EeMAP
Energy efficient Mortgages Action Plan

CREATING AN ENERGY EFFICIENT MORTGAGE FOR EUROPE

A Review of Building Performance Indicators that Impact Mortgage Credit Risk

EUROPE REGIONAL NETWORK

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PARTICIPATING EUROPE NETWORK GBCS

Alliance HQE GBC France

DGNB Deutsche Gesellschaft für Nachhaltiges Bauen German Sustainable Building Council

Dutch Green Building Council

GBCe green building council españa

Green Building Council Finland

Green Building Council Italia

Croatia Green Building Council – Hrvatski Savjet za Zelenu Gradnju

IGBC Irish Green Building Council

PLGBC Polish Green Building Council

UK GBC Together for a better built environment

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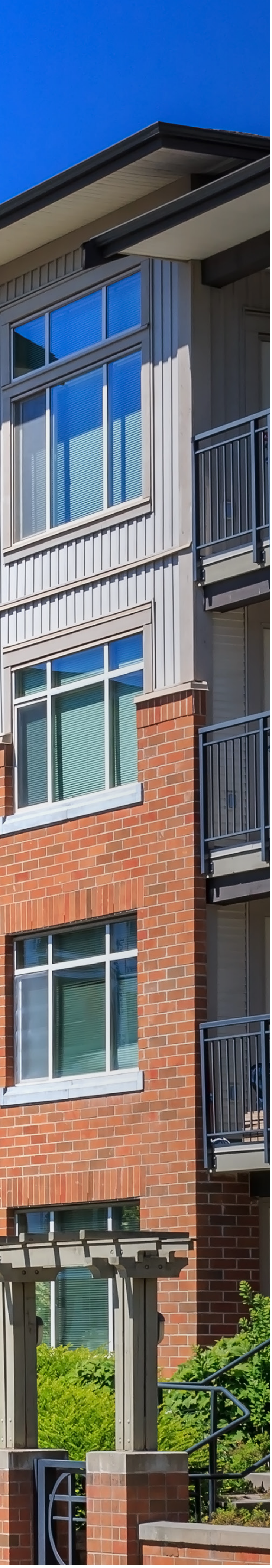


GLOSSARY

BREEAM	An environmental assessment method for buildings and communities – developed in the UK (BRE Environmental Assessment Method).
Brown discount	The potential negative differentiation in property value for a building with below average energy or environmental performance compared to an equivalent property with average or above average performance.
DGNB	**Deutsche Gesellschaft für Nachhaltiges Bauen** (the German Sustainable Building Council) has developed the DGNB System, which provides an objective description and assessment of the lifecycle sustainability of buildings (and urban districts).
EEM	**Energy efficient mortgage** – A mortgage product where the potential for a building's energy performance (and potentially wider sustainability performance – see section 6) to reduce the risk profile of a loan secured against it is reflected in the lender's credit risk assessment in order to offer preferential terms to the borrower.
EPBD	**Energy Performance of Buildings Directive** – European Union legislation on the energy performance of all buildings.
EPC	**Energy performance certificate** – A document required under the EPBD to be produced at the point of the construction, sale or rental of property. The EPC provides a rating (typically A-G, where A is the most efficient and G the least efficient).
Green value	The potential positive difference in the value of a building with above average energy or environmental performance compared with an equivalent property with average or below average performance.
HQE	**Haute Qualité Environnementale (high quality environmental standard)** is a voluntary certification scheme for new and existing buildings developed and administered by the Alliance HQE – France Green Building Council.
LEED	Developed by the US Green Building Council, Leadership in Energy and Environmental Design (LEED) is a set of rating systems for the design, construction, operation, and maintenance of green buildings.
LGD	**Loss given default** – An indication of the amount of money the lender is predicted to lose if the borrower defaults on their loan repayments. Essentially, LGD is equal to the outstanding loan amount at the point of default plus any other costs incurred by the lender during the repossession and sale process, minus the income from the sale.
LTV	**Loan to value ratio** – The ratio of the total loan amount to the total value of the property. A lower LTV represents a lower risk to the lender and would result in a reduction in the expected LGD.
IoT	**Internet of Things** – Appliances and devices that can send and receive data via the internet, and which can therefore be remotely monitored or controlled from a computer or smart phone app.
PD	**Probability of default** – An estimate of the likelihood that a borrower will default on their loan. PD is based on statistical models that are likely to include inputs such as the affordability checks performed on the borrower (income, fixed costs and other expenses) as well as the LTV and aspects such as the location of the property, the borrower's employment status and sector, number of dependants.
Smart meter	A device that measures electricity or fuel consumption and automatically records and transmits this data with high frequency (typically every half hour) to the energy supplier and the building owner or occupier (typically via a dedicated display in the building or via an online account). Smart meters can receive as well as transmit data. This allows the electricity supplier (or another authorised party) to send communications to the meter for the purposes of maintenance or to administer more flexible pricing based, for example, on time of use.

EXECUTIVE SUMMARY

Buildings account for 40 per cent of energy use in the European Union (EU), and it is estimated that the EU needs to invest around €100 billion annually in building renovations to meet its energy and climate goals. The EU has increased the amount of public funds available for energy efficiency, but the European Commission has indicated that there is a need to boost private energy investments – the EeMAP (Energy efficient Mortgages Action Plan) initiative is intended to deliver a concrete, market-led finance solution to help bridge the gap.

Mortgage lenders have a clear interest in the state of the EU building stock. Mortgage loans are estimated to account for around a third of the total assets of the European banking sector. Investments in building performance improvements can help to free-up disposable income for borrowers through lower utility bills and can enhance property value. As a result, they can reduce credit risk, so they are a win-win for lenders, investors, consumers and climate.

> ***Our Vision:*** *The EeMAP initiative (www.energyefficientmortgages.eu) aims to create a European energy efficient mortgage (EEM), to incentivise borrowers to improve the energy efficiency of their buildings or acquire highly energy-efficient properties. The incentives the EEM will offer borrowers (e.g. reduced interest rates and/or increased loan amount) aim to reflect the reduced credit risk of these loans.*

EeMAP has three workstreams addressing the technical, financial and valuation aspects of a European EEM. This report is focused on relevant technical aspects of building performance assessment. It is accompanied by EeMAP Reports on Green Finance and Green Value, analysing the perspectives and practices of the banking and valuation practitioners working with EeMAP. An EeMAP Report on the Impact of Energy Efficiency on Probability of Default also reviews academic research in this field. The reports aim to present a 'state of play' in each area.

This review of European research and best practice on the energy performance of buildings begins to explore how this could support the initiative's aims. Later this year EeMAP will publish customer research on demand and engagement with the EEM concept, which will further inform the design phase. This design phase will more closely examine practical barriers and demand drivers for the EEM. The following summary presents four key conclusions that will impact on EeMAP's subsequent work to design the technical building assessment elements of an EEM.

> ***Key conclusion 1:*** *EPCs are the most widely available source of energy performance data on individual buildings and hence are a useful starting point for the assessment mechanism behind an EEM.*

The energy performance of a building can be assessed using calculations, statistical analyses, or measurements. All three approaches are currently used, in different ways, across Europe. Each approach has different strengths and weaknesses in terms of the scope of the assessment, the data requirements, and the potential relevance to different credit risk metrics used by banks.

The most widely available instrument for building energy performance information in Europe is the energy performance certificate (EPC), a requirement for most buildings built, sold or rented. EPCs should be based on a calculation known as an asset rating. In some cases measured energy data, normalised for climate and occupancy variations, is used and these are known as ***operational rating EPCs***.

New European standards have been developed and are internationally recognised. Although not mandatory, these standards are available to member states to integrate into their EPC systems. Moreover, countries that choose to use national standards must now document these in a standardised format. This is anticipated to increase transparency as to where national systems differ and may in time lead to improved understanding of how EPCs from two different countries can be compared.

Recent research from the UK provides strong statistical evidence that using EPC data as part of mortgage affordability calculations can justify around £4,000 of additional borrowing on a standard energy renovation. The EPC is a cornerstone of EU energy policy for buildings, and further integration into property transactions will help to increase its visibility and value; acting as a driver for further improvements in the underlying EPC systems developed by each EU member state.

> ***Key conclusion 2:*** *Lack of consistency between EPCs in different member states, among other limitations, means that additional assessment criteria are likely to be required, and presents a barrier to developing a 'harmonised' approach to EEMs for all of Europe.*

Most EPC schemes across the EU follow the asset rating approach, but the way the EPC is calculated varies from one member state to another, depending on the calculation standards they use. Efforts to design a voluntary, harmonised EPC for non-residential buildings across the EU, driven in part by investor demand, began in 2010. However, initial proposals were rejected by member states and this work has not concluded.

> ***Key conclusion 3:*** *A combination of all three performance assessment approaches (calculated and statistical estimates, and measured data) may provide the optimal solution to underpin the credit risk assessment for EEMs. The feasibility of adopting such an approach needs to be investigated for key mortgage markets.*

Having access to the underlying data used for EPC calculations could make EPCs more useful as a tool for lenders, valuers and energy assessors involved in EEM originations. However, this is currently only possible in a small number of countries.

In addition, the widespread use of the asset rating approach to generate EPCs means that it is currently difficult to obtain actual measured energy data. This is particularly true where the borrower is moving to a new property and the energy data belongs to the previous occupant. The introduction of smart meters in many EU countries is expected to increase the volume of available energy data for all types of buildings, and there are pan-European initiatives to establish common standards for the authorised transfer of data from smart meters to third parties. Such a system could streamline aspects of energy performance assessment and may be particularly useful for monitoring and verification of performance over time.

Increased availability of data across portfolios of similar properties and renovation works could also facilitate creation of statistical tools, which can be used to predict energy use when measured data for a particular property is not available or if the reliability of the calculated energy performance is unclear.

Key conclusion 4: *Other building performance aspects beyond energy are likely to have a strong influence on the value of a property over time. Including some of these wider considerations in the assessment framework for EEMs is expected to further improve the risk profile of such loans.*

Energy efficiency improvements are intrinsically linked to wider co-benefits such as improved health and comfort for building occupants. These factors are often important drivers for energy efficiency renovations. The evidence reviewed for this study also makes a compelling case for looking beyond just energy performance to other building performance indicators that impact on credit risk.

The value of property is strongly linked to aspects such as quality, adaptability and location. The availability of sustainable transport options, the flexibility of the space for changing occupant needs, and resilience to future climate changes are all examples of important value drivers that are assessed in voluntary sustainability certification schemes such as BREEAM, DGNB, HQE and LEED.

The European Commission has recently launched an EU sustainability reporting framework for building projects. The framework is an indicator of the direction of travel and possible new areas of regulation that may impact the sector during the typical lifetime of a mortgage product. Such potential changes should be taken into account, so that lenders can fully realise the value-creation and risk-mitigation potential of incorporating new building performance indicators into mortgage lending.

World Green Building Council Europe Regional Network action plan

The Europe Regional Network of the World Green Building Council will now begin to prepare detailed technical recommendations for the building performance assessment process that is necessary to underpin a pilot EEM product.

- At the start of 2018, we will publish our draft recommendations for how a European EEM could work from a building assessment perspective.
- Alongside this, our national participating member Green Building Councils will publish a series of market briefs setting out the relevant building performance assessment landscape in their countries.
- Our regional partner, E.ON, will also publish its initial consumer insight research into how consumers in a number of European markets view the EEM concept, ensuring our process design is led by consumer-centred thinking.
- During Q1 of 2018, our national member Green Building Councils will host workshops – an opportunity for a wide range of experts to provide their feedback on our initial recommendations, and what would be needed to support implementation in their markets.
- In summer 2018, we will publish our updated recommendations for the pilot phase of the EEM product, and will work with the EeMAP consortium on a roadmap for how we bring the EEM product to market across Europe.

EeMAP
Energy efficient Mortgages Action Plan

The EU Horizon 2020 funded EeMAP Initiative aims to create a standardised energy efficient mortgage (EEM), that will incentivise building owners to improve the energy efficiency of their buildings or acquire an already energy efficient property by way of preferential financing conditions (reduced interest rates and/or increased loan amount) linked to the mortgage.

At the heart of the initiative is the objective to demonstrate that energy efficiency has a risk mitigation effect for banks.

Increased loss mitigation capacity + Enhanced loan-to-value via green value + Lower probability of default = Reduced capital charges

Lower risks deliver a strong incentive for banks to enter the market and play a central role in driving climate action across Europe's building sector.

This report is one of a series of four produced by the EeMAP Initiative, which respectively review the state of play in relation to energy efficiency, valuation, finance and probability of default in the context of the EU's building stock. The reports are aimed at banks and other financial institutions interested in understanding how an EEM could be established from the different perspectives of finance (both origination & funding), valuation and energy efficiency measurement.

Both new build and existing residential and non-residential buildings are within the scope of the work EeMAP is doing to establish an EEM, but the initiative's central focus is how we create the biggest impact on Europe's climate goals by driving renovation across the residential building stock.

See: http://energyefficientmortgages.eu/

1. INTRODUCTION

Across the European Union, buildings are responsible for 40 per cent of energy consumption and 36 per cent of greenhouse gas emissions[1]. The EU has set itself targets for 2030: cut greenhouse gas emissions by 40 per cent; and improve energy efficiency by 27 per cent[2]. With 75–90 per cent of the existing building stock predicted to still be standing in 2050[3], increasing the rate of energy-efficient renovation has become a top priority. Indeed, at the current rate, it will take 100 years to renovate the EU's existing building stock.[4] To put this in the context, analysis in the UK suggested it would be necessary to complete one renovation every minute to achieve UK climate change objectives.[5]

Mortgage lenders have a significant interest in the state of the EU building stock, because this is directly reflected on their balance sheets. Moreover, mortgage lenders are uniquely positioned to intervene at critical moments in a property's lifecycle to support improvement of its quality and energy performance (i.e. when it is built, bought or refinanced). Such interventions can help to free-up disposable income for the borrower through lower utility bills and can enhance property value. As a result, they can reduce credit risk for borrowers, lenders and investors.

There is a clear advantage for mortgage lenders to encourage energy efficiency, and there is mounting evidence that loans secured against more efficient properties could potentially be subject to better capital treatment from financial regulators. Conversely, for loans secured against buildings with poor performance, the risk profile is likely to increase in future as more stringent environmental regulations come into force and consumer preferences shift. Unlocking new sources of private finance to help close the EU's €100 billion energy efficiency gap can also reduce the long-term systemic risk to banks from having millions of inefficient property assets on their books.[6]

The property industry has come a long way in its understanding of what constitutes an energy-efficient and sustainable building and the value that this delivers for owners and occupiers. However, there is a disconnect between the buildings sector and the financial sector: The energy and environmental performance of buildings is not often accounted for in credit risk assessments

1 — European Commission. 2017. *Buildings – Energy.* Available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings.

2 — European Council. 2014. *Conclusions of the Council on 2030 Climate and Energy Policy Framework.* Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf.

3 — European Commission. 2014. *Thematic Research Summary: Energy Efficiency in Buildings.* https://setis.ec.europa.eu/energy-research/sites/default/files/library/ERKC_%20TRS_Energy-Efficiency_in_Buildings.pdf.

4 — European Commission. 2017. *Fact Sheet 17-172: Towards Reaching the 20% Energy Efficiency Target for 2020, and Beyond.* Available at: http://europa.eu/rapid/press-release_MEMO-17-162_en.htm.

5 — HM Government. 2010. *Low Carbon Construction Innovation & Growth Team: Final Report.* Available at: www.gov.uk/government/publications/low-carbon-construction-innovation-growth-team-final-report.

6 — Energy Efficiency Financial Institutions Group. 2015. Energy Efficiency – the First Fuel for the EU Economy. Available at: www.eefig.com/index.php/the-eefig-report.

conducted for mortgages. This is especially true of the domestic housing market, where mortgage affordability checks and valuations largely do not consider these important issues in a robust way. Key reasons for this are discussed in further detail in the EeMAP Reports on Green Finance and Green Value.

However, a number of financial institutions, including many of those working with EeMAP, are beginning to integrate energy and sustainability considerations into their lending practices. Through EeMAP we are exploring with them whether it is possible to scale-up such practice in the case of mortgage lending through a clear and more standard European approach based on best current practices. The present market for 'green mortgages' is relatively immature, with a number of different concepts being trialled, and an increasing number of banks are now asking for greater clarity and standardisation in approach to help grow this market (see EeMAP report on Green Finance).

This report describes existing ways to assess the energy and environmental performance of property, with a primary focus on residential buildings, and relates these to the financial assessments undertaken when a mortgage is issued.

We argue that robust systems already exist to assess energy and environmental performance, and these could be used at different stages in the mortgage financing process. In other words, mortgage lenders do not need to reinvent the wheel when it comes to defining building environmental performance standards.

However, we also show that there are practical and financial barriers to overcome if these two assessment processes, which are currently disconnected, are to be more integrated. In particular, this report shows that there is significant variation between existing national building assessment methods.

The work presented here draws on existing publications and research initiatives within the fields of energy efficiency and building performance across Europe. This literature-based research has been supplemented with information obtained through interviews and consultations with a range of experts from across the property value chain, and representing key European mortgage markets as well as wider EU perspectives. The individuals and organisations consulted are listed in the acknowledgements at the beginning of the document. The scope of this report is restricted to the technical aspects of energy and sustainability performance assessment. Detailed research and analysis of the perspectives of the practice and perspectives banking sector and the valuation profession are presented in the accompanying EeMAP reports on Green Finance, Green Value and the Impact of Energy Efficiency on Probability of Default

This set of reports, represent an important step forward in the journey to define the underlying building performance indicators, data and processes that will be needed to underpin a European EEM product. These reports should provide key stakeholders across the region and from relevant sectors with a useful evidence base so that they can begin to analyse how an EEM product might work in their national market.

2. ENERGY EFFICIENT MORTGAGES: THE PRACTICALITIES

Borrowers might seek an EEM at different times and for different reasons. Table 1 shows four examples of scenarios that might arise, depending on the current energy performance of the building and whether the mortgage is a new origination for a property to be purchased or a refinancing of an already owned property. The table indicates how each scenario may have an effect on the data that are available and hence how this may potentially affect the way energy performance can be evaluated.

The scenarios in table 1 are not exhaustive and there are other distinctions that could be made which may also affect what data is available and what aspects of credit risk are relevant. For example, there may be a difference between owner-occupiers and landlords, or depending on what proportion of the loan is targeted at providing finance for renovation. These other scenarios will be identified in conjunction with the EeMAP partners and committee members and will be analysed in more detail in the subsequent phases and outputs of the EeMAP initiative. At the end of November 2017, EeMAP will publish analysis of customer insight research conducted in four key European mortgage markets to support the development of a concept that has broad appeal with potential borrowers under different scenarios.

A number of key metrics are used by banks when assessing the credit risk of mortgages. These metrics capture aspects related to both the borrower and the property:

Probability of default (PD) – is determined by an affordability assessment (i.e. is an assessment of the borrower's income and expenditure in

Table 1: Different scenarios for energy efficient mortgages – developed through interviews with the European Mortgage Federation and banks participating in EeMAP

	Efficient building (e.g. new build or already renovated)	Inefficient building (e.g. existing)
New lending	*Measured energy data unlikely to be available pre-purchase** Predict** energy performance to evaluate PD (LTV known) Measure** energy performance after purchase	*Measured data unlikely to be available pre-purchase** Predict energy performance before and after proposed renovation project to evaluate improvements in PD and LTV Measured energy data used to validate post-renovation performance
Re-mortgaging	*Measured energy data likely to be available* Use measured data to evaluate PD and LTV	*Measured energy data likely to be available* Use measured data to evaluate PD and LTV pre-renovation Predict energy performance post-renovation to evaluate improvements to PD and LTV Measured energy data used to validate post-renovation performance

* There are situations where measured data may be available for a new mortgage origination and examples of this are discussed later in the report. Based on the current legislation and market situation, this is expected to only apply to a minority of cases.

** See section 2.1 below for further explanation of these terms.

relation to the value of the loan repayments). A lower PD results in lower credit risk. Since PD is directly linked to the borrower's expenditure, for an owner-occupier, energy and other building performance related costs have an influence. The situation may be somewhat different for landlord-tenant occupied properties.

Loan to value ratio (LTV) – is the proportion of the property's market value which is covered by the loan. A lower LTV gives a lower credit risk. Increasing the value of the property (e.g. through an energy-efficient renovation project) can therefore improve the LTV.

Loss given default (LGD) – is the amount of money the lender would expect to lose in the event of a default on the loan. It is linked to both LTV and PD. A lower LTV would be expected to reduce the LGD, and a lower PD means that LGD is less likely to happen.

Prepayment risk – this is the likelihood that the borrower will repay the loan early. Banks usually have early repayment penalties to mitigate losses in the event of early repayment. Nevertheless, prepayment reduces the revenue generation of the loan and is therefore considered a risk. Factors that may make the borrower more likely to remain in the property (e.g. energy efficiency and quality improvements) and to continue servicing the loan, mitigating this risk.

More detail can on these can be found in the accompanying EeMAP reports on Green Finance and The Impact of Energy Efficiency on Probability of Default. These also point to further research that has demonstrated positive improvements in each of these metrics linked to improved energy and environmental performance of buildings.

2.1 THREE APPROACHES TO ASSESSING THE ENERGY PERFORMANCE OF BUILDINGS

For EEMs to be viable, there must be tried and tested methods to evaluate the energy performance of a building. This is necessary to quantify: the savings that could be, or have been achieved; and the expected added value depending on different levels of renovation or technological improvements. In general, there are three approaches to assessing a building's energy performance:

- Performance prediction using calculations
- Performance prediction using statistical analysis
- Performance measurement using data from metered consumption or energy bills.

In essence, predicting the energy performance of a building involves relating known physical characteristics (e.g. location, size, construction and technical systems) and scenario assumptions (e.g. pattern of use and local climate) to energy consumption. This prediction can be done using calculations based on scientific equations that model the various functions for which energy is used in a building. Alternatively, if there is a large enough data set of energy consumption for different types of buildings, it is possible to use statistical analysis to identify correlations between known parameters for a building and its likely energy consumption.

Both of these approaches are subject to uncertainty. With the statistical approach, the uncertainty can usually be readily quantified by calculating the variation in the underlying dataset. But for the calculation approach, which is nevertheless an estimate, there is uncertainty about whether the inputs accurately reflect the real-life situation. This uncertainty may be related to assumptions about the local climatic conditions or patterns of use of the building, or to specific technical aspects such as whether insulation has been installed or whether the quality of installation achieves the required performance level.

The third approach – measuring energy consumption using metered data or energy bills – is only possible in situations where that data is available (see table 1). For this reason, measurement may be most relevant as a tool to monitor and verify the performance of the building after the mortgage origination. However, it is important to note that measured consumption is heavily influenced by the behaviour of the building occupants, and without further analysis, measured energy consumption may be less appropriate as a tool to evaluate the specific energy performance characteristics of the building that affect the value of the property.

All three approaches, and their implications for the EeMAP initiative, are discussed in more detail in sections 3, 4 and 5 below.

3. ENERGY PERFORMANCE CERTIFICATES

The EPC is the most widely available information document on building energy performance across Europe. The basic principle is that EPCs provide owners and occupiers with objective information to assess, compare and improve the energy performance of their properties.

EPCs were introduced through the first EPBD in 2002 (Directive 2002/91/EC), which required that a certificate be produced for buildings at the point of construction, sale or rental. Requirements for national EPC systems were strengthened by the recast EPBD in 2010 (Directive 2010/31/EU), which introduced, among other things, additional quality assurance checks. By 2013, all EU member states had implemented an EPC system.[7]

EPCs and/or nationally defined energy calculations implementing the EPBD are referenced in widely used voluntary building certification schemes such as BREEAM, DGNB and HQE. They are also already being used in a number of examples of energy efficiency financing initiatives across Europe. This adds weight to the argument for incorporating EPCs into the energy efficiency assessment underpinning an EEM across Europe. However, it is important to recognise that EPCs have limitations.

This section explains the EPC system. It also suggests ways in which EPCs could be used to support an EEM and it discusses the scope to improve their suitability for this purpose. Including the EPC into the EeMAP standardised process has the potential to drive these improvements, as the financial incentive offered by an EEM can act as a driver for EPC quality.

3.1 UNDERSTANDING EPCS FROM A LENDER'S PERSPECTIVE

The EPBD sets out requirements for EPCs, including that they should be produced by using a 'calculation' approach, known as an **asset rating**. Member states may also use the 'measurement' approach but where they do, they should also use this to generate an estimate of the asset rating. The asset rating is based on standard assumptions about the use of the building and does not reflect the behaviour of the occupant. Typically it includes only the energy consumption that is directly related to the building, such as:

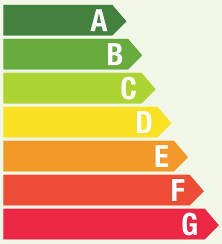
- Heating
- Cooling
- Hot water
- Ventilation
- Lighting.

7 — Buildings Performance Institute Europe (BPIE). 2014. A *Mapping of National Approaches.* Available at http://bpie.eu/uploads/lib/document/attachment/81/BPIE_Energy_Performance_Certificates_EU_mapping_-_2014.pdf.

The approach of generating EPCs based on measured energy use is known as an **operational rating**. This does reflect the actual use of the building by the occupant and includes all energy consumption (e.g. for cooking equipment and other domestic and electronic appliances). In order to adapt the measured data to more closely reflect an asset rating a normalisation is undertaken to mitigate variations due to occupancy and climate. This makes it possible to more directly compare the operational ratings of different buildings. However there will still be some discrepancies, so in most cases it is inappropriate to make a direct comparison between asset and operational ratings.

Across the EU, the asset rating is the most common system used for domestic buildings as this is what is explicitly required in the regulations. Where member state EPC systems include provision for use of operational ratings these are generally restricted to certain types or ages of building (see Case study 1).

Case Study 1: Operational rating EPCs



Several countries use some form of operational rating in their EPC systems. In Sweden, for new buildings, the asset rating is calculated during design to ensure compliance with energy efficiency standards. After completion, compliance is verified during the second year of operation using an operational rating approach.

In some countries, the operational rating approach is permitted for residential buildings of a certain age. For example, in France houses built prior to 1948 may have an operational rating EPC. France also allows this approach for multi-family dwellings with a centralised heating system, and for commercial properties. In England and Wales, it is only applied to public buildings over 250m^2 and in Slovenia it is only applicable to commercial buildings.

In the UK, organisations such as UK-GBC have advocated for the extension of the existing operational rating EPCs (which are known as 'display energy certificates' (DECs)), because of their success in reducing public sector energy use. New legislation in Scotland will make it mandatory for owners of private buildings over 1,000m^2 to either implement the energy saving measures listed in their EPC (asset rating) advisory report or else produce a DEC (operational rating) every year.

For the purpose of mortgage credit risk assessments, the operational rating could be more suited to assessing the impact of energy efficiency on PD because it more closely reflects actual energy use and hence expenditure.

The asset rating may be more useful for assessing the impact of energy efficiency on LTV and LGD, because it reflects the characteristics of the property and is independent of the occupants' behaviour. However, this depends on whether accurate data on building characteristics are available for the calculations. For existing buildings, such data may simply not be available, whereas for new and newly renovated buildings there may be discrepancies between the building characteristics as designed and what has been achieved in reality. The quality of installation plays an important role in this regard.

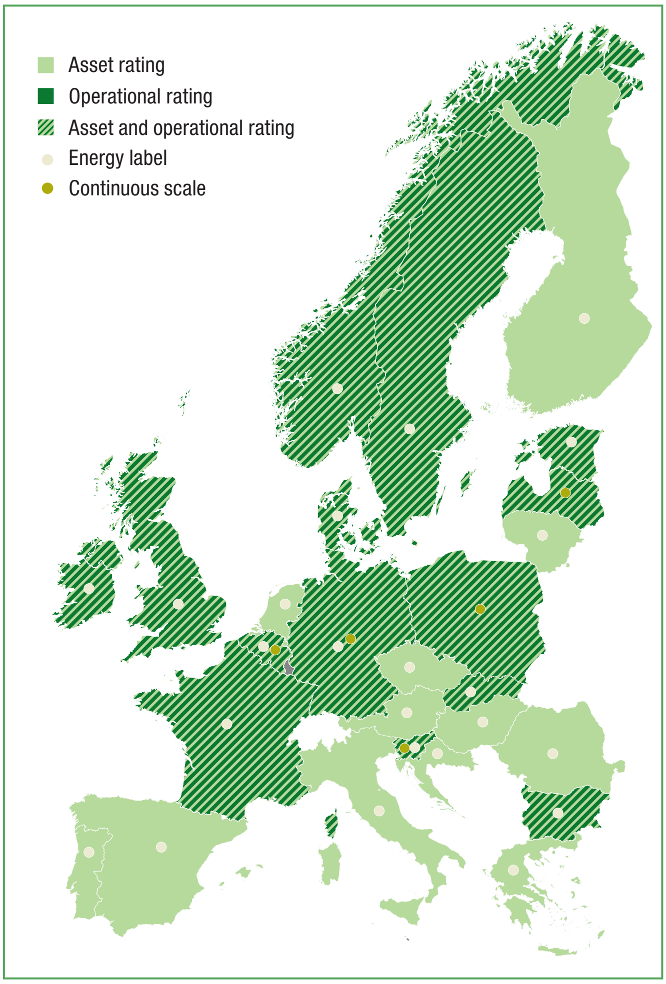
Whether valuers can access and verify the underlying EPC data during their due diligence checks is expected to be a determining factor in how significant asset ratings can become to the valuation process.

3.2 VARIATIONS IN APPROACHES TO EPCS ACROSS EUROPE

Although EPCs were introduced across Europe by the EPBD, it is not easy to compare EPCs from different countries, for several reasons.

As figure 1 shows, member states adopted different approaches for generating EPCs; and some member states allow both approaches to be used, depending on the circumstances. In addition, there are different national calculations standards (for both energy consumption and more fundamental metrics such as floor area) and different levels of performance are expected by the various national building regulations.

Figure 1: The use of asset and operational rating approaches in EPC assessments, as of 2014



Source: BPIE, 2014

Another factor is that currently each member state has the flexibility to use either European or national calculation standards. Hence the way asset ratings are calculated (and operational ratings, where these are used) varies between countries. Indeed, one research project (see Case study 2) has identified 35 different calculation methods for EPCs across Europe.

To address this, the European Committee for Standardization (CEN) has developed a new suite of standards for calculating the energy performance of buildings. There are 52 'modules' that can be used to calculate the performance of different elements that drive overall building energy performance. For example, the energy consumption of different types of heating equipment or the thermal efficiency of different types of wall construction are each defined by their own standard.

This modular approach foresees that an individual 'module' within the suite of standards may be replaced by an appropriate national calculation standard. Therefore the member states still have flexibility to implement different calculation approaches. However countries that choose to use national standards will soon be required to document these in a more transparent way, according to a common format. This should make it more feasible to understand the relationship between one national EPC system and another.

The large number of standards highlights the complexity of calculating the energy performance of buildings. Parts of the new EU modular standards have been adopted by the International Organization for Standardization (ISO), which reflects the robust and comprehensive nature of the work done by CEN to produce these resources. However, the continued flexibility that is built into the EPBD and the CEN modular standards means that any form of direct comparison of EPCs from different countries remains problematic.

Case Study 2: Voluntary Harmonised Non-Domestic EPC Initiative

The EPBD recast of 2010 included required the European Commission to adopt a voluntary common EU certification scheme for the energy performance of non-residential buildings in addition to the already existing mandatory EPC. This requirement was put in place with a view to enhancing comparability, coherence and accuracy (particularly for investor confidence), and to allow for common training and qualification schemes.

Work to implement this requirement culminated in a project coordinated by CEN that began in 2015. The objective was to develop an 'energy module' that could be voluntarily taken up by existing sustainability certification schemes (see section 6.2) or that could operate as a stand-alone energy performance certification scheme for the non-residential sector.

Significantly, CEN's proposals did not involve creating a system to compare existing EPCs because this was deemed too difficult. Instead a parallel calculation methodology was proposed based on the CEN standards and with a common reference point for the performance scale (A-G ratings).

However, at the time of writing EU member states have not accepted or adopted the results of this work, citing concerns about potential negative consequences for the mandatory EPC systems that are already in place.

Read more: www.construction21.org/community/pg/groups/25189/vcs-project/

3.3 EPC AVAILABILITY

EPCs are required when a house is built, sold or rented. For the origination of a new mortgage an EPC should be available from the property vendor. However, compliance rates vary between member states.

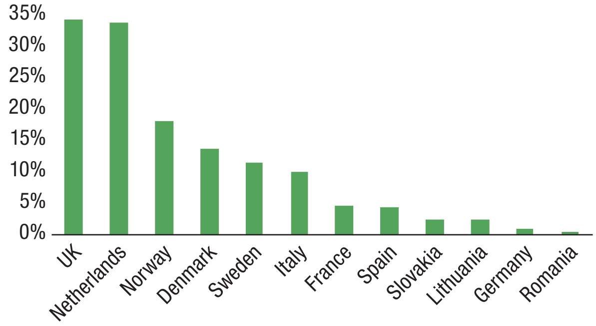
In a survey of real estate agents from eight EU countries[8] over 30 per cent of respondents answered that EPCs were not always available at the stage where a sale or rental contract was signed and more than 10 per cent said they were only available sometimes or rarely.

If EPCs are to be an integral part of EEMs and a driver of energy efficiency considerations in property transactions, this non-compliance must be addressed. Indeed, an EEM that requires an EPC may act as a driver for compliance.

Figure 2 shows the number of EPCs as a percentage of the total housing stock for eleven EU countries. The figures are correct for 2014, and for most countries the data available prior to this shows an increase year on year, suggesting that the percentages are likely to be higher at the time of writing.

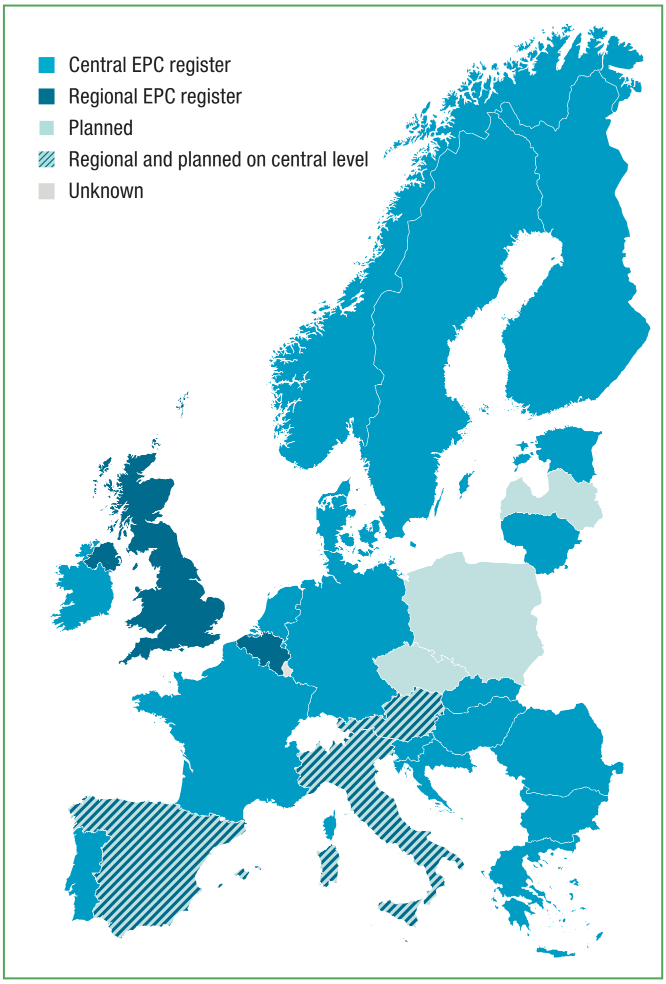
Where an EPC has been produced for a property, the existence of a central register greatly simplifies the process of obtaining the certificate. Figure 3 summarises the existence of central registers in member states.

Figure 2: Percentage of domestic properties with an EPC, as of 2014



Source: Enerdata

Figure 3: Existence of central registers of EPC data in member states as of 2014



Source: BPIE, 2014

8 — ZEBRA2020. 2016. *The Impact of Energy Performance Certificates on Property Values and Nearly Zero-Energy Buildings: Report for Policy Makers*. July 2016. Available at: http://zebra2020.eu/website/wp-content/uploads/2014/08/D3.1-Final-AR_RD_2.pdf.

Discussions and interviews with stakeholders carried out as part of the EeMAP research often highlighted that only the static EPC document is accessible through the central register, whereas having access to the underlying input data would be much more useful. That would make it possible to check the validity of the data (e.g. revealing where an assessor has used 'default' assumptions or where more accurate information on specific building characteristics has been used). Moreover, in cases where renovation works are proposed, further calculations of post-renovation performance could be conducted without duplicating work to obtain data which had already been collected.

Ireland, Portugal, Slovakia, Sweden and the UK all have EPC registers that store the input data used to calculate the EPC result. These more-sophisticated national registers allow for improved quality control of EPCs, as well as statistical analyses of the building stock covered by the EPCs in the system. For example, in England and Wales, the availability of this data from a central register was used to support the implementation of policy initiatives targeting residential energy efficiency improvements:

- Under the publically funded energy efficiency finance initiative known as 'Green Deal', registered assessors could access EPC data and combined this with additional data gathered about the occupants to perform energy savings calculations.
- Under an energy supplier obligation scheme known as 'ECO', energy companies that are required to invest in energy efficiency improvements for their customers can use EPC data to identify suitable energy conservation measures for individual properties.

Case Study 3: Irish EPC system

Ireland has one central EPC* database maintained and operated by the issuing authority for EPCs, the Sustainable Energy Authority of Ireland (SEAI). SEAI has a robust quality assurance system and a disciplinary procedure for EPC assessors, which includes both targeted and random audits of both EPC assessor and EPC assessments.

Thanks to the online platform, end-users can easily access information on EPC legal requirements and EPC assessors, and can access their property's certificate using its unique number or the serial number of the electricity meter. EPC assessors can log into the platform and upload certificates. Since 2012, the SEAI database has also operated as a national EPC research tool. The database is updated nightly, so up-to-date anonymised energy statistics on residential EPCs are widely available.

* In Ireland, EPCs are known as Building Energy Ratings (BERs)

3.4 THE LIMITATIONS OF EPCS FOR MORTGAGE LENDING

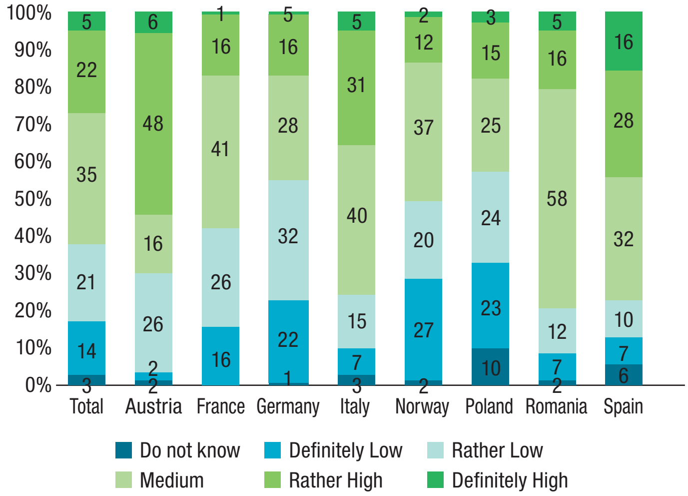
3.4.1 ACCURACY AND RELIABILITY

There is a perception among built environment professionals that EPCs are unreliable as a source of data on building performance (see figure 4).

There are several possible explanations for this, including:

- The differences in the quality assurance processes in place for EPCs
- The level of training and expertise of the assessors who produce EPCs
- The fees charged for producing EPCs vary significantly between member states, with the majority costing between €100 and €400[9] and lower fees may lead to reduced quality because the assessor may be less experienced/qualified or the fee may not be enough to cover the cost of a site visit.

Figure 4: Perceptions of EPC quality based on surveys of 6018 real estate agents carried out in 2015/16 in 8 EU countries



Source: BPIE, 2014

- Most EPCs are based on the asset rating approach and there may be a large discrepancy between the EPC result and actual consumption.

In addition, it is often difficult to obtain the data on building characteristics for existing buildings. In those circumstances, the EPBD does allow a simplified calculation approach using default values. However, these default values may be based on averages or they may assume a worst case, and either way, may not be representative of the actual building.

When the quality and reliability of EPCs is low, it becomes more difficult to rely on them as a baseline for calculating how much energy would be saved when undertaking an energy-efficient renovation.

Since the recast of the EPBD in 2010, EPCs must include recommended energy conservation measures for the homeowner to consider. The recommendations must be specific to the building, but in many cases they are generated by simple computer algorithms, which depend on input data provided by the assessor. These algorithms cannot take account of specific characteristics of the property that might mean a certain intervention is not appropriate or could have negative consequences.

Despite these concerns, there are numerous EU-funded projects investigating ways to improve the reliability of EPCs. Typically these initiatives involved making robust and reliable data more readily available to energy assessors through online data portals. Many of these initiatives could be expanded to other countries or to include more types of data.

4. STATISTICAL PREDICTION OF ENERGY PERFORMANCE

Regardless of the accuracy of the data used in the EPC calculation, an asset rating-based EPC does not reflect the behaviour of the occupants, and so has limited value for predicting actual energy costs and hence as an indicator for predicting PD (see section 3.1).

In addition, it is highly unlikely that actual energy consumption data would be available at the point of mortgage origination for a property purchase (as opposed to refinancing). In such cases, adopting a statistical approach

9 — CA EPBD.2016. *Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports.* Available at: http://www.epbd-ca.eu/ca-outcomes/2011-2015.

could provide a means of predicting energy costs using an asset rating and combining this with other known parameters. For example, research by UK-GBC and UCL Energy Institute[10] found that it is possible to double the accuracy of the model to predict likely energy costs by applying a statistical performance prediction approach that combines the EPC with several additional indicators.

Case Study 4: Lenders project – UK

LENDERS
Improving energy costs in mortgages
Promoting energy efficiency in homes

Currently, 90 per cent of UK mortgage lenders use cost data taken from the annual *Family Spending Report* published by the Office of National Statistics and adjust this data using occupancy and income information to estimate overall household expenditure. However, this method does not take account of the energy performance of the property itself.

The LENDERS project set out to better reflect household energy costs into mortgage applications. It investigated whether additional information about the property that is already available at the point of sale (e.g. EPC rating, dwelling type, age and size) could be integrated into affordability calculations.

The project used large-scale datasets of household, property and energy performance data. It concluded that the additional indicators significantly improved the accuracy of energy bill estimates, with the new calculation able to predict 70 per cent of bills within a margin of ± 15 per cent.

The difference in fuel bills between more- and less-efficient properties could improve the case for additional lending for more efficient properties whose residents would therefore have less of their income committed to paying energy costs.

The modelling suggested that additional lending of £4,000 could be offered for property in EPC band C compared to band E, or up to £11,500 for a band A property compared to band G.

The LENDERS project also created a working calculator through which homebuyers can generate estimates of their likely bills before they have purchased the home.

Read more: https://www.ukgbc.org/ukgbc-work/lenders-core-report/

5. ENERGY PERFORMANCE MEASUREMENT

The use of measurement is a relatively straightforward and accurate way to quantify a building's energy consumption. For a borrower who is purchasing a property, measurement can typically only be used to verify the performance after they have moved in. Exceptions to this include cases where an operational rating EPC has been produced, or where the vendor is able and willing to provide past energy bills.

For the mortgage refinancing scenario, metered energy consumption data or invoices would typically be available and measurement could be used both before and after an energy-efficient renovation project where this is the case.

Case Study 5: Miljöbyggnad – Sweden

Miljöbyggnad is a Swedish assessment scheme that is growing in its popularity, and applies to both new and existing buildings. It provides three different ratings (Bronze, Silver and Gold), based on around 15 indicators, which range from energy use, heat power demand and solar heating load, to wider considerations such as air quality, moisture resistance, daylighting and thermal comfort during winter and summer.

Broadly the areas covered split into energy, indoor environment and materials.

For energy use, the ratings equate to improvements on the Swedish building regulations (BBR) targets:

Indicators:	Bronze	Silver	Gold
Energy use	BBR	75% of BBR	65% of BBR
Solar heating	< 38 W/m²	< 29 W/m²	< 18 W/m²

In relation to performance measurement, it is particularly interesting to note that verification occurs two years after the building is commissioned. A preliminary certificate is issued to new buildings or renovations on the basis of documentation on building performance which is validated by external experts. This initial assessment then has to be verified within two years by testing against real performance, and the certificate can be revoked or improved depending on the results. The certificate then remains valid providing the environmental performance is reported every five years.

Read more: www.sgbc.se/var-verksamhet/miljoebyggnad

5.1 SMART METERS AND THE INTERNET OF THINGS

The technology to measure electricity and fuel consumption using meters has existed since the late 19th century. The recording of meter readings is typically carried out manually and infrequently, due to the associated costs and the cumbersome process of gaining physical access to customers' homes. The advent of smart meters and 'Internet of Things' (IoT) devices is rapidly changing this situation.

These technologies mean that data on energy and fuel consumption and other building performance parameters can be logged and transmitted automatically, making manual readings and inconsistent records a thing of the past. Smart meters provide near real-time as well as historical information on energy usage and costs, which can be accessed by the consumer in different ways (e.g. via an in-home display or web-based portal) enabling consumers to achieve energy savings by changing their energy-use patterns.

European legislation on smart metering systems defines a number of minimum functional requirements that smart meters must meet. Table 2 (see p. 14) shows functions that are of particular interest for mortgage lenders or other parties involved in the provision of services linked to an EEM.

The EU requires all member states to implement smart metering, subject to a cost–benefit analysis. This will lead to a significant increase in the number of smart meters installed. As a result, the volume and accuracy of available energy use data will grow.

10 — UK-GBC and UCL. 2015. *The role of energy bill modelling in mortgage affordability calculations*. Available at: www.ukgbc.org/resources/publication/role-energy-bill-modelling-mortgage-affordability-calculations.

Table 2: Requirements of smart meters and the potential benefits for energy efficient mortgages

FUNCTIONAL REQUIREMENT	BENEFIT FOR EEMS
Provide readings directly to the customer and any third party designated by the consumer	Enables direct data transfer to a bank or other service provider engaged in measurement and verification for the building performance
Update the readings frequently enough to allow the information to be used to achieve energy savings	Incentivises the borrower to save energy, thus increasing their disposable income, and improving their ability to service the loan and reducing PD
Support advanced energy tariff systems	Could enable the borrower to further control their energy costs, by choosing tariffs where energy costs are cheaper at certain times during the day

This trend will be amplified by the growth of IoT devices such as smart appliances and home energy management systems, increasing the amount and granularity of energy-use data that is available. There is an existing EU regulatory framework that provides a basis for how this data will be collected and possibly shared. Any sharing of data proposed as part of an EEM will have to conform with the European General Data Protection Regulation (Regulation EU/2016/679). This regulation sets rules on who can access personal data and under what circumstances.

Although there are clear benefits to having access to smart meter data when measuring the performance of a property, in reality the availability of such data in different EU member states differs depending on the different regulations and mechanisms that allow the data to be made available to customers and third parties. However, there are a number of initiatives at the EU level (e.g. Case study 6,) which address this situation and demonstrate how to guarantee that consumers (or third parties, acting on their behalf) can gain access to metering data via a communications interface that would be standardised across Europe.

Case Study 6: My Energy Data

My Energy Data is an initiative that stems from the European Smart Grids Task Force. One of the main aims is to ensure that across the EU, there are mechanisms in place which allow customers' energy data to be shared with authorised third parties.

My Energy Data analyses ongoing smart meter data initiatives from ten member states, highlighting lessons learned and common challenges. In addition it makes recommendations on a common data format, built on what is already available at the EU level, to guarantee that data can be transferred and correctly received. This will help facilitate the further development of the energy services market.

The first report was published in November 2016. In the next steps, the Smart Grid Task Force will propose areas that should be covered by future legislation to achieve these aims. A final report is expected by the end of 2018.

Read more: https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters/smart-grids-task-force

5.1.1 LIMITATIONS OR BARRIERS TO EFFECTIVE USE OF SMART METERS

For an EEM, a bank or other third party that seeks to use smart meter data as part of a performance assessment needs to bear in mind the following issues:

- A meaningful analysis of metered data (e.g. to benchmark one building against others in a portfolio) needs to consider other operational factors such as the internal temperature, the external climatic conditions and the hours of occupation. This data is not automatically provided by a smart meter system. This could be overcome by installing additional IoT technology such as a smart home energy management system and sub-meters, capable of delivering additional data to that offered by the smart meter.
- Different approaches to smart meter roll out among member states mean that the ownership of the meter, and hence the point of access to the data, is likely to differ. However, regulations and initiatives at the EU level (e.g. Case study 6) are working to address this.
- The cost of smart meters means that they may not be widely available in the near future in some countries where the cost outweighs the benefits (see section 5.1.2).

5.1.2 STATE OF SMART METER ROLL OUT IN (KEY) EU MEMBER STATES

The EU requirement for smart meters is not mandatory: it is subject to a national cost–benefit analysis. The member states also have discretion over the precise mechanisms by which smart meters are then implemented. For example, in Germany the smart meter market is competitive, because there are several different firms offering metering services to suppliers. By contrast, most other member states have opted for a more closely regulated approach where, typically, the energy distribution company is responsible for the roll out of smart meters. In some cases, customers can reserve the right to refuse the installation of a smart meter (an opt-out clause), but they could incur penalties if they choose to exercise this right. Table 3 shows that the percentage penetration of smart meters varies greatly across the EU.

Table 3: Status of smart meter roll out across EU member states. (Source E.ON & European Commission)

Country	Total electricity meters (millions)	Smart meters (%)	Status
Austria	5.7	12	Full roll out under way
Belgium	6.0	–	No roll out plans
Czech Republic	5.7	–	No roll out plans
Denmark	3.3	55	Full roll out under way
Estonia	0.7	90	Full roll out under way
Finland	3.3	100	Full roll out completed
France	35.0	10	Full roll out under way
Germany	47.9	–	Partial roll out starts in 2018
Greece	7.0	–	Full roll out expected
Hungary	6.0	–	No roll out plans
Ireland	2.2	–	Full roll out starts in 2019
Italy	37.0	100	Second roll out starts in 2017
Latvia	1.0	10	Full roll out under way
Luxembourg	0.3	5	Full roll out under way
Malta	0.3	100	Full roll out completed
The Netherlands	7.6	45	Full roll out under way
Poland	16.5	3	Full roll out under way
Portugal	6.5	3	No plans for roll out
Romania	9.0	3	Full roll out under consideration
Slovakia	2.6	–	Partial roll out under way
Slovenia	1.0	50	Full roll out under way
Spain	27.7	80	Full roll out under way
Sweden	5.2	100	Second roll out starting in 2019
UK	59.6	6	Full roll out under way

Source: European Commission (2014) updated based on information provided by E.ON

5.2 OTHER PERFORMANCE MEASUREMENT TECHNIQUES

There are further site testing techniques that can help to verify the energy performance of a building, either as a means of establishing accurate input data for an energy calculation or as a means of verifying the quality of the installation. Two key examples are airtightness testing (see Case study 8) and thermography.

Airtightness can have a significant impact on the heating demand of a building and an airtightness test can help to establish the current benchmark for improvement or it can be used to ensure that the construction or renovation of the building envelope meets required performance standards. In a similar way, thermography, using heat-sensitive cameras, can help to reveal thermal bridges where heat can escape more rapidly from the building (e.g. due to gaps in insulation or openings in the walls).

The costs of both of these site testing techniques may be high and there are limitations to their applicability. Airtightness testing is more commonly applied to new rather than existing buildings because it can be disruptive (it generally involves the building being pressurised using a large fan system). Thermography requires certain conditions to be effective, in particular a large difference between indoor and outdoor temperatures.

Case Study 7: KfW Effizienzhaus (Efficiency House) Loans

Kreditanstalt für Wiederaufbau (KfW), or 'Credit Institute for Reconstruction', is a German financial institute that administers public funds in the form of grants, subsidies and loans to support construction and, in particular, energy-efficient new buildings and renovations.

The KfW Effizienzhaus system uses federal funds to provide finance to homeowners looking to carry out extensive energy-efficient renovation works or those who build highly efficient new properties: the more ambitious the project, the more support is provided. The scheme provides either a subsidised loan or a grant to those who already have capital to undertake a project.

KfW has finance packages that target specific measures (e.g. new efficient heating systems), as well as packages for whole-house refurbishments. For a whole-house refurbishment, the level of support is determined by reference to the national building regulations relating to energy performance (Energieeinspar-Verordnung or EnEV). For new builds, support is available if the property meets either the KfW Effizienzhaus 55 or Effizienzhaus 40 standards. For existing properties, renovation loans are available to improve the performance to one of five standards, Effizienzhaus 115, 100, 85, 70 or 55.

An Effizienzhaus-70 property uses only 70 per cent of the primary energy of a new house built to meet the current EnEV standards, while an Effizienzhaus 115 uses 15 per cent more energy.

Measures that could form part of an overall concept in order to reach the KfW Effizienzhaus-55 standard include.

- Wood pellet, biomass heating or heat pump
- Solar heating system for hot water
- Exterior wall insulation – 18 cm
- Roof insulation – 24 cm
- Windows with triple glazing and special frame.

The system is supported by a community of approved energy consultants who are qualified to advise owners regarding appropriate energy conservation measures. They can also provide support during the KfW application process and offering additional project management or quality assurance services during the renovation works.

Read more: www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/

Case Study 8: Passivhaus and EnerPHit

The Passivhaus standard, developed in Germany and now present in many countries around the world, can be applied to residential and non-residential properties. Passivhaus certification requires high levels of insulation and airtightness in order to keep the calculated annual heating (or cooling) consumption of the property below 15 kWh/m^2.* For comparison, this is less than a quarter of the calculated heating energy consumption for a typical new building in many EU countries.

In addition there is a primary energy requirement taking into account all energy uses in a building and a rating system for renewable primary energy, called PER. Buildings with a low PER demand use renewable energies most efficiently.

The Passivhaus Institute (PHI), which developed and administers the scheme, requires a wide range of evidence to be submitted, including an energy performance calculation, evidence of the thermal performance of the specified building elements and results of an airtightness test.

However, for renovations, aiming for these very stringent standards could be prohibitively costly. PHI therefore established the EnerPHit standard for building renovations.

EnerPHit has two different routes to certification. The energy demand method for EnerPHit is similar to Passivhaus, but with less stringent criteria (e.g. the calculated annual heating energy consumption of the building must not exceed 25 kWh/m^2*). The building component method sets minimum requirements for the thermal performance of each part of the building envelope but does not specify a threshold for annual heating demand.

* The criteria required for Passivhaus and EnerPHit vary depending on the climatic region of the property. The values shown here are for cool temperate climates such as central Europe.

Read more: http://passiv.de/downloads/03_building_criteria_en.pdf

6. WIDER PERFORMANCE INDICATORS THAT IMPACT CREDIT RISK

Energy is currently the central focus of many EU initiatives on building performance, largely driven by EU and national climate and energy legislation. However, there are other aspects of performance which may affect credit risk assessments.

Over the life of a typical 25- or 30-year mortgage, there are also regulatory risks which lenders or investors looking at covered bonds that encompass mortgage loans should be aware of. For example, EU policy makers have already started to look at moving the EU 'green building' debate beyond an energy-centric approach as part of their drive towards a resource efficient economy and to begin to codify widespread elements of voluntary standards.

The first EU-wide voluntary framework of sustainability assessment indicators for buildings was introduced in August 2017 (see section 6.3). From a regulatory risk perspective, therefore, it is important to be aware of the other core indicators that European legislators are beginning to look at, and which are anticipated to form the basis of further EU policy over the next decade.

6.1 GREEN VALUE AND BROWN DISCOUNT

The potential for building energy and wider sustainability performance to drive 'green value' and to mitigate the opposite effect of 'brown discount' is an important factor in proving that EEMs represent a reduced risk profile within a bank's loan portfolio. However, whilst analyses of large numbers of property transactions show indications of these trends, there is not yet a clear way of addressing this in valuations of individual properties.

The value of a property may be defined in a number of different ways and is influenced by many different factors. Some of these factors are qualitative and subjective. The EeMAP report on Green Value provides an explanation of different valuation methods and more detailed analysis of current best practice in terms of assessing green value and brown discount.

There are important causal links between measures to reduce energy use and other, wider sustainability performance considerations. For example, increasing the level of insulation may reduce energy use and hence energy costs, but may also contribute to improved thermal comfort for the occupants. Likewise, upgrading single-glazed windows to double or triple glazing should reduce heating bills, and may also reduce noise ingress and improve comfort levels. Conversely, implementing some energy efficiency measures without due consideration for wider issues could have unintended negative consequences either for the occupant, the property or for the environment. And for some older properties, pursuing very high levels of energy performance may not be economically viable. For this reason there has been some criticism of initiatives that only focus on energy reduction as an outcome.

For residential buildings in particular, the co-benefits of energy performance improvements are often strong motivators for energy-efficient renovations[11]. There are also wider aspects of sustainability assessment that are increasingly seen as critical to ensure that the building can be considered a high-quality asset.

Figure 5: Different aspects of the sustainability of buildings that can drive value

Technical quality	Cultural and social quality	Environmental quality
Structural safety	Aesthetic quality	Energy performance
Fire protection	Urban design quality	Resource depletion
Noise protection	Cultural value	GHG-emissions and GWP
Moisture protection	Health and well-being	Other impacts on the global and local environment incl. risks to the local environment
Maintainability	Indoor air quality	Land use change and sealing
Flexibility and adaptability	Comfort (thermal, visual, acoustic, olfactory)	Water consumption
Ease of cleaning	User safety	Wastewater
Durability	User participation and control	Waste (construction and user related)
Resilience against natural and man-made hazards	Accessibility (to and inside the building)	
Design for deconstruction and recyclability		

Functional quality		Economic quality
Serviceability (fitness for purpose, usability)		Life cycle costs
Space efficiency		

Source: adapted from UNEP-FI, 2014

Figure 5 lists a range of these considerations linked to five broad concepts of quality. It is important to note that these considerations will be prioritised differently by lenders and borrowers, and for commercial and residential buildings. Furthermore, these priorities are likely to vary by region, demographic, and in time. This aspect of driving value in buildings is discussed further in the EeMAP Report on Green Value.

Any bank that seeks to fully reflect the value-creation potential of energy or other environmental performance improvements will need to find ways to assess some of these other factors, particularly in markets where assessment in these areas is becoming more widespread.

There are already tools or assessment methods that could be used to incorporate wider sustainability performance aspects into an EEM. Water efficiency is one example, which could bring a benefit in terms of reduced utility bills, and is seen as increasingly important by consumers in more arid countries such as Italy. The European Water Label, an industry-led initiative to create a water consumption performance certificate (using a similar approach to an asset rating EPC) for sanitary fittings such as taps and showers could be a useful source of data for such an assessment. Aspects relating to location, such as distance to key local amenities and sustainable transport options, which impact transport emissions, can also be relatively easily assessed using online data from map providers (see Case study 9).

Case Study 9: DGBC Home Quality Mark ('Woon Kwaliteit Richtlijn')

Dutch Green Building Council

The Dutch Green Building Council (DGBC), which certifies around 75 per cent of new build commercial property in the Netherlands with the label 'BREEAM NL', is currently developing a quality mark for homes that is intended to support EEMs as well as other products.

The process builds on the best criteria from certifications already on the Dutch market, and aims to become the central location where sustainability documentation for homes is brought together. Its scope covers all types of homes and apartments, and assessment can take place either on a single home or a group of homes in a project. The principal areas of building performance covered are:

Surroundings:
- Transport
- Ecology
- Safety

Home:
- Energy and water efficiency
- Indoor climate and comfort
- Accessibility
- Materials and maintenance

The assessment involves two phases: self-assessment, by which everyone can use the tool to determine a basic score; and certification, to substantiate the score using quantitative evidence.

The first step is streamlined by a number of automated assessments which use publically available data (such as Google Maps) to determine factors such as the proximity to public transport links. Together with the evidence of any existing certifications such as an EPC, and responses to a questionnaire, this self-assessment provides a baseline measurement of the building's performance and can help to determine where improvements can be made. The second step involves a test by an independent auditor to ensure the robustness of the data.

11 — Energy Efficiency Financial Institutions Group (EEFIG). 2015. *Energy efficiency – the first fuel for the EU economy: how to drive new finance for energy efficiency investments. final report.* Available at: www.eefig.com/index.php/the-eefig-report.

6.2 VOLUNTARY SUSTAINABLE BUILDING CERTIFICATION SCHEMES

Voluntary green building certification schemes (sometimes referred to as 'rating tools') are increasingly being used to evaluate and demonstrate environmental and wider sustainability performance of buildings. They have been most widely used in commercial real estate, although many are growing their presence in the residential sector. Although there is some variation in scope between the different schemes, they generally cover multiple indicators across the 'three pillars' of sustainability, sometimes referred to as the 'triple bottom-line', as shown in table 4.

Table 4: Sustainability indicators commonly covered in voluntary building certification schemes

Environmental	Primary energy consumption
	Water management
	Materials (rational use and low impact)
	Waste (construction and operation)
	Global warming potential (GHG emissions)
	Land use and ecological value of the site
Economic	Building adaptability
	Ease of maintenance
	Life cycle costs
	Process quality (planning and preparation)
	Innovation
Social	Indoor air quality
	Access to transport (for building users)
	Comfort (visual, thermal, acoustic)
	Access to public services and amenities
	Access for users with physical impairments
	Safety and security

Source: SB Alliance, 2015

Schemes differ in how they group and assess these indicators and the weighting that each is given when calculating the final results. Generally, they also have minimum requirements for a number of key indicators such as energy. This is to ensure that an inefficient building cannot obtain a high rating simply by scoring highly in other indicator categories.

Some of the better-known green building certification schemes across Europe are listed in table 5.

These voluntary certification schemes are already referenced in the green bond market in respect of commercial property (see Case study 10), in relation to which they have become a de facto market standard in some European countries.

Case Study 10: Vasakronan green bond framework

VASAKRONAN

When Swedish property company Vasakronan launched the first ever green bond in the commercial property sector in 2013 it referenced 'BREEAM' and 'LEED' certifications as benchmarks – two well-known green building certification schemes that are widely used in Sweden.

Vasakronan updated its framework in April 2017 and the new green bond framework includes:

1. New construction and major renovation of buildings that have an energy performance at least 25 per cent better than the current building regulation (Swedish BBR code) and that have or will receive a certification of either: LEED New Construction or Core and Shell, minimum certification level 'Platinum'; or BREEAM-SE, minimum certification level 'Outstanding'.
2. Existing buildings that have an energy consumption of under 100 kWh/m^2 and either have a certification from the construction phase (as per item 1) that is not older than ten years or have received a LEED Existing Buildings: Operations and Maintenance certification (minimum certification level 'Gold').

Read more: http://en.vasakronan.se/welcome-to-vasakronan/sustainability

6.3 LEVEL(S): AN EU-WIDE APPROACH TO SUSTAINABLE BUILDING PERFORMANCE REPORTING

In August 2017, the European Commission published a voluntary framework of sustainable building assessment indicators, with the aim of establishing a 'common language' for green building assessment in Europe.[12]

The framework, known as 'Level(s)', is the result of extensive consultations with policy makers, industry experts and organisations that administer existing building assessment schemes. One of its core objectives is to drive

Table 5: Examples of Green Building Certifications Across Europe*

Certification Scheme		Originates from:	Operates in other countries:
BREEAM	BRE Environmental Assessment Method	UK	Yes
DGNB	German Sustainable Building Association	Germany	Yes
GBC Home		Italy	No
HPI	Home Performance Index	Ireland	No
HQE	High Environmental Quality	France	Yes
LEED	Leadership in Energy and Environmental Design	USA	Yes
Miljöbyggnad	Environmental Building	Sweden	No
Rakennusten elinkaarimittarit	Building Performance Indicators	Finland	No
Verde		Spain	Yes

* This list is not exhaustive and has been compiled from information provided by the organisations that contributed to the report.

12 — European Commission. 2017. Level(s) – *A common EU framework of core sustainability indicators for office and residential buildings: Introduction to Level(s) and how it works.* Available at: http://susproc.jrc.ec.europa.eu/Efficient_Buildings/docs/170816_Levels_EU_framework_of_building_indicators_Parts.pdf.

the collection of more reliable and comparable data on building performance; hence its potential relevance to the EeMAP initiative.

The development of Level(s) is a response to national governments' calls for clarity on the direction of travel of policy in this area, and calls from market actors for greater harmonisation in green building assessment.

The framework is structured around six main areas, each with one or more specific assessment indicators for new build and renovation projects:

Greenhouse gas emissions along the building lifecycle – as well as delivered and consumer energy, this looks at global warming potential of the entire building, and therefore includes the life cycle (embodied) energy associated with the production and disposal of building materials.

Resource efficient and circular material flows – aimed broadly at reducing construction waste (which currently accounts for around a third of all waste in the EU) and associated environmental impacts.

Efficient use of water resources.

Healthy and comfortable spaces – looking primarily at factors such as 'indoor air quality' and 'thermal comfort', though a wider set of considerations is included in the guidance.

Adaptation and resilience to climate change – as well as resilience to extreme weather events and flooding, this also looks at the time a building will spend outside the 'thermal comfort' range.

Lifecycle cost and value – including operational utility costs, and acquisition and maintenance costs. The 'value' indicator is essentially a matrix of ratings of the quality and reliability of the calculations for each of the other framework indicators. The approach set out in this section of Level(s) could be particularly useful for EeMAP.

At this stage the framework remains voluntary, and there is no data collection infrastructure in place for projects that report against it. These are significant barriers to using the scheme as a foundation for any widespread green mortgage product. However, the main areas of assessment give clarity on three key things:

- The areas that building and construction professionals see as core to sustainable building assessment
- What a 'European' approach to assessment in these areas looks like
- The areas that EU policy makers are likely to look to next as they expand EU sustainable building legislation beyond energy.

For investors looking at regulatory risk over the 25–30 year term of some mortgages, it is likely that some of the above areas will be codified within EU and/or national buildings regulations. This will depend on benchmarks being established to determine the level of performance required from the EU buildings stock to deliver macro policy objectives. Therefore, it is well worth reflecting on the approaches set out in the Level(s) framework as we shape our recommendations for EEMs and to consider alignment where appropriate based on the availability of data.

7. WHAT THE ENERGY EFFICIENT MORTGAGE PROCESS MIGHT LOOK LIKE

A number of publically funded initiatives across Europe also offer opportunities to study what elements of building performance assessment could help to ensure the success of privately financed EEMs. These include the German KfW energy efficiency loans (see Case study 7 above), the Green Deal in the UK, and several regional initiatives in other countries such as France (see Case study 11) and Belgium.

Case Study 11: Picardie Pass Rénovation

The French region of Picardie (now part of Hauts de France) has established a public funding mechanism for energy efficiency finance known as Picardie Pass Rénovation. The initiative is currently in a full-scale pilot stage and aims to deliver 2,000 residential renovation projects to reduce their current energy consumption by a target of 40 per cent. The regional authority set up Public Service for Energy Efficiency (PSEE) to provide a 'one stop shop' for home owners to receive technical as well as financial support to plan and implement the works.

The loan is fixed at 2.5 per cent interest over a 15- to 25-year repayment period and works on a 'pay as you save' principle. Borrowers repay the loan in monthly instalments calculated based on the predicted energy savings. To date, the average loan amount for single-family homes is around €30,000 and €14,000 for multi-family dwellings.

The energy assessment is undertaken by PSEE, which has expertise in building regulations and energy systems and typical renovation works programmes for different types of houses in the region. The assessment involves a site visit to conduct the energy performance evaluation, and to develop and cost the programme of works.

As part of the financial assessment, a risk rating is calculated based on the household income and the LTV. The energy assessment is based on energy bills (for several years, if possible), all technical data the owner can share, and an estimate of the thermal performance of the building envelope through visual checks and discussion with the owner.

PSEE supports the homeowner throughout the renovation works and provides 5 years of additional monitoring and advice on energy-efficient operation of the home.

The EeMAP initiative will analyse some of the most relevant national initiatives in further detail, in conjunction with national Green Building Councils, to identify which elements of each could be adopted in our recommendations.

There are also examples of tools or practical systems that are being developed to improve the availability of energy performance data of buildings and to support energy-efficient renovations of existing buildings. These point to approaches that could be adopted or adapted to support the delivery of EEMs.

For example, 'building passports' and 'building renovation roadmaps' are tools which have been the subject of recent work at European level, and could support the lender, the valuer and the borrower with additional information. They could also provide a single source of much of the technical information that would be needed to support an EEM.

A building passport could contain both an asset rating (calculated energy performance) and measured energy consumption data. It could also function as a data repository of building characteristics which a valuer can use in producing a valuation report and conducting the relevant due diligence checks which support their valuation. A renovation roadmap included as part of a building passport could give detailed guidance on what energy efficiency improvement measures could be considered with the objective of ensuring that these are fully coordinated and thereby deliver maximum impact.

Building performance passports and renovations roadmaps are being trialled in several locations in Europe, including:

- *Individueller Sanierungsfahrplan* (Individual Renovation roadmap) in Germany
- *Woningpas* (Dwelling ID), in Flanders, Belgium
- Passeport Efficacité Énergétique, P2E (Energy Efficiency Passport) in France.

The EU-funded iBROAD (Individual Building Roadmap) project, which seeks to develop and pilot a European model for building renovation passports, is running in parallel to EeMAP.

The iBROAD project anticipates a tool that looks at the building as a whole and provides a customised renovation plan with a long-term horizon (15–20 years). The renovation roadmap will be combined with a repository of building-related information (building logbook/passport) on aspects like the energy consumption and production, executed maintenance and building plans (see Resources).

In the subsequent work of EeMAP, it will be important to consider the different mortgage origination scenarios (some of which are shown in table 1, above) and how these affect the selection of an appropriate approach to building performance assessment.

8. BARRIERS FOR THE DESIGN OF A BUILDING ASSESSMENT PROCESS FOR EEMS

Table 6 draws together some of the key barriers to implementing the building performance aspects of an EEM.

As well as providing a useful summary, the table also helps to frame the next steps of the EeMAP initiative – which will include consulting widely with expert networks on the design of the building assessment aspects of an EEM.

Our work will need to make sensible, practical recommendations for how these barriers can be overcome in order to progress to a robust set of recommendations for how EEMs could operate across a wide range of EU countries. It is important to note that there will be other barriers in the areas of finance, valuation, customer engagement and data management that are not listed here. The EeMAP reports on Green Finance, Green Value and The Link Between Energy Efficiency and Probability of Default provide some further detail on these other areas.

Table 6: Key barriers to the implementation of energy and environmental performance assessments as part of an energy efficient mortgage

General barriers	
▪ Diversity of the EU building stock – significant variation in age, construction, fuel and technology types, tenure, and so forth, both between and within member states ▪ Access to reliable data – due to practical or financial considerations or to concerns about data security and privacy	
EPCs	**Predicting energy use**
▪ Underlying data not sufficiently accessible / in paper format for various regions ▪ Two approaches (asset rating and operational rating) not consistently used in all member states ▪ EPC quality is variable, as is the training for assessors ▪ Default values commonly used for EPCs of existing buildings may be too conservative ▪ Compliance levels vary between countries and evidence suggests EPCs are often not available at the important decision-making points in the mortgage origination process	▪ Building energy performance is complex and is affected by many different factors related to the building, the occupants and the climate ▪ Using readily available indicators (e.g. occupancy, size, age) still leaves large margins of uncertainty ▪ Detailed energy modelling, beyond the standard EPC calculations, would have lower uncertainty but is expensive in most cases for single-family and small multi-family dwellings ▪ Frequently, improvement measures remain uncoordinated, and thus their impact is uncertain
Measuring energy use	**Assessing wider sustainability**
▪ In some mortgage origination scenarios, use of measured energy data is only possible for monitoring purposes and not for the initial assessment ▪ Standard meters are still in place in the majority of homes across the EU. Manual reading/recording of these meters is generally infrequent ▪ Further data is required to generate an operational rating by normalising measured consumption against variation in climatic conditions and hours of occupancy ▪ Operational ratings cannot be directly compared to asset ratings	▪ Complex relationships between different qualitative and quantitative sustainability indicators make assessments resource intensive ▪ The relatively high cost of existing certification schemes means they are less viable for single-family homes (more viable for larger multi-family residential) ▪ The low number of certified residential buildings means data to establish links to financial performance and risk are not widely available
Process barriers	
▪ Multiple interactions are needed to implement an EEM, particularly: - The need for qualified experts to undertake assessments - The need for qualified tradespeople to implement quality assured renovation works ▪ Accreditation costs, time, fatigue with accreditation processes and slow growth of market ▪ Cost of the assessment process	

9. CONCLUSIONS AND RECOMMENDATIONS

The next phase for the EeMAP initiative will take a much deeper look at the research summarised above and other relevant sources, with the aim of putting forward some more detailed recommendations. However, here we present some initial conclusions at this early phase and recommendations for the next steps relevant to the establishment of energy performance indicators:

1. **EPCs are the most widely available source of energy performance data on individual buildings and hence are a useful starting point for the assessment mechanism behind an EEM.**

   Recent research from the UK provides strong statistical evidence for linking EPC data to borrowers' household expenditure in mortgage affordability calculations, justifying around £4,000 of additional borrowing based on an EPC improvement of two bands (e.g. D to B).

   Including the EPC as part of the EeMAP concept could help to strengthen the case for improving EPCs at both the national and EU level, and would certainly act as a commercial driver to produce more robust data at the project level. Ultimately, the wider availability of EPCs and access to the underlying data, and increased use of both asset and operational ratings in national EPC systems, would improve the availability of data for making mortgage credit risk assessments.

2. **Lack of consistency between EPCs in different member states, among other limitations, means that additional assessment methods are likely to be required, and presents a barrier to developing a 'harmonised' approach to EEMs for all of Europe.**

   Efforts to design a voluntary harmonised EPC for non-residential buildings across the EU, in part driven by investor demand, have yet to conclude or be adopted, despite being a requirement under the EPBD (2010). A more flexible approach, based on statistical evidence and performance assessments that are equivalent rather than harmonised, should therefore be investigated. Predicting performance of an individual building will always be subject to uncertainty, so statistical performance prediction could be one way to manage this. The average performance across groups of equivalent assets in a loan portfolio, and the potential for improvement, may be more reliably predicted.

3. **A combination of all three performance assessment approaches (calculated and statistical estimates, and measured data) may provide the optimal solution to underpin the credit risk assessment for EEMs. The feasibility of adopting such an approach needs to be investigated for key mortgage markets.**

   The calculated energy performance focusses on the energy use of the building under a standard set of operating conditions. This approach makes it possible to compare one building with another, and may be useful for assessing potential green value, provided that the underlying data is reliable. The actual consumption based on measured values takes account of the occupants' behaviour and the effects of local climate and weather, and so gives the most accurate picture of energy costs for the borrower. If a suitable, large dataset is available, a statistical assessment can provide another means of predicting the energy use of a borrower when actual consumption data is not available.

4. **Other building performance aspects beyond energy are likely to have a strong influence on the value of a property over time. Including some of these wider considerations in the assessment framework for EEMs may further improve the risk profile of such loans.**

   In terms of regulatory risk, EU policy makers have already begun to standardise the approach to wider sustainable building assessment. The degree to which these are included in the infrastructure of the EEM's pilot phase must be explored further in order to future-proof and strengthen the product.

9.1 WORLD GREEN BUILDING COUNCIL EUROPE REGIONAL NETWORK ACTION PLAN

The Europe Regional Network will now begin to prepare detailed technical recommendations for the building performance assessment process that is necessary to underpin a pilot EEM product.

- At the start of 2018, we will publish our draft recommendations for how a European EEM could work from a building assessment perspective.
- Alongside this, our national member Green Building Councils will publish a series of market briefs setting out the relevant building performance assessment landscape in their countries.
- Our regional partner, E.ON, will also publish its initial consumer insight research into how consumers in a number of European markets view the EEM concept, ensuring our process design is led by consumer-centred thinking.
- During Q1 of 2018, our national member Green Building Councils will host national workshops – an opportunity for a wide range of national experts to provide their feedback on our initial recommendations, and what would be needed to support implementation in their markets.
- In summer 2018, we will publish our final recommendations for the pilot phase of the EEM product, and will work with the EeMAP consortium on a roadmap for how we bring the EEM product to market across Europe.

RESOURCES

Energy performance

BPIE. 2014. *Energy Performance Certificates Across the EU – A Mapping of National Approaches*. Available at: http://bpie.eu/uploads/lib/document/attachment/81/BPIE_Energy_Performance_Certificates_EU_mapping_-_2014.pdf.

BPIE. 2016. *Building Renovation Passports*. Available at: http://bpie.eu/wp-content/uploads/2017/01/Building-Passport-Report_2nd-edition.pdf.

CA EPBD. 2016. *Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports*. Lisbon: ADENE. Available at: www.epbd-ca.eu/outcomes/2011-2015/CA3-BOOK-2016-A-web.pdf. See also CA EPBD: Concerted Action | Energy Performance of Buildings Directive www.epbd-ca.eu/.

Enerdata. 'Data Tool'. Available at: www.zebra-monitoring.enerdata.eu/.

Energy Efficiency Financial Institutions Group (EEFIG). 2015. *Energy efficiency – the first fuel for the EU economy: how to drive new finance for energy efficiency investments. final report*. Available at: www.eefig.com/index.php/the-eefig-report.

European Commission. 2014. *Benchmarking Smart Metering Deployment in EU-27*. Available at http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1403084595595&uri=COM:2014:356:FIN.

QUALICHeCK. 2016. *How to Get Compliant and Accessible Data for the Energy Rating Calculation of a Building? Overview of Some Existing Approaches*. Available at: http://qualicheck-platform.eu/2016/03/report-compliant-and-easily-accessible-epc-input-data-final/.

UK-GBC. 2017. *Lenders: Improving energy costs in mortgages; promoting energy efficiency in homes*. Available at https://www.ukgbc.org/ukgbc-work/lenders-core-report/.

UK-GBC and UCL. 2015. *The role of energy bill modelling in mortgage affordability calculations*. Available at: www.ukgbc.org/resources/publication/role-energy-bill-modelling-mortgage-affordability-calculations.

ZEBRA2020. 2016. *The Impact of Energy Performance Certificates on Property Values and Nearly Zero-Energy Buildings: Report for Policy Makers*. July 2016. Available at: http://zebra2020.eu/website/wp-content/uploads/2014/08/D3.1-Final-AR_RD_2.pdf.

Wider performance affecting value

RenoValue. 2015. *Market Insights Report*. June 2015. Available at: http://buildupon.eu/wp-content/uploads/2016/01/151114_RenoValue-Market-Insights-Report.pdf.

Sustainable Building Alliance. 2015. *Sustainability Thresholds Generating Value*. Available at: www.sballiance.org/wp-content/uploads/2015/12/sustainability-thresholds-generating-value_2015.pdf.

UNEP-FI. 2014. *Sustainability Metrics: Translation and Impact on Property Investment and Management*. Available at: www.unepfi.org/fileadmin/documents/UNEPFI_SustainabilityMetrics_Web.pdf.

PROJECT CONTACTS

If you want to learn more about the energy efficiency workstream of the EeMAP initiative, please contact: europe@worldgbc.org

CONTACT YOUR LOCAL GREEN BUILDING COUNCIL

Organisations such as banks, valuers, utilities and building and construction companies looking to explore how an EEM could work in your local market can contact any of the national Green Building Councils that are officially participating in the EeMAP initiative. These GBCs are currently working on EEM research notes, and preparing for national workshops with expert organisations to begin examining how an EEM could work across their markets.

COUNTRY	MAIN CONTACTS	WEBSITE
Croatia	Tanja Marković	http://www.gbccroatia.org/
Finland	Mikko Nousiainen, Sami Lankiniemi	http://figbc.fi/gbc-finland/
France	Anne-Sophie Perrissin-Fabert, Yona Kamelgarn	http://www.hqegbc.org/accueil/
Germany	Christine Lemaitre, Samuel Koch	http://www.dgnb.de/de/
Ireland	Pat Barry, Marion Jammet	https://www.igbc.ie/
Italy	Valentina Marino	http://www.gbcitalia.org/
Netherlands	Martin Mooij	https://www.dgbc.nl/
Poland	Alicja Kuczera	https://plgbc.org.pl/
Spain	Bruno Sauer, Emilio Miguel Mitre	http://www.gbce.es/
UK	John Alker, Richard Twinn	http://www.ukgbc.org/

A full list of European Green Building Councils that are members of the World Green Building Council network can be accessed here: http://www.worldgbc.org/our-regional-networks/europe

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