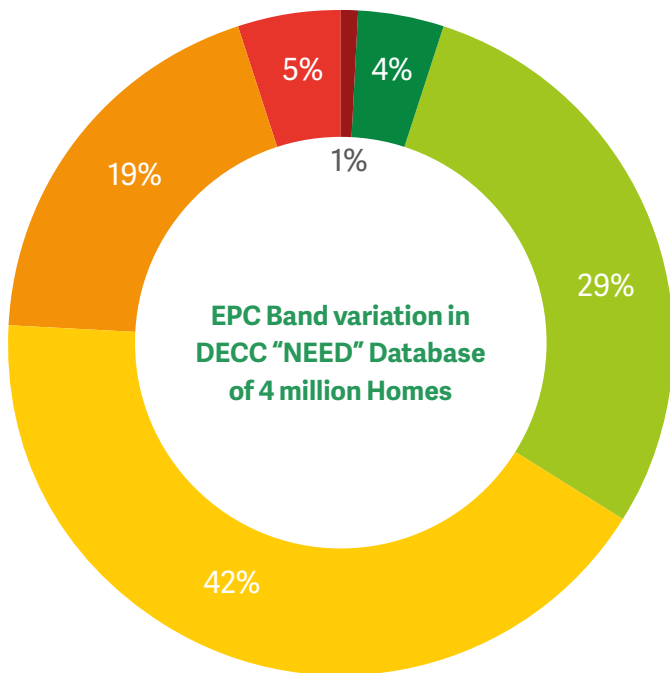
The mortgage market also stands on the edge of potential major change from the increasing use of emerging technologies such as open banking, open sources of data and Artificial Intelligence. These may result in new funding sources such as peer-to-peer lending on a debt or equity basis.

Current Financial Requirements/Framework

Since the Financial Services Act 2012[9], UK financial regulation has been the responsibility of three main bodies. Firstly, the Financial Policy Committee (FPC), part of the Bank of England, is responsible for macro-prudential regulation and aims to prevent the build-up of systemic risks across the financial system as well as enhancing macroeconomic stability. Secondly, the Prudential Regulatory Authority (PRA) is responsible for micro-prudential regulation and has the main aims of tackling any vulnerabilities in an individual financial services organisation whilst limiting the impact and systemic consequences of the failure of any financial services organisation. Finally, the Financial Conduct Authority (FCA) is responsible for the functioning of markets by protecting consumers, protecting financial markets and promoting competition. The regulation of individual mortgage loans, including underwriting and affordability processes, sits with the FCA.

8   https://www.cml.org.uk/news/press-releases/december-2016-monthly-lending-trends-press-release/
9   http://www.legislation.gov.uk/ukpga/2012/21/contents/enacted

Statutory regulation of the market came into effect in November 2004 in the form of the Mortgage Conduct of Business (MCOB) rules. MCOB rules are crucial in that they govern the relationship between mortgage lenders and borrowers. They were primarily designed to increase transparency in the market and allow customers to make more informed choices. The rules were overhauled significantly in 2014 because of the FCA's Mortgage Market Review (MMR), and again in 2016 as a result of the European Union's Mortgage Credit Directive.

MMR was introduced in April 2014 and was the largest set of reforms to mortgage regulation since the introduction of statutory regulation in 2004. The reforms resulted in fundamental changes to the market, including a ban of self-certification loans, and tighter controls around interest-only lending. Most relevantly to this project, and to the majority of homebuyers going through the journey to obtain a mortgage, MMR fundamentally controlled and changed the way that mortgage affordability needed to be calculated, taking into account household expenditure

Existing Homebuyers' Mortgage Journey

To aid later sections, it is worth drawing out at which points a homebuyer will come into contact with mortgage affordability, typically in the form of a mortgage affordability calculation or calculator. The first encounter is likely to be when a homebuyer uses a very basic affordability calculator to give them a rough idea of how much they can borrow: Most major lenders offer an online calculator for this purpose. This is unlikely to be the final amount as it's based on some simple assumptions. At this stage the homebuyer is unlikely to know what kind of property they will buy and it may well be used at the very outset to understand whether the homebuyer can afford to buy a home at all.

The next time an affordability calculator becomes relevant is typically during the home search process itself. Here, the homebuyer's goal normally is to achieve more certainty over the amount they can borrow than can be offered with online, self-assessment calculator tools. A more detailed assessment will take place and normally includes checking a customer's credit history, which may be undertaken by the mortgage

lender themselves or via a broker. The mortgage industry has a number of terms for this step in the mortgage journey, but for consistency in this report we refer to this stage as the "Decision in Principle". The Decision in Principle is often the first non-generic guidance on how much can be borrowed, and in some circumstances is used by homebuyers as a demonstration to venders that they can secure a mortgage of an appropriate value.

The final key interaction with an affordability calculator occurs once the homebuyer has found their preferred property and is ready to apply for a mortgage product. The lender will complete a far more detailed check where they will look to understand and evidence the homebuyers financial position in detail. This will include a detailed assessment of income and expenditure and, in contrast to the relatively brief checks noted above, can take two or more hours to produce a detailed lending picture. This final step comprises the formal "Full Mortgage Application", forming a binding offer based on the information provided, and likely to be conditional on other factors such as suitable mortgage condition surveys being undertaken (if not already included).

Existing Mortgage Affordability Calculation

As highlighted above, a mortgage lender is obliged to take steps to ensure that the homebuyer is reasonably able to meet their mortgage payments, both at the time of taking out their mortgage and throughout the mortgage term. When a lender assesses how much a potential homebuyer can borrow, they need to understand how much money a customer has coming in, what money they pay out, and how they could cope with future changes in circumstances. Lenders use an affordability calculator to do this.

The start point for the affordability calculation is the net monthly household income. For many individuals this will be the amount they receive into their bank account each month after allowing for income tax, national insurance and pension deductions, for families this will be an aggregation of incomes, and for self-employed or others more detailed reviews of financial accounts are often necessary. Once complete, this establishes the net income.

The affordability calculation then turns to deductions from this net income. It recognises any committed expenditure, such as outstanding loans and child maintenance that is already in place when applying for a mortgage; basic essential expenditure, for example utilities and essential travel; and quality of living costs.
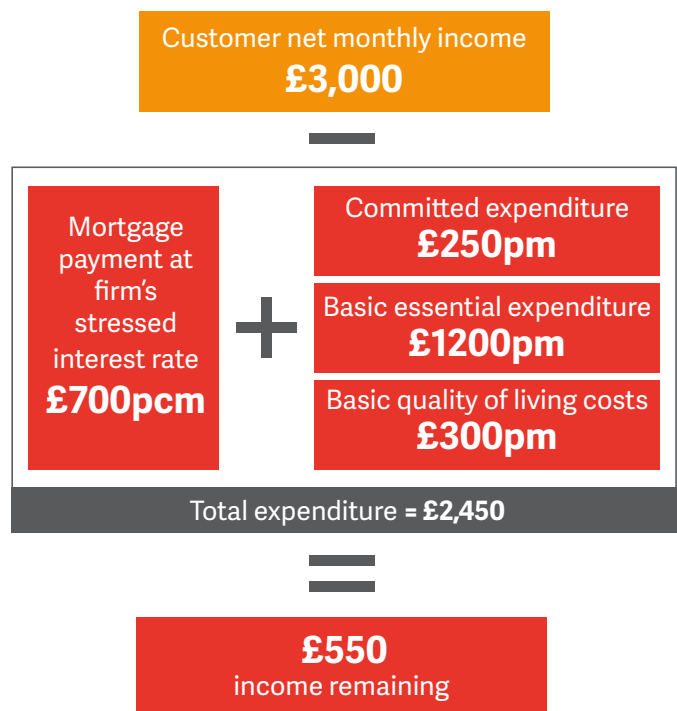
For basic essential expenditure and basic quality of living costs, there are two acceptable approaches under the MCOB regulations. Lenders may either obtain actual data from customers or they may model data appropriately depending on the household composition and realistic assumptions on their level of expenditure[10]. The FCA found that the majority of large lenders use modelled household expenditure figures, occasionally using data available to the lender (such as current account data)[11]. Smaller lenders might typically use an application form to obtain expenditure, augmenting or adjusting this with modelled data if the homebuyer's information appears unexpected – most commonly if the homebuyer has optimistically entered lower costs than might be anticipated.

A mortgage is considered affordable if a customer has sufficient income to meet their committed expenditure, basic essential expenditure and basic quality of living costs in addition to making their mortgage payments allowing for potential future rises in interest rates. A customer borrowing to the maximum amount will therefore have no remaining income according to their affordability calculation. However, in practice even those customers who do borrow the maximum amount are likely to have some discretionary spending capacity due to the prudent assumptions in the affordability calculation. Furthermore, the affordability calculation is based on an average quality of living assumption that can be perceived as a reasonable or "normal" average, which each individual's perceptions of quality of living will be likely to deviate above or below to a degree (i.e. one person's essential holiday is another's luxury break).

Under the current affordability calculation, energy costs are incorporated into the overall basic essential expenditure either through the modelled data or, typically for smaller lenders, through direct customer input. However, the challenge to mortgage lenders is that the energy costs used in the calculation do not reflect the energy efficiency of the property that is being purchased, and at best (if accurately provided by the customer), reflect the fuel costs of that homebuyer in the property that they currently live in, rather than the one that they are intending to buy. Whilst actual fuel bills

could therefore be inputted into affordability calculations for remortgages or mortgage extensions where no physical changes to the property are being planned, in instances where moving home or home energy improvement works are planned, past fuel bills may well not represent future fuel bills.

Currently, 90% of lenders[12] typically model energy expenditure in the affordability calculation based on fuel data from the Office of National Statistics' "Family Spending in the UK" (ONS FSR)[13]. Electricity, gas and other fuel sits in item 4 on the ONS FSR and comprise roughly 4.4% of the total expenditure. It is therefore one of the larger components, along with food, personal transport and mortgage payments. As such, should lenders choose to make only one element of their affordability calculator more sophisticated, electricity, gas and other fuels would be a prime choice as it is one of the largest elements of modelled expenditure and therefore may make a not insignificant impact to the results of the affordability calculator overall.

Customer net monthly income
£3,000

Mortgage payment at firm's stressed interest rate **£700pcm**	**+**	Committed expenditure **£250pm**
		Basic essential expenditure **£1200pm**
		Basic quality of living costs **£300pm**

Total expenditure **= £2,450**

£550
income remaining

Customer's income is **£550** more than total expenditure. Mortgage is deemed ffordable.

Source: FCA TR16/4 Embedding the Mortgage Market Review: Responsible Lending Review

10 MCOB, 11.6.12 R (3) https://www.handbook.fca.org.uk/handbook/MCOB/11.pdf
11 https://www.fca.org.uk/publication/thematic-reviews/tr16-04.pdf

12 Results from our own survey of lenders elsewhere in this report
13 Released annually, now online, most recent at time of publication: https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/bulletins/familyspendingintheuk/financialyearendingmarch2016

Existing Affordability Calculation Analysis

The fuel estimation for the vast majority of existing affordability calculations undertaken in the UK can therefore be expressed in two steps – the first step being the 'raw' data taken from the ONS FSR, with the second being the individual lenders' affordability calculations based on this (and other) data about expenditure.

The ONS FSR shows that, as can be expected, households in higher income quartiles spend a lower percentage of their total outgoings on fuel as there is a natural limitation to dwelling sizes and comfort levels that limit its purchasing requirement. There is also a clear indication that the percentage of total outgoings spent on fuel raises significantly when children are in the home – from 17% down to 8-11% over the 4 income bands used. This compares to 9% falling to 6% of household outgoings for a household without children over the same income bands (£20-65k). Furthermore, whilst averaged across all demographic types, the ONS FSR suggests that an annual fuel expenditure of approximately £900 rising to £1200 would be typical of a UK household as income rises incrementally. This increase in absolute expenditure occurs as the relative percentage of total outgoings that is fuel bills falls with added household income.

A comparison of the fuel costs reported from the smaller ONS FSR dataset[14] against the 4 million properties contained within the NEED dataset is not directly possible in that the FSR collates fuel expenditure and NEED fuel consumption data. However, when the standard Ofgem comparison tariff is applied to the mean of all on gas properties in NEED an annual bill of £1,150 is created. The FSR creates a band of annual fuel costs related to demographic and income types, however the mean of all central income groups and demographic types creates an annual cost for gas and electricity of £1,006 per annum. These results suggests that, whilst not perfectly aligned, the ONS FSR costs do approximate those suggested from NEED, albeit divided against differing factors. The use of ONS FSR places significant reliance on a small data sample, and on one not specifically undertaken for mortgage affordability, but given the historically limited availability of data to mortgage lenders, its use as 'raw' data for affordability calculations is not unreasonable.

The second step within the affordability calculations undertaken by lenders is the modelling of the homebuyers' expenditure using the 'raw' data available to comply with MCOB rules. The approach to these calculations is unique to each lender and commercially sensitive, therefore cannot be publicly reported for individual lenders. However, work undertaken by the project including through the survey of CML[15] members has identified that the common approach to affordability calculations comprises the importing of ONS FSR expenditure data from multiple categories (including item 4's "Electricity, gas and other fuel costs") to produce an aggregated expenditure cost across all those categories. This combined figure is then used in individual lenders affordability calculators and adjusted by factors that include (depending on the individual lender) total household occupancy, number of dependents, income decile, geographic region, working/retirement status, and more.

To disaggregate the annual fuel costs element from this multi-variable total is therefore difficult and cannot necessarily be replicated for all lending institutions, furthermore it is unlikely to have ever been intended to be disaggregated to predict fuel costs specifically, but rather functions as an expenditure calculation 'in the round'.

The fuel cost is therefore modified by the majority of lenders as an integral part of their affordability calculation, and consequently is subject to the variations in these overall modelling approaches identified by the FCA's EMMR[16] report, which revealed a 36% difference (on average) in total outgoings predicted between lenders using the same customer data, where two sample lending companies' calculations could be compared both against one another and given the same input information across four household income ranges (£20k-65k p.a.). This research is not seeking to question this overall variation across the total outgoings predicted, though it does acknowledge such a difference between lenders may

14 ONS FSR 2015/16 comprised 11,484 surveys with 4,760 fully cooperating households
15 Council of Mortgage Lenders
16 FCA "Embedding the Mortgage Market Review: Responsible Lending Review", May 2016

Existing "Energy Performance" Mortgages

influence the capacity for more accurately forecast home energy performance to be clearly perceived by the homebuyer. Instead, this work seeks to understand whether the existing fuel cost element of the total expenditure is achieving the accuracy that could be possible through the current methodology.

This research has investigated the outputs of affordability calculations set against known fuel cost data, and has additionally undertaken a direct householder survey to supplement this analysis. Specific comparisons of affordability calculation outputs show, for example, that the proportion of fuel costs for the same home can range from 17% of total outgoings for a sole applicant earning £30k yet may be just 11% of outgoings for a family of two earning £50k. Analysis across a range of combinations of household incomes and occupancy demonstrated significant variations between different lender's predicted outgoing costs when these were provided but more pertinently that the implicit fuel costs within these predicted outgoing costs differed to the evidence for actual fuel costs for comparable homes and occupancies.

As part of the project, we undertook research to understand what evidence of energy performance is already being considered in existing mortgage products. All Council of Mortgage Lenders members' websites who provided residential mortgage products were visited to identify affordability calculators and the presence of energy in the assessment methods was examined. Relevant information was collected pertaining to whether the provider had an online calculator and if so whether it included energy or energy-related expenditures and what method did it use. This calculator review found that:

- No mortgage lenders online affordability calculators requested information on the prospective dwellings energy performance;
- Numerous lenders (mostly building societies) included utilities as a key outgoing expenditure and this was sometimes broken down further to fuel type;

It should be noted that the search did include lenders who offered 'green' or 'ecological' mortgages where these appeared within the criteria defined. Whilst a number of mortgage products are offered that have relevance to energy, these commonly vary commercial factors (such as interest rates, deposit, etc.), or restrict entry requirements based on specific criteria (such as types of building certification, construction materials, etc.).

At the time of the study, no lenders provided a detailed methodology or even advice to affordability calculator users on how to estimate their fuel expenditure, nor did any lenders apparently use this to vary their expenditure estimates and consequentially the potential maximum borrowing amount. Based on this, there appears to be considerable scope to include fuel expenditure and energy performance in affordability calculators and the associated guidance to homebuyers.

Energy in Mortgages - Customer Research

In recognition of the realities of the mortgage market, the project undertook customer research on the idea of 'green' mortgages and 'green' loans in order to understand the potential of homebuyers taking up this type of mortgage product, and to understand the potential positive and negative perceptions homebuyers may have. Three surveys were undertaken, with those by Nationwide and Principality's having an additional objective of assessing whether such a product would fit with their brand.

The survey asked questions about contextual information such as the respondent's current mortgage situation, some open-ended questions to allow for thematic analysis, and Likert scale responses where respondents rated how much they agreed with certain statements relating to the product concept. The concept of the potential 'green' product linking a property's energy performance to the maximum loan amount through the affordability calculation was explained to participants during the survey after contextual information was given.

The table below shows the combined results across all three surveys for a question which sought to explore the appeal of a 'green mortgage' to homebuyers. The EST survey documented 58.3% of respondents finding the idea "very appealing" which is higher than the total aggregated positive appeal from Principality (50%) and Nationwide (54%). Both Principality and Nationwide surveys recorded similar levels of negative appeal with 20% of Nationwide respondents finding the idea unappealing to some extent, 12% and 11% of Principality respondents found the idea "quite unappealing" and "very unappealing" respectively.

How appealing do respondents find the 'green' mortgage idea?

Category	EST (n=95)	Principality (n=109)	Nationwide (n=475)
Very appealing	58.3%	16%	54%
Quite appealing	18.8%	34%	
Neither / Nor	11.5%	30%	26%
Quite unappealing	5.2%	12%	20%
Very unappealing	5.2%	11%	

The survey also explored the idea of 'green' secured loan for home improvements, building on the concept that the same revision to the affordability calculation's fuel estimation would enable energy performance improvements to be repaid (at least in part) from the fuel savings they generate. The EST results documented 47.9% of respondents to be very likely to purchase a 'green' loan compared to 23% of Principality respondents. The proportion of respondents "quite likely" to be a part of a 'green' loan scheme was comparable with 33% from EST and 35% from Principality surveys. Overall 58% of Nationwide respondents were likely to some extent to take part in a 'green' loan scheme.

How likely would 'green' loan uptake be?

Category	EST (n=95)	Principality (n=109)	Nationwide (n=475)
Very likely	47.9%	23%	58%
Quite likely	33.3%	35%	
Neither / Nor	13.5%	28%	27%
Quite unlikely	3.1%	11%	15%
Very unlikely	2.1%	4%	

Energy in Mortgages – Customer Journey Intervention Points

Across the respondents of all three organisations a majority of more than 50% expressed that they find the product concept appealing to them to some extent; this suggests that the concept is appealing to homebuyers. There is also a notable variation between the mortgage situations of respondents, with those planning to take out a mortgage soon, or who have done so recently, more inclined to find the idea of a 'green' mortgage appealing. This finding suggests that a 'green' mortgage product may be more attractive to those going through a change in mortgage situation.

Thematic analysis showed that there was concern about the complicated nature of the scheme and various dependencies it would be based upon. The largest reason given affecting uptake was interest rates, which suggests that reasons for taking up the loan would come down to financial conditions. It is also notable that although most respondents saw the 'green' mortgage method to be a responsible way of providing mortgages, fewer respondents across all surveys agreed that the method was fair. This may be due to concern about limitations raised in other open text answers such as if those buying old houses or less energy efficient houses would be prohibited from taking up this product: It was not possible within the scope of the surveys to clearly set out the potential for additional borrowing potential being released through the same affordability calculator changes based on property energy performance enhancement works, which the project feels may allay this concern.

To change the behaviour of homebuyers to better reflect energy performance during the mortgage journey requires an understanding of what is or can reasonably be known at each step, and what might be influenced as a result. If the impact of fuel costs is to influence the choice of home, the key intervention point must occur before the final home is known, therefore before any EPC or survey data is available for use in the forecast: Intervention here allows the variation in maximum mortgage lending amount that results from better forecasting fuel costs to become a factor in the search without expecting it to replace traditional search priorities such as location and number of bedrooms.

The project identified the following potential indicators that can in most instances be expected to be known as part of the homebuyers 'search criteria'; this means these potential indicators are known at the right point in the process, not necessarily proving at this point that they are useful in the forecasting of energy bills. The indicators comprise:

- Region,
- Income,
- Number of Residents,
- Number of Bedrooms,
- Built Form (solely as "House" or "Flat"),
- Age (solely as "New" or "Period")

A secondary intervention point after the preferred property has been identified was also included in the analysis, which also has relevance for remortgages and similar instances where the property is already known. Here, potential indicators are available in abundance since the specifics of the property are available, including the EPC. However, it is recognised that after the home has been found, this intervention point only enables better accuracy of the Affordability Calculation (itself a good outcome), but would only influence future homebuyers behaviour rather than the selection of home in that instance – it would be very unlikely to change homebuyers minds. For this reason, this intervention point was considered secondary.

Energy in Mortgages – Potential Indicators

With a knowledge of the potential indicators that a homebuyer may know before selecting their preferred home, as well as those available once the property is identified, the project looked to understand whether other potential indicators could be useful in forecasting domestic energy consumption. Building indicators are commonly seen as being easier to assess and more temporally stable, and potentially cheaper to measure than attitudes and behaviours. However, if non-building factors played a significant role as well in understanding domestic energy consumption, the project was keen to investigate whether there were ways that these could be incorporated.

Previous research has shown that building indicators alone can explain at least 40% of the variability in energy use: A large number of studies have looked at the impact of building variables[17] and they have been found to explain between 42 and 54% of the variability in energy use[18]. Building size was one of the strongest indicator[19] and dwelling type is likewise an important indicator[20]. Without providing a combined score for the total predictive power of building factors, it has been found that those were more important than occupant characteristics in explaining space heating demand[21]. Location of the building is another highly important indicator[22], because of local differences in climate and building characteristics. Generally, indicators that could not be easily changed through energy-efficiency interventions, such as floor area[23], dwelling type[24] and climate[25] were most important in predicting energy demand. The role of dwelling age has been shown to have a linear negative relationship with energy consumption in some studies[26] but not all[27].

A recent paper has shown that total energy consumption (most of which will end up as heat in the building) in English households is largely explained by dwelling characteristics[28], with a comparatively small contribution of socio-demographics, self-reported behaviours, and attitudes towards environmentally significant behaviour and climate change. For electricity consumption without space and water heating

it is expected that appliances ownership and use and socio-demographics would have a bigger impact[29].

In terms of fuel expenditure, the cost of energy and its affordability will be influenced by the amount of energy used, which is a function of the above dwelling, household and societal factors, but also the price of energy. For the most part, energy use, whether measured as cost, fuel or energy, are very similar outcomes for identifying drivers. This research primarily focuses on energy demand, which is well studied as it relates to energy performance in dwellings.

The key conclusion is the dominance of building variables in explaining domestic energy consumption over socio-demographic, self-reported heating behaviour, and attitudes and values. This holds true both when looking at the overall explanatory power of models with indicators from different classes of variables, and when looking at the incremental explanatory power when adding more variables to building stock models. Hence, whilst people use energy, it is indeed buildings that determine to a much larger extent the amount of energy used.

The review also concluded that there are limits in how much of the variability in domestic energy consumption (e.g. fuel bills) that can currently be explained with existing data. However, the review finds that existing building factors explain 40% of the variability, this does not mean that the remaining 60% is down to people.

Combined with considerations around the unpredictability of behavioural indicators over a 25 year period, and potential for optimistic reporting by homebuyers, the project concluded that at this point focusing on building indicators was appropriate. However, increases in available data for both buildings and (independently verifiable) socio-demographic indicators can and should be encouraged to assist in further helping to predict fuel expenditure and to support creating new methods to estimate demand in future.

17 For an excellent summary and overview, see Guerra Santin, Itard, & Visscher; 2009
18 Guerra Santin et al., 2009; Sonderegger, 1978
19 Kelly, 2001; Theodoridou et al., 2011, Santin et al., 2009
20 e.g. Guerra Santin et al., 2009
21 Steemers and Young Yu, 2009
22 Steemers & Young Yun, 2009

23 e.g. Theodoridou et al., 2011, Guerra Santin et al., 2009; Yohanis et al., 2008
24 Santin et al., 2009; Yohanis et al., 2008
25 Steemers & Young, 2009
26 e.g. Guerra Santin et al.
27 Theodoridou et al., 2011
28 Huebner, Hamilton, Chalabi et al., 2015
29 Brounen, Kok, & Quigly, 2012

13

Energy in Mortgages and Property Value

Energy in Mortgages – Collation of Research Data

This project does not aim to demonstrate a link between property valuations and energy performance, nor to the related sales values or speed of property sales. Other research is investigating and trying to guide these areas[30]. The goal of the LENDERS project is to provide a more accurate means of forecasting a homebuyers' future fuel costs, though the intent is this will have influence (see "Opportunities" chapter). However, it was appropriate for our work to include an understanding of the current effect of energy performance on property value since this would impact homebuyers' and mortgage lenders. The project's review found:

- There is an impact of energy performance on dwelling purchasing, but that the impact on prices is moderate and positive though the precise mechanism affecting prices is unclear due to limitations of the data;
- There is moderate to weak relationship between energy performance ratings and actual energy demand of dwelling, but this relationship is complicated by the models and data used;
- Households are not solely motivated by energy savings and therefore energy performance and energy efficiency may in themselves may not be a strong motivator when purchasing, instead ancillary benefits such as warmth and comfort, aesthetics and consumer competition could be of greater value;
- However, there is evidence that if mortgage lenders were to use energy performance data in mortgage calculations that risk levels could be reduced and building values better reflected.

Many UK lenders do consider fuel costs, but only as it relates to how much energy the customers might use as a basic measure and not the energy performance of the building. Lenders could include more detailed energy costs estimates that reflect energy performance of the dwelling alongside other major household expenses when assessing customer affordability.

The project invested very considerable time endeavouring to source datasets to use as the basis for the research, and gratefully received help from a number of parties most notably NPower, Elmhurst Energy and BEIS[31].

The intended project aspiration was to combine multiple very large (1 million+) datasets using addresses as the match in order to create one large dataset (c.200,000-400,000). This would have had recent data on occupancy, EPC and actual recorded fuel costs covering both gas and electricity for individual specific properties, though through anonymisation the addresses would have been redacted. Unfortunately, agreements were achieved to source all but one of the required datasets, but the nature of the challenge meant the failure to achieve all sources equated to failure to build the usable large dataset.

However, the project pursued acquiring medium-sized datasets in parallel, with one source being Green Deal Assessments that have been undertaken in significant number in the UK. Under this approach, and with a suitable Data Protection Agreement, Elmhurst Energy sold the project a dataset of 40,000 appropriate properties (referred to in the project as the 'medium' dataset), which provided the project with a dataset of sufficient scale to undertake the analysis, not least as it is more than eight times the size of the dataset the current energy costs are drawn from.

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30 See http://revalue-project.eu/ and http://renovalue.eu/ amongst other ongoing work

31 "BEIS": Department for Business, Energy & Industrial Strategy

Energy in Mortgages - Predicting Fuel Costs at the 'Decision in Principle' Stage

Using this sample of approximately 40,000 individual property level records, we investigated which of the available indictors that could reasonably be expected to be known at the 'Decision in Principle' stage provided the best forecast of the future fuel costs for each home. From this, the project has developed a model that predicts a property's annual fuel bill based on;

- the number of residents in the home
- the dwelling type (simplified to the number of bedrooms and a choice of 'house' or 'flat')
- the EPC band of the property

The resultant forecasting model has an adjusted R^2 value[32] of 0.586 and predicts 60% of fuel bills accurately within a confidence band of +/- 15%.

Whilst the level of accuracy of any prediction could always be sought to be improved, and as highlighted earlier additional data available at the right stage may assist with this in future, it is important to understand that this prediction should be compared to the existing affordability calculation methodology. This existing methodology does not use dwelling type or EPC band as indicators, and uses number of residents to adjust the aggregated household expenditure 'in the round', rather than individually for energy costs. Individual lenders affordability calculations vary the base ONS FSR figures, but to provide a guide to their likely accuracy the project looked at our dataset to understand the likely accuracy of any fuel forecast based solely on the number of residents' indicator. This produced a model has an adjusted R^2 value of 0.15, which predicts just 38% of fuel bills accurately within a confidence band of +/- 15%.

As a result, the project has demonstrated that the use of the EPC band together with simplified dwelling type (solely differentiating 'house' or 'flat' and by number of bedrooms), provides an improvement in the forecasting of homebuyers' fuel bills based on indicators that should be known at the Decision in Principle stage of the mortgage journey.

32 The R^2 value is a statistical measure which indicates how close a model's predicted values are to the data points from an observed sample. An R^2 value near 0 indicates a poor fit and lack of correlation while an R^2 value near 1 indicates a high fit and strong correlation. In empirical research, an R^2 value of 0.6 is often used as a benchmark to determine if a model is fitting the data reasonably well.
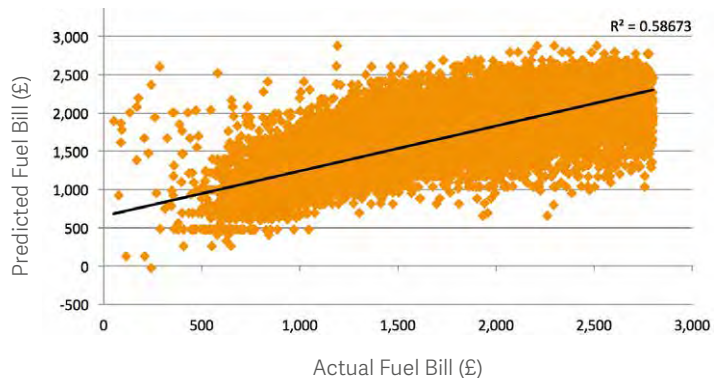
Number of Residents vs. Fuel Bill
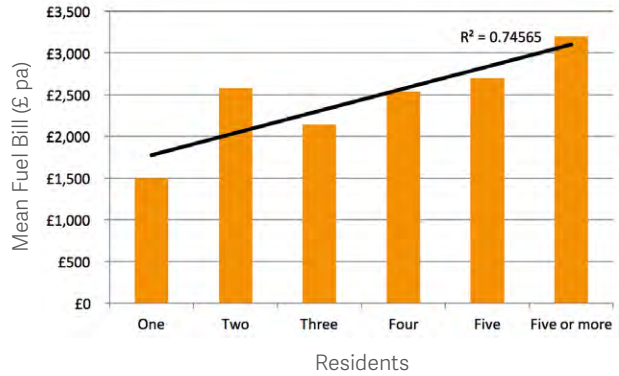
EPC Band vs. Fuel Bill
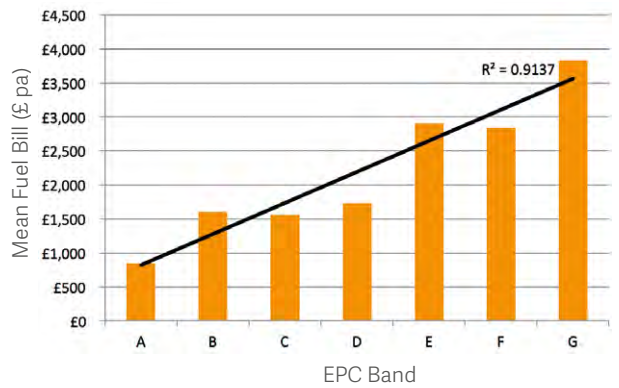
'Decision in Principle' stage model: Predictions vs. actual fuel bill

Energy in Mortgages – Predicting Fuel Costs at the 'Full Mortgage Application' Stage

Using the Elmhurst sample data, we also investigated what improvements to the accuracy may be possible once the homebuyer's preferred property is identified, and therefore when the information from the Energy Performance Certificate is available. Their availability to prospective homebuyers and lending associations before a mortgage is granted helps ensure that more detailed cost data can be accounted for prior to the 'Full Mortgage Application'. Our analysis showed that the 'Full Mortgage Application' stage model can be improved by adding additional indicators that are available at this later stage, the most important indicators comprising;

- the number of residents in the home
- the dwelling type
- fuel type
- CO2 emissions
- Energy consumption
- SAP lighting, water and space heating costs
- the EPC band of the property

Together these variables produce a 'Full Mortgage Application' model with an adjusted R^2 value of 0.667 and which accurately predicts a property's annual fuel bill to within +/- 15% of the known value 70% the time (or +/- 20% for 80% the time). As before, whilst a precise comparison to individual lender's existing affordability calculators was not possible, the evidence strongly suggests this model would improve the accuracy of the forecast fuel cost.
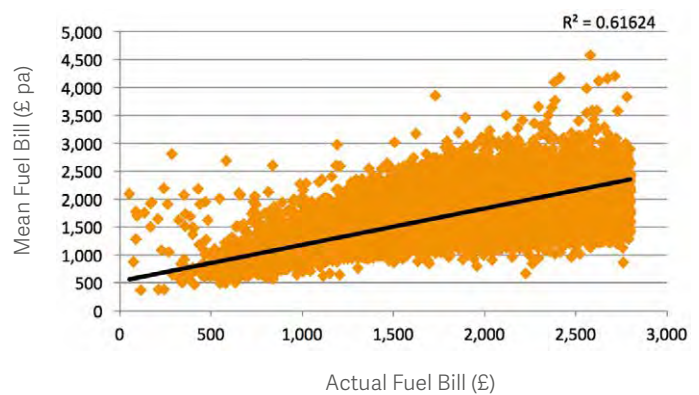
SAP Region vs. Fuel Bill
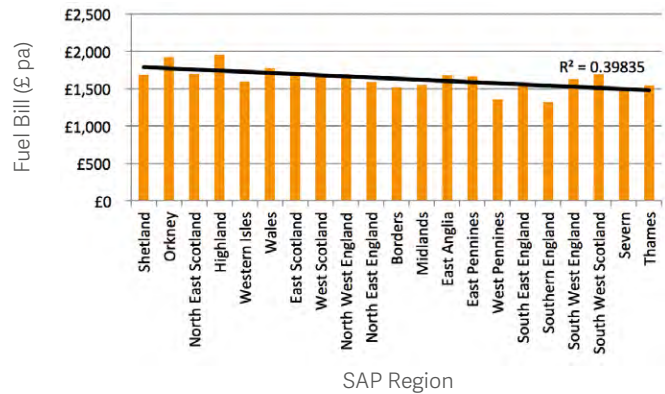
Property Age vs. Fuel Bill
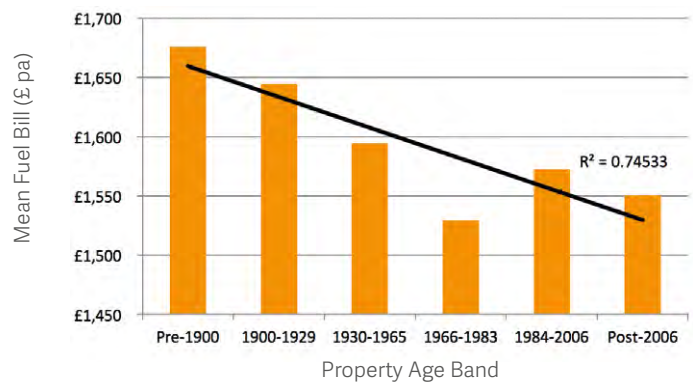
'Full Mortgage Application' stage model: Predictions vs. actual fuel bill

Online Household Fuel Bill Estimator:
A free, working example LENDERS estimator tool can be found at **www.EPCmortgage.org.uk**

Energy in Mortgages – Possible Impact of Related Factors

Alongside the work to produce a better fuel cost forecasting method, the project sought to ensure that other potential associated issues which could be considered related did not have a significant impact on any resultant forecast costs. This was undertaken to see whether predicted fuel savings were absorbed by other costs, or not realised.

Maintenance Costs

The work investigated whether low energy properties were likely to incur notably different maintenance costs than conventional heating systems such as gas boilers. Major replacement or refurbishment costs were excluded from this to align with the current affordability method that also do not model works of this nature (ranging from replacement boilers, new kitchens and bathrooms through to re-roofing or other major works). Whilst the existing affordability models do not specifically identify annual maintenance costs, a baseline for a conventional gas-fired boiler service/maintenance contract at approximately £100 per annum was used for comparison.

The project sought information about maintenance costs during 2016 and early 2017 from manufacturers of solar thermal systems, voltage optimisers, wind turbines, biomass boilers, solid fuel fires (e.g. wood burning stoves), ground- and air-source heat pumps, and mechanical ventilation and heat recovery (MVHR) systems. Costs for 'fabric' enhancements that may contribute to low energy performance were not included on the basis these commonly do not require any different maintenance (or any) compared to existing building fabric elements. The project found the following:

Based on the table below, it can be shown that the more popular low energy technologies are likely to have maintenance costs not significantly different to those of a conventional gas boiler. The exceptions are wind turbines and biomass boilers. If more than one low energy system is installed then the cumulative maintenance costs will be higher, though perhaps the most common combination of a heat pump alongside MVHR is still likely to be only a little more expensive to maintain than a gas boiler.

It should also be noted that neither the likely reduction in fuel bills resulting from any of the renewable heat or electricity generation systems listed above, nor any income from FIT[33] or RHI[34], was included in this review, which is likely to have a reduction (or in rare cases negation) of the home's combined fuel and maintenance costs.

EPC Quality

Concerns about the quality of assessments undertaken to produce EPCs could lead to questions about how EPCs can be usefully applied to the mortgage lending process. It is important to note here that the tools developed are based on the contents of the 40,000 homes dataset of reported fuel costs. The EPC is used as one of the indicators that help predict likely 'normal' household fuel costs directly from this dataset, but is only one of the variables (see earlier for full list).

The project looked at the impact of an individual EPC band indicator not representing the actual performance of the

System	Annual maintenance cost	Required or ecommended	No. of firms contacted
Photovoltaic Arrays (PV)	£0-100	Recommended	6
Solar Thermal	£75-150	Recommended	4
Voltage Optimisers	N/A	N/A	2
Wind Turbines	£200-400	Required	4
Biomass Boilers	£200-400	Required	6
Solid Fuel Fire	£40	Required	5
Ground Source and Air Source Heat Pumps	£160	Required	9
Mechanical Ventilation and Heat Recover (MVHR)	£30	Required	4

33 Feed In Tariff is a financial incentive for householders for electricity generation and export from eligible installations, see https://www.ofgem.gov.uk/environmental-programmes/fit

34 Domestic Renewable Heat Incentive is a financial incentive for householders for heating systems that use eligible low carbon energy sources, see https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi

Barriers to Implementation

property by one band (e.g. if the EPC said "D" but the home should have been an "E"). Whilst this did result in an impact on fuel cost accuracy, there are important contexts: Firstly, any affordability calculation is designed to predict 'normal' expenditures and actual costs will vary around those assumed averages; second, that typical energy consumption ranges of homes in adjacent EPC bands overlap; and third, the existing mortgage affordability calculation method effectively assumes the national average EPC for all, therefore even a 'one band' error in EPC can be expected to place the home's performance more accurately than the national average.

Overheating & Other Issues

The project acknowledges there are many other issues affecting homebuyers and household expenditure, including challenges of overheating, construction quality and more. Whilst important, these have been deemed out of scope for the specific aim of improving the accuracy of estimating household fuel costs and better dealt with elsewhere in the overall homebuying process: For example, risk of overheating could be addressed as a specific item to be reported in mortgage survey reports.

The work undertaken in this project has also considered what might prevent the adoption of the findings. Here, with regard to mortgage regulation, the project has found there are no regulatory barriers to the adoption of the more sophisticated consideration of fuel costs in affordability calculations. Furthermore, although only three initial surveys, the project has found homebuyers are on balance supportive of including energy performance in mortgages (see this report's "Energy in Mortgages - Customer Research" section).

It is acknowledged, however, that these represent only the first barriers for implementation. While the project has demonstrated that a more accurate projection of fuel expenditure can be made available, adoption of these projections and the corresponding impact on available lending within the mortgage journey is extremely complex, particularly given the multiplicity of systems and sales processes across the sector. Individually, lenders will need to consider how and when it is appropriate to consider home efficiency as part of their lending decision. Adjustments to existing processes at this scale can be extremely costly, and lenders will need to consider these changes alongside the emergence of new innovations and technologies. These represent significant barriers and mean adoption of any changes will require further work and is unlikely to occur quickly under normal conditions.

Barriers to implementation are, however, less present for the provision of guidance to homebuyers than to systemic changes in financial systems. In this regard, the calculator developed by this project could be an extremely effective guidance tool to homebuyers, which could become a supporting tool for the mortgage process. Whilst it is recognised that homebuyer's are already presented with a range of complex financial information which can be hard to understand, particularly for inexperienced purchasers, and that it is crucial that any additional information be presented in the right manner, the provision of guidance to homebuyers may represent a route to early adoption that could precede any changes to financial systems.

Energy in Mortgages – Opportunities of Implementation

The project has identified several potential benefits from the implementation of a more accurate fuel estimation in the affordability calculation, two more readily quantifiable whilst the last potentially with the most impact.

The first, and most obviously quantifiable, is the change in assumed household expenditure in relation to the property's EPC band. For example, a family of four in a three bedroom home would range from more than £200/month for a "G" rated property, down to nearly £50/month for the lowest "A" rated home. Adoption of this improved method into the overall household expenditure, used in an (otherwise unchanged) affordability calculation, would more accurately reflect the higher or lower costs associated with higher or lower home energy performance respectively.

Where the fuel costs are lower, and if adopted by lenders, the quantifiable difference may affect the maximum mortgage amount offered by the lenders, where the only variable is the EPC of the property. Our work shows that, across a range of household incomes, a difference of two EPC bands (i.e. "E" to "C") would result in the better performing property enabling that household to borrow approximately £4,000 more. Taking this to the full range, those whose search for a home includes properties at both the "G" and "A" end of the energy performance spectrum might see maximum borrowing amounts varying by up to £11,500 at these extremes.

EPC "A" rating (92-100)	Maximum Mortgage	£200,000
EPC "B" rating (81-91)	Maximum Mortgage	£198,000
EPC "C" rating (69-80)	Maximum Mortgage	£196,000
EPC "D" rating (55-68)	Maximum Mortgage	£194,000
EPC "E" rating (39-54)	Maximum Mortgage	£192,000
EPC "F" rating (21-38)	Maximum Mortgage	£190,000
EPC "G" rating (1-20)	Maximum Mortgage	£188,000

Illustrative example of how individual property efficiency could be reflected in available lending; care will be needed to ensure clarity for borrowers

In terms of this direct impact, the project recognises that a minority of borrowers actually approach their maximum mortgage offer amount, with other variables such as deposit amount or length of mortgage affecting the homebuyer's final decision. Therefore only a minority of mortgage borrowers would directly benefit from this additional borrowing capacity – being those who are borrowing close to their limit and buying homes with an energy performance (effectively) better than the national average.

The second opportunity from implementation considers the same improvement in maximum mortgage offer amount, but is relevant to either of the remortgage or additional mortgage borrowing processes. Incorporating energy performance in the affordability calculation means changes, such as from energy performance improvement works, would then be captured by this calculation. Simplistically, improving the EPC band of a property frees income from energy bills that could be 'switched' to support additional borrowing repayments. The project acknowledges there are commercial issues around whether the loan is given before the work is undertaken and what evidence is needed, as well as a need for the forecast not to be considered a guaranteed fuel cost saving.

The last and potentially greatest opportunity from implementation comes from the impact on homebuyer behaviours, rather than any direct financial benefit. Whilst behavioural impacts are harder to predict, correlation between energy performance and lending capacity, may, in principle, encourage UK homebuyers towards more efficient housing. This has potential to influence habits in a manner comparable to that seen in vehicle fuel economy (through tax bands and fuel usage costs) and household goods (through their EPCs), where in both instances the behaviour change triggered could be considered greater than the direct financial benefits alone may merit.

The opportunity from changing homebuyers' behaviours around energy performance is significant, arguably generating consequences that could initially include driving the speed of sales of better performing properties, and then potentially a price differential, which in turn could stimulate venders towards undertaking energy performance improvements. However, much will depend upon clarity of communication to the homebuyers during an already complicated mortgage process, and this awareness becoming public knowledge.

Energy in Mortgages – Conclusions & Recommendations;

Conclusions

There is a quantifiable relationship between home occupancy, home energy efficiency and the household's expenditure on fuel. This relationship is not sufficiently flagged to the homebuyers during the home buying process and does not currently feature in any known mortgage affordability calculations.

For greatest chance of influencing a homebuying decision, the impacts on household expenditure should be highlighted before the homebuyer has selected their preferred home; they are unlikely to change their mind solely for energy efficiency.

The project has demonstrated expenditure on fuel can typically be forecast to ±£26 for 60% of households based on the homebuyer's "search criteria" - factors known before the preferred home is selected. The project has produced a freely available tool that undertakes this estimation on the LENDERS project website at www.epcmortgage.org.uk.

The research has also demonstrates this forecast can be improved once Energy Performance Certificate information is available, therefore when the home to be mortgaged is known, which is applicable at the offer stage, or at the start of the process for remortgages or where an existing homeowner is requesting additional borrowing.

Using information which can be available at the appropriate points in the mortgage process, the project has therefore demonstrated it is possible to improve the existing estimations of a homebuyers' likely expenditure on fuel compared to those made under current mortgage affordability calculations.

For mortgage lenders, undertaking changes to direct affordability calculations or secondary adjustments represents a significant process change that, in terms of improvement in the overall affordability calculation, equates to a small financial impact. It is therefore likely to take some time for lenders to make this change, however provision of customer advice on the topic can be more quickly adopted.

For customers, any implementation beyond basic guidance needs to carefully consider how to explain that the impact of household fuel costs affects the potential maximum mortgage without overly increasing the complexity of the mortgage application process; a range of methods of presenting the link to customers may be appropriate, and customer's desire to process complex information must be considered.

Recommendations

The household fuel expenditure estimation tool, freely available on the www.epcmortgage.org.uk website, should be promoted as information for homebuyers to assist them in understanding the impact of home occupancy and home energy efficiency on their monthly household expenditure on fuel. This could be undertaken by mortgage lenders, estate agents, letting agencies and others.

The database on which the household fuel expenditure estimation tool is based should be enlarged from the current c.40,000 properties. The possibility of using anonymised mortgage customer data in conjunction with large scale energy databases (such as NEED) should be explored. It is not anticipated that this will affect the principles of the tool, but will be likely to modestly improve the accuracy.

The mortgage industry should review the ways that affordability calculations currently estimate household fuel expenditure with respect to the demonstrated relationship with property occupancy and energy efficiency. When appropriate for the individual lender, and subject to a mechanism that customers are comfortable with, these improvements should be adopted into their assessments.

The Office of National Statistic's Family Spending Review currently provides source data for 90% of known affordability calculations, a purpose for which this survey was not specifically designed. The mortgage industry, together with government, should look to utilise larger datasets in compatible formats to provide more accurate estimation for household expenditure, including for fuel expenditure. This could include enhanced ONS surveys or lenders own customer information, the latter benefiting further if the energy performance of mortgaged properties is collected in future.

The interaction between lending, energy efficiency and customer behaviours merits further work in order to maximise the potential for influencing change. This should include relationships between consumer energy behaviours, mortgage default rates, energy performance information & affordability processes; the effect on customer behaviours & knock on implications for market values; and finally support for customers and lenders to help prioritise and sequence property improvements appropriately.

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Online Household Fuel Bill Estimator:
A free, working example LENDERS estimator tool can be found at **www.EPCmortgage.org.uk**